



Medical Evidence

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Back in 2004, ODPM published a document titled Medical and Occupational Evidence for Recruitment and Retention in the FRS (MOERRFRS), primarily as a resource guide for use by medical advisers and occupational health staff within Fire and Rescue Services.

With the passage of time, some of the evidence within the original document has been superseded and the NFCC (at the time of publication the company group was The Chief Fire Officers Association) recognised the need to update this piece of work.

As a result our publication company at that time (CFOA Publications Ltd) worked with the CFOA Occupational Health Group and external medical experts to provide this document. The tool makes available evidence on the most prevalent medical conditions to assist medical personnel in providing advice to service managers on medical and fitness issues for recruitment and retention within the Fire and Rescue Service.

It should be noted that this document does not seek to provide the sole source of guidance for managers in arriving at decisions on recruitment or retention. This document was refreshed and re-published in 2011.

Managers are obliged to carry out individual assessments, including appropriate risk assessments in consideration of whether reasonable adjustments could be made to enable the Fire and Rescue Service to recruit or retain on a case by case basis.

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Cardiovascular

Cardiovascular problems are common and can be a major risk to firefighters and colleagues. At best a condition can cause pain or discomfort that is a distraction, at worse it can lead to altered consciousness, reduced physical capability or sudden collapse.

If there is any doubt about fitness, an assessment by a cardiologist should be sought to enable the Medical Adviser to assess the risk and advise on short and long-term management of the individual.

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Cardiac Rhythms

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Sinus Rhythm

The rate and rhythm of the heart is normally controlled by an impulse originating in the sino-atrial node and spreading through the atria then the ventricles. Normal sinus rhythm implies normal conduction through this pathway.

Sinus Arrhythmias

Sinus arrhythmia is a variation of normal sinus rhythm where there are alternate periods of slow and more rapid discharges from the sino-atrial node. It is usually related to respiration with the faster heart rates towards the end of inspiration. It is most obvious in younger people. If it is not related to respiration an underlying cause should be considered [1](#).

Sinus Bradycardia

Classically defined as a pulse rate less than 60 bpm, sinus bradycardia is a normal finding in many individuals, particularly the athletically trained where rates as low as 35 – 40 and pauses of up to 2 seconds are not uncommon. These are often found on 24 hour ECG monitoring. In these circumstances there should be no cause for concern in preemployment or routine medical screening. The presence of these findings on a routine ECG should however prompt the examiner to check that the individual is asymptomatic and is physically fit [2](#) [3](#).

Sinus bradycardia may also be related to sinus node dysfunction associated with drug therapy, chronic degenerative changes of the sinus node, excessive enhancement of vagal tone, and acute ischaemic infarction of the sinus node. If underlying pathology is suspected you should seek a cardiologist opinion and only recommend employment if the individual is at low risk from employment as a firefighter and the long term prognosis is good.

Sinus Tachycardia

Defined as a pulse rate greater than 100 originating from the sino-atrial node. Anaemia and thyrotoxicosis should be excluded as the underlying cause. Caffeine and anxiety may also cause tachycardia. The presence of tachycardia may make step-test results difficult to interpret, but in the absence of any related medical conditions it should not be considered significant.

1 Julian D. Diseases of the Heart. Second Edition. London: WB Saunders. 1996

2 Viitasalo MT, Kala R, Eissalo A. Ambulatory electrocardiographic findings in young athletes between 14 and 16 years of age. Eur Heart J 1984;5:2-6.

3 Talan DA, Bauernfeind RA, Ashley WW et al. Twenty-four hour continuous ECG recordings in long distance runners. Chest 1982;82:19-24.

Conduction Disturbances

Sick Sinus Syndrome

Sick sinus syndrome may present as palpitations, syncope or presyncope. Most cases are idiopathic and probably related to a degenerative disease of the sinus node, atria and possibly other parts of the conducting system [4](#) [5](#). Many individuals will be asymptomatic initially, but can develop significant signs such as pauses,

bradycardia, and escape tachycardias, and there is a risk of presyncope or syncope. The risk of sudden collapse is significant. A cardiology report should be sought although it is unlikely that employment as a firefighter will be recommended.

Atrioventricular (AV) Block

First Degree Heart Block

Generally benign, first degree block is defined as a prolonged P-R interval greater than 0.22-0.23 seconds. This implies slowing of atrio-ventricular conduction. If there are symptoms of syncope or presyncope, investigation to exclude other conditions should be considered with a cardiology opinion. If the individual is asymptomatic, first degree heart block can be accepted as a normal variant and employment as a firefighter can be recommended.

Second Degree Heart Block

Defined as occasional blocked ordinary P waves, Mobitz type I (Wenkebach) and Mobitz type II can both progress to complete heart block, with the risk of both presyncope and syncope. In young people an intermittent type I (Wenkebach phenomenon) may be seen in fit individuals, often just nocturnally on a 24 hour ECG, that is due to high vagal tone. Over the age of 45 it is unlikely to be benign and even in asymptomatic individuals pacemakers should be considered [6](#). If high vagal tone is suspected, a cardiology opinion should be sought before recommending employment as a firefighter. The finding of either type of second degree block on a standard ECG requires further assessment. Most cases of second degree AV block, apart from type I in the young, will need pacing [7](#).

Third Degree Heart Block

Often referred to as complete heart block, there is complete independence of atria and ventricles. Even in its congenital form this is not benign [8](#) and any development of symptoms will need pacing (see pacemakers below).

Interventricular Conduction Disturbances

Incomplete Bundle Branch Block

There is a delay in conduction through either right or left ventricle but overall QRS duration is <0.12 seconds.

Incomplete Right Bundle Branch Block pattern is seen in 2% of children and young adults [9](#). It may also be present in Congenital Heart Disease. In middle aged males there is no evidence of increased cardiovascular risk [9](#).

Incomplete Left Bundle Branch Block is thought to be a step in development of the complete form and should be considered as such.

Right Bundle Branch Block (RBBB)

RBBB can occur as a congenital, normal, finding in 1% of young adults [10](#), although it may be associated with congenital heart disease. Its development in adults may be

associated with conditions such as hypertension although about 30% still have no cause (Framingham Data) [11](#).

Left Bundle Branch Block (LBBB)

LBBB generally indicates underlying hypertension or coronary heart disease. It may also occur in other conditions such as cardiomyopathy and valvular disease (see below). Its development in adults is often associated with cardiac disease with a high mortality (Framingham Data 11). A cardiology opinion should be sought before advising on employment in a physically active or high pressure role.

Complete Heart Block

Complete heart block at ventricular level is generally incompatible with long-term survival without pacing (see pacemakers below). Where this is a result of myocardial infarction it is generally associated with extensive myocardial damage and poor long-term survival. Right or left bundle branch block is also associated with large infarct size and although it is not an indication for pacing it is associated with higher one-year mortality, although this is mostly early mortality in-hospital [3](#) [5](#). Mortality is greatly increased in the presence of heart failure. A cardiology opinion should be sought before advising on employment in a physically active or high pressure role.

4 Benditt DG, Milstein S, Goldstein M, Reyes W, Gornick CC. Sinus node dysfunction: pathophysiology, clinical features, evaluation and treatment. In Cardiac Electrophysiology (eds DP Zipes and J Jalife). Philadelphia, WB Saunders, 1990.

5 Thery C, Gosselin B, Lekieffre J, Warembourg H. Pathology of sinoatrial node. Correlations with electrocardiographic findings in 111 patients. Am Heart J 1977;6:735-40.

6 Shaw DB, Gowers JI, Keswick CA, New KH, Whistance AW. Is Mobitz type I atrioventricular block benign in adults? Heart 2004 Feb;90(2):169-74.

7 Levander-Lindgren M, Lantz B. Bradyarrhythmia profile and associated diseases in 1,265 patients with cardiac pacing. Pacing Clin Electrophysiol 1988;11:2207-15.

8 Esscher EB. Congenital complete heart block in adolescence and adult life. A follow-up study. Eu Heart J 1981;2:281-8.

9 Hiss RG, Lamb IE. Electrocardiographic findings in 122,043 individuals. Circulation 1962;25:947-61.

10 Liao YL, Emidy LA, Dyer A. Characteristics and prognosis of incomplete right bundle branch block. An epidemiologic study. J.Am Coll Cardiol 1986;7:492-9.

11 Schneider JF, Thomas ME, Kreges BE. Newly acquired left bundle branch block: The Framingham study. Ann Intern Med. 1979;90:303-10.

Atrial Arrhythmias

Atrial Extrasystoles

Atrial extrasystoles are occasionally found on 12 lead ECGs, with an incidence of around 0.5%. They will be seen on 24 hour tapes in the majority of adults. Rarely they may trigger symptomatic palpitations, and will need to be differentiated from other causes. They are generally of no prognostic significance.

Atrial Flutter

Atrial flutter is almost always associated with underlying organic atrial disease and is very rarely seen in normal subjects [12](#). It can be paroxysmal or chronic, and the rate and any other symptoms are related to the degree of atrioventricular block. The predominant symptoms are palpitations although a degree of deterioration of exercise capacity can be seen. Palpitations can be precipitated by exercise. This would compromise an individual's ability to function. Individuals may be successfully treated with either drugs or ablation therapy. Fitness for work should be determined by the individual's symptoms taking into account the nature of any underlying cardiac condition, with advice from a cardiologist. This is a complex area as some individuals tolerate this rhythm well whilst others do so badly, even at similar rates.

Atrial Fibrillation (AF)

Atrial fibrillation is the most common cardiac arrhythmia. It can be paroxysmal or chronic and has a very variable presentation from being asymptomatic through palpitations without haemodynamic effect to those that include haemodynamic collapse and heart failure. Exercise intolerance is not uncommon, even in those who feel they are asymptomatic. Paroxysmal AF develops into chronic AF in about 30% of patients [13](#). AF is most often associated with hypertension but is also due to underlying ischaemic heart disease in men only [14](#), whilst high alcohol consumption, thyrotoxicosis, and valvular heart disease are amongst the many other causes. It is more common with increasing age and can be present in normal hearts (lone AF). Prevalence in the 55-64 age group is 6.2/1000 for men and 3.8/1000 for women [15](#).

When AF occurs in young patients it may be due to a focal arrhythmia that can be effectively treated by ablation in some patients.

AF may be vagally mediated; this occurs more commonly in younger men aged 30-50 and only rarely progresses to permanent AF. Attacks tend to occur at night and are often aborted by exercise although they may be precipitated by rest and alcohol and the relaxed state after exercise or eating. It is usually unrelated to structural heart disease [15](#), and should not be considered a contra-indication to employment as a firefighter.

AF may also be adrenergically mediated; this tends to occur during the day, and is associated with stress, exercise, caffeine or alcohol. Although rarer than vagally mediated AF, and usually only lasting a few minutes, it is more frequently associated with structural heart disease [16](#).

AF is of clinical significance both because of its immediate clinical effects, and because of long-term complications. Immediate effects may be palpitations, chest pain, shortness of breath, and low exercise tolerance. Heart failure may follow. Syncope is rare but may be associated with the start or termination of arrhythmia. Long-term effects include ventricular dysfunction and complications from thromboemboli. The relative risk of death is twice that of individuals with normal sinus rhythm [17](#) and the risk of stroke is increased by a factor of five independent of age [18](#).

Rheumatic mitral valvular atrial fibrillation has a 17 fold increased risk of TIA or CVA while non-rheumatic AF has over a five fold increased risk. Both have an annual rate of stroke of around 4.5% [19](#). A meta-analysis of trial outcomes with warfarin demonstrates an average of 45/1000 strokes per year in untreated patients, with a reduction to 14/1000 on warfarin associated with an increase of 3/1000 with major bleeds [20](#). These are general statistics, and the risk of stroke is significantly lower in individuals under 60 with no other risk factors. One such study had no strokes among 112 patients [21](#).

A number of anti-arrhythmic treatments are available; however individuals on treatment should be viewed with caution. Paroxysmal AF is often diminished by treatment, not cured. It recurs in over 90% of patients in spite of treatment, and up to 50% of patients discontinue drug therapy because of side effects of drugs or treatment failure [22](#). One study of sotalol versus propafenone showed 37% and 30% of patients attack-free during a oneyear period [23](#). Cardioversion may have good short-term results, however only around 10% can be expected to remain free of AF over four years, and this increases to only 27% when combined with anti-arrhythmic treatment [24](#). Anti-arrhythmic drugs are not without side effects; these include heart failure and other arrhythmias, including fatal ventricular dysrhythmias associated with co-existing heart disease.

Current DVLA guidelines for Group 2 drivers require the arrhythmia to be controlled for at least 3/12, and allow driving provided that the left ventricular ejection fraction is good (i.e. LVEF is >0.4), and there is no other disqualifying condition [25](#).

In summary, AF is associated with serious physical symptoms that are incompatible with effective operational firefighting, although symptoms vary significantly between individuals. There is also a significant risk of sudden collapse, again varying between individuals with varying risk factors. Young individuals with no other risk factors who are relatively or absolutely asymptomatic may be considered fit for operational firefighting after advice from a consultant cardiologist.

12 Ricou F et al. Influence of right bundle branch block on short- and long-term survival after acute anterior myocardial infarction. J Am Coll Cardiol 1991;17:858-63.

13 Fosmoe RJ, Averill KH, Lamb LE. Electrocardiographic findings in 67,375 asymptomatic subjects: II. Supraventricular Arrhythmias. Am J Cardiol 1960;6:84-95.

- 14 Godtfredsen J. Atrial fibrillation. Etiology, course and prognosis. A follow-up study of 1212 cases. Thesis, University of Copenhagen, 1975.
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- 16 Coumel P. Neural aspects of paroxysmal atrial fibrillation. In Falk RH, Podrid PJ eds. Atrial fibrillation: mechanisms and management. New York: Raven Press, 1992, pp109-25.
- 17 Kannel WB et al. Epidemiologic features of chronic atrial fibrillation. N Engl J Med 1982;306:1018-22.
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- 22 Crijns HJG et al. Atrial fibrillation: antiarrhythmic therapy. In Yusuf S et al. Evidence Based Cardiology. London: BMJ Books, 1998. pp 527-43.
- 23 Reimold SC et al. Propafenone versus sotalol for suppression of recurrent symptomatic atrial fibrillation. AM J Cardiol. 1993;71:558-63.
- 24 Van Gelder IC et al. Chronic atrial fibrillation. Success of serial cardioversion therapy and safety of oral anticoagulation. Arch Intern Med 1996;156:2585-92.
- 25 Drivers Medical Group, DVLA. At a glance guide to the current medical standards of fitness to drive. http://www.dvla.gov.uk/at_a_glance/ch2_cardiovascular.htm

Supraventricular Tachycardia (SVT)

There are three main types:

- Atrial tachycardia
- Atrio-ventricular nodal (junctional) re-entrant tachycardia
- Atrio-ventricular re-entrant tachycardia.

In atrial tachycardia (the rarest) there is usually underlying heart disease.

In the other two types there is usually no associated gross structural heart disease but there may be demonstrable electrocardiographic or electrophysiological abnormalities. Treatment of accessory pathways by ablation therapy can eliminate the problem but not all individuals are suitable. They generally appear in youth with recurrent attacks throughout life. Attacks tend to present as palpitations that may be associated with syncope or reduced exercise tolerance and in some cases shortness of breath and chest pain. They are considered benign unless they are associated with a rapid heart rate greater than 250 bpm or if attacks are prolonged.

Wolfe Parkinson White Syndrome

Wolfe Parkinson White Syndrome is a condition associated with pre-excitation via an accessory pathway and ranges in incidence from 0.1 to 3.7/1000 [26](#). The risk of suddendeath is low at approximately 0.0015 per patient year [27](#) but many deaths occur without warning [28](#). Frequency of tachycardia increases with age and can rarely be fatal, especially with paroxysmal AF which can degenerate into VF. The diversity of presentations means that specialist opinion will usually need to be sought for risk stratification, and restrictions placed on virtually all symptomatic individuals. Those who have successful ablation however are usually cured and returned to normal risk levels.

26 Josephson M. Preexcitation syndromes. In Clinical Cardiac Electrophysiology. Lea & Febiger, 1993; 311-416.

27 Munger TM, Packer DL, Hammil SC et al. A population study of the natural history of Wolff-Parkinson-White syndrome in Olmsted county, Minnesota, 1953-1989. Circulation 1993;87:866-73.

28 Montoya PT, on behalf of the European Registry on Sudden Death in the Wolff-Parkinson-White syndrome: Ventricular fibrillation in the Wolff-Parkinson-White syndrome. Circulation 1988;78(suppl. II):II-22(abstr).

Ventricular Arrhythmias

Ventricular Extrasystole

Ventricular extrasystoles (ectopic beats) are generally asymptomatic and although seen in less than 1% of 12 lead ECGs [29](#) they are expected as an incidental finding in 24 hour tapes in the majority of adults. They are usually benign and can be caused by nicotine or coffee. In rare cases they may indicate underlying disease. If

the individual is asymptomatic and the finding is incidental with no clinical abnormality of the cardiovascular system the individual should be considered fit.

If symptoms such as discomfort, palpitations, syncope or breathlessness are present, the individual should have 24 hour monitoring to quantify the extrasystoles and look for other dysrhythmias. A specialist opinion should be sought before providing advice on employment in these circumstances. The presence of ventricular ectopics with underlying cardiac disease, especially if accompanied by left ventricular dysfunction, often indicates a worse prognosis. Ventricular ectopics provoked by exercise or occurring in the recovery period of an exercise test also carry a worse outcome [30](#).

Ventricular Tachycardia

Ventricular tachycardia is defined as five or more consecutive ventricular beats at a rate of >120 bpm. There are many forms and mechanisms but individuals should be considered at potential risk of sudden cardiac death or major debilitating symptoms and should be investigated. A specialist opinion must be sought before providing advice on employment as there is great variety between individual types.

Ventricular Fibrillation

Individuals presenting with a history of ventricular fibrillation would be survivors of a serious cardiac event. It is essential to investigate the underlying pathology and steps taken to prevent recurrence before advising on employment.

29 Averill KH, Lamb LE. Electrocardiographic findings in 67,375 asymptomatic subjects: I. Incidence of abnormalities. *Am J Cardiol* 1960;6:76-83.

30 Frolkis JP, Pothier CE, Blackstone EH Lauer MS. Frequent ventricular ectopy after exercise as a predictor of death. *N Engl J Med*. 2003 Feb 27;348(9):781-90.

New section for 2012

Ischaemic Heart Disease

The heart becomes ischaemic when there is an imbalance between oxygen & nutrient supply and demand. This usually arises when the coronary blood flow is compromised but can arise when there is inadequate oxygen due to anaemia or a pathological process such as carboxyhaemoglobin. There may be excessive demand in conditions such as thyrotoxicosis, myocardial hypertrophy or phaeochromocytoma. This section will only consider conditions of compromised blood flow.

Blood flows to the heart through the coronary arteries, and blood flow in these may be reduced by narrowing of the whole artery through spasm or inflammation, by a luminal obstruction from thrombus or embolus, or a partial obstruction by atheroma. There may be a combination of these. An understanding of the process leading to

obstruction is important in order to understand risk, and to understand how treatment and lifestyle changes can modify the risk.

Emboli may arise outside the coronary artery, for example a thrombus formed in the left atrium during atrial fibrillation may pass through the ventricle and into the coronary artery. Similarly, a gas embolus or clot could pass across a Patent Foramen ovale from the right to the left heart and thence into the coronary arteries. So called Paradoxical Emboli are an important but rare cause of myocardial ischaemia.

Thrombi, other than those that embolise to the coronary arteries are generally formed in-situ from rupture of an atheromatous plaque within the wall of a diseased coronary artery.

Epidemiology:

Ischaemic heart disease (IHD) is common, so common that many firefighters will develop it while in service and it would be unnecessary, inappropriate and very costly to remove all firefighters from service if they develop it. In most cases it is treatable, risks can be dramatically reduced, and remaining in a physically active employment is the most beneficial long-term approach to treatment and risk reduction.

One in five men and one in seven women in UK die from IHD. 19% of premature deaths in men and 10% of premature deaths in women are from IHD. Of more importance, the death rate from IHD in UK has been progressively declining since the 1970's but remains higher than many other Western countries, with some parts of the UK (particularly Scotland) among the highest rate worldwide. In 2006 in England 8% of men and 3% of women aged 55-64 had angina. The total mortality rate in IHD patients in a 2006 review was 1.4-5.5% per annum and the total mortality for angina patients was 2.8-6.6% per annum. **31**

31 Chest pain of recent onset: clinical guideline 95. National Institute for Clinical Excellence. London. 2010.

Atherosclerosis:

Most ischaemic heart disease is caused by atherosclerosis. This is a complex process that probably starts with a fatty streak in late teenage years and progresses to atheromatous plaque formation. A combination of haemodynamic stress altered vascular tone resulting from dysfunctional endothelial cells producing lower levels of thiolate nitric oxide, inflammatory changes and raised levels of lipids lead to accumulation of lipids within the intima, and proliferation of smooth muscle cells. The combination of lipids and smooth muscle cells is a 'plaque', an extra-cellular connective tissue matrix embedded with lipid, foam cells (macrophages full of cholesterol) and necrotic debris.

Progressive plaque growth either progressively obstructs the lumen or leads to vascular remodelling with dilation of the artery to accommodate the plaque. Flow limitation normally requires loss of 50-70% of luminal cross-section. A stable plaque will gradually lead to increased flow limitation with symptoms such as angina. Flow limitation sufficient to produce effort angina does not usually occur until it is greater than 70% luminal diameter **32**.

Plaques may also be unstable, where the endothelium over the plaque is lost, or the integrity of the fibrous plaque covering is lost, leading to thrombus formation around the highly thrombogenic plaque contents, or plaque rupture leading to rapid occlusion of the whole lumen with thrombus.

The initial cause of atherosclerosis has not been clearly demonstrated but may be due to a process of vascular injury. There are a number of risk factors that may cause or be associated with the injury to promote atheroma formation including smoking, hypertension, dyslipidaemia (particularly low-density lipoprotein), diabetes and infection. Age-related changes may also predispose to plaque formation and genetics probably plays a significant role.

The main lifestyle factors promoting atherosclerosis are smoking, and the combination of lack of exercise and obesity leading to increased lipid levels, hypertension and increased inflammatory markers.

Factors reducing the risk and incidence of atherosclerosis include moderate alcohol consumption which raises high density lipoprotein, and a diet rich in monounsaturated fats such as olive oil and omega-3 fats from fish oils.

A number of genetic factors have been identified, particularly hypercholesterolaemia, but there are epigenetic factors related to parental lifestyle and stress, prenatal exposures and early childhood exposures which become non-modifiable by adulthood. Family history is a key part of the history when assessing risk.

32 McMahon M, Brown B, Cukingnan R. et al. Quantitative coronary arteriography; measurement of the 'critical' stenosis in patients with unstable angina and single vessel disease without collaterals. *Circulation* 1979;60:106-13.

Presenting Features:

The classic presentation of IHD is either angina, shortness of breath on exertion or a myocardial infarct. Presentation with other features, such as heart failure, is unlikely in a firefighter. Some patients are now identified during screening with Coronary Calcium Scoring. High levels of coronary calcification are closely correlated with an adverse prognosis and in the presence of symptoms or other tests suggesting ischaemia, the diagnosis can be confirmed by coronary angiography.

Where a firefighter presents with symptoms suggestive of IHD but before diagnosis is made, a decision may be needed on fitness to remain at work, and fitness to continue operational firefighting. A judgement should be made based on the presenting symptoms and associated risk factors. A 25 year old with a couple of

episodes of stabbing chest pain, normal pulse and no risk factors would not normally be taken 'off the run' as the likelihood of this being due to IHD is extremely small. There is no simple algorithm that can be followed to decide who can continue and who should not. In general, in a firefighter older than 40, or a firefighter older than 30 with substantial risk factors such as diabetes, hypertension, obesity and smoking, care should be taken before advising they are fit to remain operational. In most cases the risk of undertaking a mostly sedentary administrative role pending the outcome of testing is unlikely to put the individual at greater risk than leaving them at home, and if anything untoward were to happen colleagues at work can call an ambulance while if the individual is alone at home they will be more vulnerable.

Angina:

Angina is a clinical symptom, the discomfort is usually described as 'heavy', 'tight' or 'gripping', and is generally located retrosternally and classically radiates to the jaw and/or arms. There may be associated breathlessness and sweating. The symptoms are usually brought on by effort and rapidly disappear on rest, usually within a minute or two. The exercise threshold for pain is not always predictable. In a patient in whom a diagnosis of angina is being considered, chest discomfort should be classified as non-Cardiac, atypical angina or typical angina. Atypical angina may be defined as symptoms of angina that may not be reliably induced by exertion or where the location of discomfort may be unusual or where the symptoms are very prolonged. Typical angina is chest discomfort provoked by exertion and relieved by rest or GTN within 10 minutes.

Simple investigations are usually normal, with normal pulse, heart sounds and resting ECG. Blood pressure may be raised when there is associated hypertension. In a middle-aged male patient with typical angina the chance of the cause being due to underlying ischaemic heart disease is very high and these patients should be offered diagnostic coronary angiography as this is the gold standard method for confirming diagnosis, determining prognosis and management strategy. Historically exercise testing has been used to determine diagnosis in men with Atypical Angina, but recent guidance from NICE has suggested that these patients should perhaps undergo Myocardial Perfusion scanning. Patients with few risk factors and atypical angina or non-cardiac symptoms should be offered Coronary Calcium scoring and CT coronary angiography. Exercise testing is recognised to have a high false positive result (upto 20% in men and more than 30% in women) so is probably no longer useful as a diagnostic or screening tool **33**.

Subsequent testing generally includes echocardiography to look at overall cardiac function including valve function.

Annual mortality from those diagnosed with angina is less than 2%. Treatment of associated risk factors significantly reduces risk, and lifestyle change can substantially reduce risk.

33 National Clinical Guideline Centre for Acute and Chronic Conditions. Chest pain of recent onset: assessment and diagnosis of recent onset chest pain or discomfort

of suspected cardiac origin. NICE clinical guideline 95. National Institute of Clinical Excellence. London: March 2010.

Coronary Artery Spasm:

Coronary artery spasm presents as angina without provocation, usually at rest. It is more frequent in women than men, and the ECG shows ST elevation associated with pain, while coronary arteriography is normal when the patient is asymptomatic.

Diagnosis usually requires provocation tests. The main risk, besides the disabling pain, is arrhythmia during the ischaemic episode.

Treatment:

Patients with angina should be treated with the aim of eliminating symptoms, reducing risks of further IHD and encouraging lifestyle changes to further reduce the risks. All patients will have pharmacological treatment, and interventional treatment will be based on the severity and location of any coronary artery atherosclerosis. Percutaneous intervention (PCI) is not recommended for stable angina that is adequately managed with standard drug therapy, providing it is well tolerated.

Psychological factors, particularly depression and anxiety, are common in patients diagnosed with IHD, and have a significant negative prognostic effect. It is therefore important to screen for these and address these issues actively as a part of any rehabilitation programme.

Treatments include:

- Lifestyle Change
- Risk of Exercise, and Risk Modification during Training
- Personality, Stress and Lifestyle Pressures
- Pharmacologic Treatment
- Percutaneous Coronary Intervention
- Coronary Artery Bypass Grafting

Acute Coronary Syndrome and Myocardial Infarction:

Myocardial infarction (MI) is irreversible death of heart muscle secondary to prolonged ischaemia. The usual cause is a ruptured plaque leading to thrombus formation acutely occluding the coronary artery. MI is at one end of the spectrum of Acute Coronary Syndrome (ACS) with unstable angina at the other.

It is important to differentiate symptoms from investigative findings when assessing ACS. Patients may present with acute chest pain, with or without a history of angina, or they may present with no pain but shortness of breath and or palpitations. Some have no symptoms, a 'silent MI'. The degree of pathology is determined by

assessing ECG changes and the presence of cardiac enzymes in the blood. The presence of cardiac enzymes normally denotes damage to myocardium, and is diagnostic for MI. There may or may not be evidence of ST segment elevation on ECG. The spectrum therefore includes unstable angina, non-ST-segment elevation MI (NSTEMI), and ST-segment elevation MI (STEMI). STEMI suggests ongoing acute transmural myocardial injury and immediate reperfusion therapy may reverse some or all of the ischaemia. Current optimum treatment of STEMI in the UK includes both immediate thrombolysis and Primary PCI although the DoH aims to have 96% of all STEMI treated by Primary PCI by 2015. Thrombolysis should always be followed by early coronary angiography and revascularisation as required. The longer-term outcome depends substantially on the results of early intervention. It is important to establish whether there is any residual myocardial damage in order to assess the ongoing risk to the individual.

There are many sources of evidence for risk associated with unstable angina, NSTEMI and STEMI, however these guide early investigation and treatment and are not particularly relevant to Medical Advisers assessing fitness to return to operational firefighting. Key issues are the longer-term assessment of prognosis and risk factors.

Residual damage depends to some extent on which artery is obstructed but is mainly a result of the time lapse between symptom onset and restoration of normal blood flow (reperfusion). Mortality increases by 7% for every 30-minute delay in achieving normal coronary blood flow.

With the introduction of early reperfusion therapy, mortality and in survivors, subsequent complications are far fewer. Patients who experience a large Myocardial infarct are less likely to be able to return to full activity. Significant anterior wall infarction is still associated with the presence of intraventricular thrombus. An individual with this history will not recover to the point where they are physically capable of firefighting and the risks would be substantial if they attempted to do so.

Following MI, all patients are expected to start treatment with aspirin, an ACE inhibitor, a beta-blocker and a statin. As most patients are now treated by PPCI, the use of another antiplatelet drug, either Clopidogrel, Prasugrel or Ticagrelor in conjunction with Aspirin is now commonplace. This not only places patients at a higher risk of bleeding but is also associated with a risk of large or significant bruises. More details on these medications can be found under 'hypertension' and 'drugs affecting bleeding'.

[Fitness Following Treatment](#)

[Mechanical Risk](#)

[Arrhythmia Risk](#)

[Risk from Heavy Physical Exertion](#)

Fitness Following Treatment:

Recovery from treatment depends on residual symptoms. The aim is to combine medical treatment with lifestyle change to reach a point where the individual is symptom free and physically fit enough for operational firefighting duties. This is a realistic goal in the great majority of individuals with ischaemic heart disease.

Overall, the mortality rate associated with MI is 30%, half of these before the individual reaches hospital, and 5-10% die within a year of their first MI with half re-hospitalised within a year. This partially reflects co-morbidities and age-related problems. Aggressive treatment with lifestyle change will substantially reduce the risk of future events in those without major irreversible cardiac pathology.

Depression and anxiety are commonly seen after MI and have poor prognostic outcomes. It is important to screen for these and address them as a part of the rehabilitation programme **60 61** A useful approach to holistic rehabilitation will be found in the Scottish Intercollegiate Guideline Network (SIGN) Guideline 57 **62**.

60 Frasure-Smith N, Lesperance F, Talajic M. Depression and 18-month prognosis after myocardial infarction. *Circulation* 1995; 91: 999-1005.

61 Mayou RA, Gill D, Thompson DR, Day A, Hicks N, Volmink J, et al. Depression and anxiety as predictors of outcome after myocardial infarction. *Psychosom Med* 2000; 62: 212-9.

62 Scottish Intercollegiate Guidelines Network. Cardiac Rehabilitation: National clinical guideline 57. SIGN, Edinburgh 2002

Mechanical Risk:

Myocardial damage of less than a third thickness is likely to recover to normal function. Full thickness damage can lead to ventricular rupture, but most ruptures occur within the first week after MI. Ventricular septal rupture rarely occurs more than two weeks after an MI but the rate of recurrence after surgical repair is about 28%. Papillary muscle or chordae tendinea rupture is seen in the first two weeks after MI in 1% of cases and usually only arises acutely within the first day. The risk of these mechanical events has substantially decreased with the use of PCI. Mitral valve regurgitation may also occur when a substantial posterior infarction disrupts the normal heart geometry. Left ventricular aneurysms arise in 3-15% of patients after MI, most in relation to left anterior descending artery blockage with aneurysm of the anterolateral wall. Overall, the risk of acute mechanical disruption is greatest immediately after MI and does not appear to be significant after recovery from the acute phase.

Those with an ejection fraction of less than 40% have significantly increased risk of fatal arrhythmia, they have a 20% mortality rate over 3.5 years, and half the deaths were sudden **63**. For this reason, DVLA bar such patients from driving Group 2

vehicles and a similar approach would be expected with operational firefighting. However, because of acute stunning of the myocardium, assessment of ejection fraction for DVLA purposes should not occur before one month after the MI.

63 Stevenson WG, Rickler PM. Should survivors of myocardial infarction with low ejection fraction be routinely referred to arrhythmia specialists? JAMA. 1996;276(6):481-5.

Arrhythmia Risk:

Ventricular arrhythmias were found in 64.1% of patients before hospital discharge post-MI, more than 10 premature ventricular beats per hour were seen in 19.7% and non-sustained ventricular tachycardia was present in 6.8%. Death by 6 month follow-up was noted in 2% of those without arrhythmia, 2.7% of those with one to 10 premature ventricular beats, 5.5% of those with more than 10 premature beats and 4.8% of complex premature ventricular beats, but no increased risk with non-sustained ventricular tachycardia **64**. These differentials suggest a low predictive accuracy and the best predictor for a further acute event would be recurrent symptomatic arrhythmias. Patients at most risk are those who have experienced a large MI resulting in an EF of less than 40%. These patients should undergo screening for arrhythmia and in some instances would be offered an ICD for Primary Prevention of ventricular arrhythmia. Where there is a substantial risk of symptomatic or fatal arrhythmia, an implantable cardioverter defibrillator (ICD) can significantly reduce the risk, but there is an associated risk of sudden collapse in the individual when the defibrillator activates. For this reason, these are an absolute bar to driving Group 2 vehicles and a similar approach would be expected with operational firefighting.

Any rehabilitation programme should be undertaken with the support of the treating cardiologist, following the principles outlined above for exercise prescription. The final decision on fitness for operational firefighting should only be made when the individual meets the required physical standard with no signs or symptoms of IHD when exercising at this level.

64 Maggioni AP et al. Prevalence and prognostic significance of ventricular arrhythmias after acute myocardial infarction in the fibrinolytic era. GISSI-2 results. Circulation. 1993;87(2):312-22.

Risk from Heavy Physical Exertion:

The main risk from high physical load is from arrhythmia. Those at high risk should be excluded, including those with exercise-induced ischaemia, complex arrhythmias or ejection fraction less than 40%. A study of 23 men post-MI without these risk factors randomly allocated to aerobic training or aerobic training plus weight training saw significant increases in VO₂max, arm and leg strength with no changes in

resting haemodynamic, LV wall segment motion, LV fractional shortening or early diastolic function and no adverse clinical events [65](#).

65 Stewart KJ et al. Safety and efficacy of weight training soon after acute myocardial infarction. *J Cardiopulm. Rehabil.* 1998;18(1):37-44.

Revascularisation

In the 1970s and early 1980s several trials looked at the long term outcome of coronary artery bypass graft surgery against standard medical treatment. A consensus of opinion emerged that individuals who had either significant triple vessel disease or left main stem disease or reduced left ventricular function benefited in terms of prognosis from coronary artery bypass graft surgery. It was also indicated for symptomatic relief of individuals with significant triple vessel disease.

Where symptoms were not severe or troublesome and investigation showed single or double vessel disease (excluding proximal anterior descending disease and left main stem disease), particularly in the presence of good left ventricular function, medical therapy was found to offer comparable long term results [66](#) [67](#) [68](#) [69](#) [70](#) [71](#). These trials were summarised in guidelines and indication for coronary artery bypass graft surgery such as those by Kirklin [72](#).

Around twenty years ago coronary angioplasty started to develop. The ACME trial compared angioplasty with medical treatment and demonstrated that patients with single vessel disease treated with angioplasty showed at six months a reduction in numbers of attacks of angina and improved quality of life over those treated medically. Nevertheless 46% of this angioplasty group still had angina [73](#). Similarly the RITA 2 study comparing angioplasty to medical care for an initial treatment strategy showed that after a median of 7 years, death or MI had occurred in 14.5% of angioplasty patients and 12.3% of the medical care patients. Symptom improvement was greater in the angioplasty group [74](#). Thus despite symptomatic improvement adverse events were similar in both groups.

Despite these successes of angioplasty against medical treatment, the longer term results versus surgery were less convincing. The RITA I trial compared outcome in patients with single or multi vessel disease that was considered suitable for either angioplasty or surgery.

These results showed that mortality was similar but at six months those patients randomised for coronary angioplasty had a higher incidence of recurrent angina (32% compared to 11% in those randomised to surgery). There was also a greater need for both repeat angiography and procedures in the angioplasty group [75](#). This supported previous published observational data on the early natural history of angioplasty which reported restenosis following angioplasty in up to 40% of patients [76](#). It was also noted that restenosis was most likely to happen in the first four to six months. The two year follow up data from the RITA trial supported this.

For the longer term however graft occlusion resulted in recurrent disease in the coronary artery bypass graft patients. Meta-analyses support this with little difference

in mortality but around one third of patients treated with angioplasty requiring a further procedure compared to around 3.3% of surgical ones [77 78](#).

These factors led to further developments. Unfortunately saphenous vein grafts occlude with time [79 80](#). With around 50% of vein grafts being blocked by ten years arterial grafts were increasingly used as these have lower occlusion rates with around 90% of these arterial grafts being patent at ten years [81 82 83 84 85](#).

Angioplasty also developed with the use of stents to try and reduce early restenosis. This was endorsed in 2000 by the National Institute of Clinical Excellence. The BENESTENT study clearly showed that stenting in native vessels reduced the incidence of restenosis [86](#).

The arterial revascularisation therapy study (ARTS) is looking at these more efficacious treatments [87](#). It compares coronary artery bypass graft surgery to angioplasty in patients with multi vessel disease in terms of major cardiac or cerebrovascular events. In the surgical group 93% of patients received an arterial graft. The angioplasty group used stents. The one year results show the rates of death, acute MI or stroke were low, not differing between the two groups (9.5% for stented patients and 8.8% for surgical patients) however the event free survival was higher in the surgical patients (87.3% versus 73.3% of patients) entirely because of the need for re-intervention in the stented patients.

From an occupational health point of view these studies offer clear messages. Despite active intervention there are still significant proven long term problems for patients who required intervention. New methods such as stenting and bypass graft surgery with arterial grafts are reducing the event rate but it remains significant and all patients will need very careful assessment which will have to take in to account the procedures, the length of time from the procedure and the underlying state of the coronary artery disease together with intervention.

Single vessel arterial grafting carries the best prognosis if all other vessels are normal, there is no evidence of myocardial damage and full risk factor intervention is in place. In these circumstances, a single stent with the same preconditions will be expected to do well after the first 6 month high recurrence period is over.

In both of these groups employment will need careful consideration, with the results of a recent exercise test to confirm good exercise tolerance and lack of evidence of myocardial ischaemia (symptoms and electrocardiographic evidence). More diffuse disease and multiple stenting/grafting have more risk of recurrence and ongoing symptoms.

Many individuals will consider themselves effectively cured by these procedures but the evidence is not in favour of this. Palliation has occurred with a significant future event rate and need for further intervention.

- 66 Long term results of prospective randomised study of coronary artery bypass surgery in stable angina pectoris. European Coronary Surgery Study Group. *Lancet* 1982 Nov 27;2(8309):1173-80.
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- 68 Weinstein GS, Levin B. The Coronary Artery Surgery Study (CASS). A critical appraisal. *J Thorac Cardiovasc Surg.* 1985 Oct;90(4):541-8.
- 69 Bonow RO, Epstein SE. The indications for coronary artery bypass surgery in patients with chronic angina pectoris; implications of the multi centre randomised trials. *Circulation* 1985: Dec;76 6 (pt 2);V23-30.
- 70 Myers WO, Gersh BJ, Fisher LD et al Medical versus early surgical therapy in patients with triple-vessel disease and mild angina pectoris; a CASS registry study of survival. *Ann Thorac Surg* 1987 Nov;44(5);471-86.
- 71 Loop FD, CASS continued. *Circulation* 1985; 72 (3 Pt 2): II1-6.
- 72 Kirklin JW, Akins CW, Blackstone EH et al. Guidelines and indications for coronary artery bypass graft surgery. *J Am Coll Cardiol* 1991;17:543-89.
- 73 Parisi AF, Folland ED, Hartigen P. A comparison of angioplasty with medical therapy in the treatment of single-vessel coronary artery disease. Veterans affairs ACME Investigators. *N Eng J Med* 1992 Jan 2;326 (1): 10-16.
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- 76 Gershlick AH, de Bono P. Restenosis after angioplasty. *Br Heart J* 1990;64:351-3.
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- 78 Rickards AF, Davies SV. Coronary angioplasty versus coronary surgery in the management of angina. *Curr Opin Cardiol* 1995;10:399-403.
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- 80 Lytle BW, Loop FD, Taylor PC et al. Vein graft disease: The clinical impact of stenoses in saphenous vein bypass grafts to coronary arteries. *J. Thorac. Cardiovasc. Surg.* 1992;103:831-40.

81 Okies JE, Page US, Bigelow JC et al. The left internal mammary artery: the graft of choice. *Circulation* 1984;70(suppl. I):213-21.

82 Tector AJ. Fifteen years' experience with the internal mammary artery graft. *Ann Thorac Thorac Surg* 1986;42(suppl):S22-7.

83 Tector AJ, Schmahl TM, Canino VR. Expanding the use of the internal mammary artery to improve patency in coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 1986;91:9-16.

84 Loop FD, Lytle BW, Cosgrove DM et al. Free (aorta-coronary) internal mammary graft. Late results. *Cardiovasc. Surg.* 1986;92:827-31.

85 Green GE, Swistel DG, Cameron AA. Bilateral internal thoracic artery surgery: 17 year experience. *Eur Heart J* 1989;10 (suppl. H):57-60.

86 Serruys PW, de Jaegere P, Kiemeneij F et al. A comparison of balloon – expandable – stent implantation with balloon angioplasty in patients with coronary artery disease. Benestent Study Group. *N Eng J Med* 1994 Aug 25;331:489-95.

87 Serruys PW, Unger F, van Hout BA et al. The ARTS Study (Arterial Revascularisation Therapies Study). *Seminars in Interventional Cardiology* 1999;4:209-19.

Heart Failure due to Ischaemic Heart Disease

Heart failure generally represents the terminal stages of ischaemic heart disease with a high risk of acute events and poor long-term prognosis. Mortality within 2 years for all grades of heart failure in the Framingham study was 25%. This varies from 10-20% for mild heart failure to 75% for severe heart failure. Of all deaths, up to 50% will die suddenly from either arrhythmic or embolic causes [88](#). Such a high risk would generally be considered incompatible with operational firefighting, and could have a significant impact on controlroom operators.

[Valvular Heart Disease](#)

[Congenital Heart Disease](#)

[Heart Muscle Disorders](#)

[Pericardial Disease](#)

88 Kannel WB et al. Cardiac failure and sudden death in the Framingham study. *Am Heart J* 1988; 115:869-75.

Valvular Heart Disease

Mitral Stenosis

Mitral stenosis is almost always due to rheumatic heart disease. As the incidence of rheumatic fever has declined in Western Europe it is no longer frequent in the young.

By contrast it remains prevalent in many parts of the world including Eastern Europe where it causes significant morbidity even in young adults. Signs will often be present at preemployment screening but any history of rheumatic fever should alert the examiner to a careful search. There are underlying risks with further damage to the valves and a need for ongoing surveillance, and as the condition progresses, there is usually a requirement for medication and often intervention. If atrial fibrillation develops, anticoagulants will be needed (see separate guidance).

Mitral Regurgitation

Mitral Regurgitation was also mainly due to rheumatic heart disease but now the majority is non rheumatic in the Western World [89](#). Mitral regurgitation should be investigated for the underlying cardiac cause (including ischaemic heart disease, chordal rupture, mitral valve prolapse and secondary to cardiac dilatation from other causes). There is a significant risk of progression with cardiac chamber dilatation.

Serving firefighters should be fully assessed and only advised to continue if their condition is mild, investigations (such as echocardiography) show no major haemodynamic upset and the risk of sudden incapacity is very low. They must be kept under annual specialist review.

Mitral regurgitation is also a sequel to myocardial infarction. Severe regurgitation is usually related to papillary muscle rupture or severe dysfunction and is not generally compatible with long-term survival without valve replacement. Individuals with mitral regurgitation post-MI have twice the relative risk of death compared to post-MI individuals with no regurgitation [90](#).

Applicants with mild mitral regurgitation may be considered for firefighting following cardiac assessment, which will take into account the underlying cause, and should be kept under annual review.

Mitral Valve Prolapse

The commonest cause of malfunction of the mitral valve is prolapse of one or both of its cusps during systole. The extent of this is extremely variable as are the consequent signs and haemodynamic effects [1](#). Mitral valve prolapse is more commonly found in adult women [91](#) [92](#). Mild degrees are so common as to be regarded as normal a variant. Rarely significant regurgitation may give rise to haemodynamic consequences. If found at preemployment screening or during routine medical examination it needs cardiological assessment.

Aortic Stenosis

Aortic stenosis is now most frequently related to degeneration of the aortic valve, often with an underlying bicuspid valve. The natural history is very variable with some cases remaining static for years whilst others can progress quite quickly [93](#) [94](#) [95](#) [96](#) [97](#). Chest pain, syncope and dyspnoea are the classic symptoms and sudden death is a risk [98](#). Generally aortic stenosis is considered critical when the gradient exceeds 50 mm Hg or the valve area is less than 0.4cm²

/m2 body surface area [99](#). Symptoms including sudden death are often provoked by exertion; therefore intensive follow-up is required in any symptomatic individual exposed to exertion in their occupation.

Aortic Regurgitation

In aortic regurgitation there is a significant risk of progression with dilation of the cardiac chambers. This will eventually lead to cardiac failure. Exercise tolerance will be limited as the condition progresses. At pre-employment screening, great care should be taken in assessing recruits to detect the early diastolic murmur of aortic regurgitation. Other signs and the development of symptoms occur relatively late in the disease process. Serving firefighters should be assessed by a cardiologist and kept under annual review.

Prosthetic Heart Valves

Individuals with mechanical prosthetic heart valves will need permanent anticoagulation. See separate guidance on this.

Individuals with tissue prosthetic heart valves are not routinely anticoagulated. The majority of these individuals will develop problems later as the prosthetic valve degenerates faster than the native valve, and they will require a mechanical valve later in life. This is often 10 or more years down the line from surgery (and lengthening with better surgical techniques). Firefighters with tissue valves should be kept under annual cardiology review.

1 Julian D. Diseases of the Heart. Second Edition. London: WB Saunders. 1996

89 Selzer A, Katayama . Mitral regurgitation: Clinical patterns, pathophysiology and natural history. Medicine 1972;51:337-66.

90 Lamas GA et al. Clinical significance of mitral regurgitation after acute myocardial infarction. Circulation 1997;96:827-33.

91 Jeresaty RM. Mitral Valve Prolapse. New York: Raven Press, 1979: 139.

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95 Bogart DB, Murphy BL, Wong BYS et al. Progression of aortic stenosis. Chest 1979;76:391-6.

96 Cheitlin MD, Gertz EW, Brundage BH et al. Rate of progression of severity of aortic stenosis. Am Heart J. 1979;98(6):689-700.

97 Jonasson R, Jonasson B, Nordlander R et al. Rate of progression of severity of aortic stenosis. Acta Med Scand 1983;213:51-4.

98 Hohn AR, van Praagh S, Moore AAD et al. Aortic stenosis. Circulation 1965; 32(suppl 3):III 4-12.

99 Morrow AG, Roberts WC, Ross J Jr et al. Clinical staff conference. Obstruction to left ventricular outflow. Current concepts of management and operative treatment. Ann Intern Med 1968;69:1255-86.

Congenital Heart Disease

Defects are often associated with each other and in any individual it is necessary to get full information from the centre that provided care for the patient.

Ventricular Septal Defect

Small, high membranous lesions are benign and occur in 1 in 500 live births. Most close spontaneously with most no longer patent by 10 years of age. Apart from the risk of endocarditis small residual defects pose no problem.

Individuals with large lesions can develop haemodynamic disturbances and pulmonary hypertension. This usually occurs early in childhood. Where a successful repair has been carried out, individuals should be able to serve as firefighters if they are symptom free.

Atrial Septal Defect

Small defects are benign, but should not be confused with patent foramen ovale which is not a true defect and does not normally lead to symptoms or pathology later in life.

Larger defects with significant shunting of blood can lead to haemodynamic disturbances and pulmonary hypertension. These complications usually start in mid-adult life. Since a murmur is often the only presenting feature this is one of the reasons why individuals with ejection systolic murmurs should be investigated by a cardiologist. Significant signs such as fixed splitting of the second sound, and any symptoms such as reduced exercise tolerance should be treated with particular caution. Specific advice should be sought for those treated with the new percutaneous closure devices as there is little evidence for the longterm prognosis with these techniques.

Patent Ductus Arteriosus

Patent ductus arteriosus may be successfully treated pharmacologically in the newborn, and by ligation and device closure. Unless associated with other significant pathology individuals should be considered fit for all duties.

Coarctation

Aortic coarctation is strongly associated with bicuspid (potentially stenotic) aortic valves. Untreated coarctation has a high risk of morbidity and mortality. Even after 'successful' surgery there are long term sequelae [100](#). Systemic hypertension may persist after surgery. Individuals should be kept under regular cardiologist review to ensure they do not develop further cardiovascular disease.

Pulmonary Stenosis

Pulmonary stenosis does not always require treatment. If necessary, balloon valvuloplasty or valve replacement is carried out in childhood following which the condition is rarely progressive. Potential recruits who are symptom free should therefore be considered fully fit.

Bicuspid Aortic Valve

Bicuspid aortic valve occurs in 1–2% of the population and is more common in males than females. Problems usually only arise later in life when one third will calcify leading to aortic stenosis and another third will lead to aortic regurgitation [101](#) [102](#).

Asymptomatic bicuspid valves will not usually present at medical screening other than by a soft ejection systolic murmur. Any identified either through history or signs such as a murmur should be referred to a cardiologist. Further five-yearly assessments are recommended to identify any significant degree of aortic stenosis or regurgitation. It is these consequences which limit employability.

Complex Congenital Heart Disease

Many individuals with complex lesions such as tetralogy of Fallot are surviving in to adult life after surgery. In many cases the results are excellent but the surgery has to be viewed as 'repair' rather than 'correction'. There are still significant risks from decompensation and therefore despite seemingly good results specialist advice is always necessary [103](#) [104](#).

100 Celermajer DS, Greaves K. Survivors of Coarctation repair: fixed but not cured. Editorial. Heart 2002;88:113-114.

101 Roberts WC. The congenitally bicuspid aortic valve. A study of 85 autopsy cases. Am J Cardiol 1970; 26:72-83.

102 Fenoglio JJ, McAllister HA, DeCastro CM, Davis JE, Cheitlin MD. Congenital bicuspid aortic valve after age 20. Am J Cardiol 1977;39:164-9.

103 Hokanson JS, Moller JH. Adults with tetralogy of Fallot: Long term follow up. Cardiol Rev 1999 May;7:149-155.

104 Nollert G, Fischlein T, Bourtevek S, Bohmer C, Klinner W, Reichart B. Long term survival in patients with repair of Tetralogy of Fallot 36 year follow up of the first year after surgical repair. J Am Coll Cardiol 1997 Nov 1:30(5):1374-83.

Heart Muscle Disorders

Cardiomyopathies

Hypertrophic [105](#) [106](#) [107](#) [108](#) [109](#), dilated [110](#) and restrictive cardiomyopathy are all associated with significant morbidity and mortality. To this classic list, arrhythmogenic right ventricular cardiomyopathy (also referred to as 'right ventricular dysplasia') has been added and also has significant risk associated with it [111](#). Individuals may develop permanent disease as a result of chemotherapy.

Besides the physical limitations these conditions impose, there is also a considerable risk of increased morbidity and mortality to themselves and risk to others if individuals were to continue to work as active firefighters.

Myocarditis

Acute viral myocarditis can be self limiting with full resolution of any associated cardiac failure. It can also lead to chronic cardiac failure with permanent cardiac damage. Such individuals will need careful assessment.

105 Maron BJ, Roberts WC, Epstein SE. Sudden Death in Hypertrophic Cardiomyopathy: A Profile of 78 patients. *Circulation* 1982;65:1388-94.

106 Maron BJ Bonow RO, Cannon RO III, Leon MB, Epstein SE. Hypertrophic Cardiomyopathy: Interrelations of Clinical Manifestations, Pathophysiology and Therapy. Part 1. *N Engl J Med* 1987;316:780-9.

107 Maron BJ, Roberts WC, Edwards JE, McAllister HA, Foley DD, Epstein SE. Sudden Death in Hypertrophic Cardiomyopathy: Characterisation of 26 patients without Functional Limitation. *Am J Cardiol* 1978;41:803-10.

108 Maron BJ, Bonow RO, Cannon RO, III, Leon MB, Epstein SE. Hypertrophic Cardiomyopathy: Interrelations of Clinical Manifestations, Pathophysiology and Therapy. Part 2. *N Engl J Med* 1987;316:844-52.

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110 Redfield MM, Gersh BJ, Bailey KR et al. Natural history of idiopathic dilated cardiomyopathy: effect of referral bias and secular trend. *J Am Coll Card* 1993;22:1921-6.

111 Thiene G, Nava, Corrado D et al. Right ventricular cardiomyopathy and sudden death in young people. *N Engl J Med* 1988;318:129-33.

Pericardial Disease

Pericarditis

Most episodes of pericarditis are either viral or idiopathic in origin. They are usually self limiting but may be recurrent. A cardiologist opinion should be sought if there is a

recent history of the condition or the individual is subject to recurrent bouts, although most have a complete and uncomplicated recovery.

Constrictive Pericarditis

Individuals with constrictive pericarditis generally have significant underlying pathology, morbidity and mortality.

Infective Endocarditis

Episodes of infective endocarditis usually indicate underlying structural cardiac disease such as valvular or septal abnormalities. Any history of endocarditis should require a cardiology assessment and decisions on employment should depend on the nature of the underlying pathology.

New section for 2012

Hypertension:

There is a continuous relationship between blood pressure and cardiovascular risk which renders a numerical definition arbitrary. In the past the main focus has been on diastolic blood pressure, but more recent studies have shown that cardiovascular morbidity and mortality have a continuous relationship with both systolic and diastolic blood pressures. Pulse pressure appears to be significant in the elderly but much less so in those under 55. Cardiovascular risk increases incrementally as blood pressure rises from levels that are considered normal, such as systolic levels of 110-115mmHg and diastolic levels of 70-75mmHg. The 2007 European Guidelines have retained the classification from 2003 with the following provisos: where systolic and diastolic fall into different categories the higher category applies, a large pulse pressure associated with a low diastolic blood pressure (e.g. 60-70mmHg) should be regarded as an additional risk and other risk factors should be taken into account **112**.

Category	Systolic	Diastolic
Optimal	<120	<80
Normal	120-129	80-84
High Normal	130-139	85-89
Grade 1 Hypertension	140-159	90-99
Grade 2 Hypertension	160-179	100-109

Grade 3 Hypertension (severe)	>180	>110
Isolated Systolic Hypertension	>140	<90

The European Society of Hypertension decided not to adopt the concept of 'prehypertension' to describe normal and high normal levels as these groups had substantial variation in risk across them and using such a term increased anxiety and medicalisation.

A blood pressure of 220/140 or greater is life-threatening and should be treated as an emergency, with immediate referral to hospital.

Hypertension is classified as primary or essential (no secondary cause identified) in 95% of cases, and secondary (usually renal or endocrine) in 5% of cases. Primary hypertension results mostly from environmental factors, with some genetic factors. Salt intake is likely to be one of the most important environmental causes in most populations. The Yanomamo to whom dietary salt as an additive was unknown and no alcohol was consumed had an average blood pressure of 103/63mmHg in the INTERSALT study, and blood pressure did not increase with age **113**. Other important environmental factors are obesity and lack of exercise.

112 The Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). 2007 Guidelines for the management of arterial hypertension. J Hypertens. 2007;25:1105-1187.

113 Carvalho JJ et al. Blood pressure in four remote populations in the INTERSALT study. Hypertension. 1989;14:238-46.

Hypertension and sub sections:

Advising on Employment:

Where hypertension (systolic > 140, diastolic > 90) is identified at pre-employment screening, the individual should be referred to their GP and recruitment delayed until the condition has been assessed and the outcome of any treatment required is known. Most recruits are young, and a blood pressure reading at this level in someone below the age of 30 is likely to indicate substantial increased risk. Any decision on employment should be based on the presence of additional modifiable risk factors such as obesity and smoking. Where hypertension is asymptomatic, although there may be a high risk of future pathology the individual would not meet the criteria for a 'disability' in accordance with the Equality Act 2010.

It would be prudent to remove firefighters from operational duties if their resting blood pressure exceeds 180mmHg systolic and 110mmHg diastolic. Firefighters with a resting blood pressure exceeding 180/100 should not drive LGV until a reading below this has been achieved (in accordance with DVLA requirements), and regular monitoring is recommended until a stable reading below this has been achieved.

Individuals with controlled hypertension with no symptoms from medication are usually fit for service as firefighters. The choice of drug should be tailored to the individual's need to cope with physical exertion, and where side effects appear to be impacting on training and performance firefighters should be encouraged to discuss this with their GP or specialist with a view to adjusting the dose or type of treatment.

Where hypertension has been identified in serving firefighters, a referral to their GP should be considered if appropriate and with consent. Advice on lifestyle interventions should be given, and where appropriate management should be informed so that help can be given to adjust lifestyle, for example referral to a physical training instructor for remedial exercise training. Where lifestyle advice is given, Medical Advisers should consider the best approach, for example considering techniques such as Motivational Interviewing **122 123** to maximise the chance of success.

Where hypertension is having a substantial adverse effect on performance, and lifestyle factors are likely to be a significant factor, it would be inappropriate to consider the firefighter permanently unfit until appropriate lifestyle changes have been made.

122 Miller WR, Rollnick S. Motivational Interviewing: Preparing People for Change. New York, NY: Guilford Press; 2002

123 Rollnick S et al. Motivational interviewing. BMJ 2010;340:c1900

Measuring Blood Pressure and Diagnosing Hypertension:

Correct conditions for measuring blood pressure **114** are to have the patient seated, relaxed, with tight clothing removed from the arm. The arm should be supported at heart level. Avoid talking during the procedure. Lower the pressure slowly at 2mmHg per second, reading to the nearest 2mmHg. Measure the diastolic as the disappearance of sounds (phase V).

Equipment should be properly validated, maintained and regularly recalibrated according to manufacturer's instructions. An appropriate cuff size should be used.

Blood pressure can be affected by several factors. The following table lists some of these factors and the degree they may affect blood pressure **115**. In the context of an employment medical the white coat effect is often the major problematical area and may lead to further assessment being required such as ambulatory recording.

Choice of sphygmomanometer and calibration are also relevant. Choosing a cuff size appropriate to the patient is also vital if falsely high readings are to be avoided. It is therefore essential that the medical examiner has both a standard and large or thigh-cuff available.

Patient factor	Systolic	Diastolic	Technical Factor	Systolic	Diastolic
'White coat' to physician	+11 to 28	+3 to 15	Cuff too narrow	-8 to +10	+2 to 8
'White coat' to non-physician	+1 to 12	+2 to 7	Cuff not centred	+4	+3
Acute smoking	+6	+5	Low elbow	+6	+6
Acute caffeine	+11	+5	Back unsupported	+6 to 10	+6 to 10
Acute ethanol	+8	+8	Arm unsupported	+1 to 7	+ 5 to 11
Distended bladder	+15	+10	Cold season	+6	+3 to 10
Talking, sighing	+7	+8			

The latest guidelines from NICE recommend that if a clinic blood pressure reading is 140/90 or higher, ambulatory blood pressure monitoring should be offered. This is not a practical undertaking for Medical Advisers and a referral to the GP would be appropriate. The emphasis of the new guidelines is that a single measurement should not be considered indicative and further investigations are needed to confirm hypertension [116](#).

Any measurement over 140/90mmHg should be repeated, and if still at or above this level the individual's GP should be informed with the individual's written consent. There is no requirement to recommend any change in fitness for duty unless the blood pressure exceeds the levels indicated below.

114 British Hypertension Society. www.bhsoc.org

115 Reeves RA. The rational clinical examination. Does this patient have hypertension? How to measure blood pressure. Journal of the American Medical Association 1995; 273:1211-18.

116 Newcastle Guideline Development and Research Unit. Hypertension: clinical management of primary hypertension in adults. NICE clinical guideline 127. National Institute of Clinical Excellence. 2011.

Risks from Hypertension:

There is a 7% increased risk of mortality from ischaemic heart disease and 10% increased risk of stroke with every 2mmHg rise in systolic blood pressure **117**. The risk from hypertension is substantially affected by co-morbidity. Risks increase with lifestyle factors such as smoking, alcohol and caffeine consumption and poor diet. Genetic factors are relevant where there is a family history of cardiovascular disease in close male relatives under 55 and female relatives under 65. Co-morbid pathology includes diabetes mellitus (both types), dyslipidaemias and a variety of less common conditions. There are numerous publications demonstrating increased risk which is quantified in many studies. These factors are generally combined into algorithms for calculating risk.

A variety of risk calculators have been developed. The first, based on the Framingham study in the US, may overestimate the risk in UK populations. NICE do not recommend a specific calculator **118**. A UK-specific calculator, Q-Risk, has been developed using the Framingham risk equation, adjusted by factors developed by the Joint British Societies **119** and published on the Heart UK Website (www.heartuk.org). Standard 10-year cardiovascular risk assessments can underestimate the lifetime risk of cardiovascular events in people under age 40, and a specialist referral would be expected in these cases **120**.

117 Newcastle Guideline Development and Research Unit. Hypertension: clinical management of primary hypertension in adults. NICE clinical guideline 127. National Institute of Clinical Excellence. 2011.

118 Newcastle Guideline Development and Research Unit. Hypertension: clinical management of primary hypertension in adults. NICE clinical guideline 127. National Institute of Clinical Excellence. 2011.

119 JBS 2: Joint British Societies' guidelines on prevention of cardiovascular disease in clinical practice. Heart. 2005 Dec;91 Suppl 5:v1-52.

120 Newcastle Guideline Development and Research Unit. Hypertension: clinical management of primary hypertension in adults. NICE clinical guideline 127. National Institute of Clinical Excellence. 2011.

Treatment:

Medical Advisers will not be treating, but can ensure that individuals are on appropriate treatment, and need to understand potential side effects related to treatment. GPs treating firefighters would be expected to follow NICE guidelines for treatment which are outlined below **121**.

Step 1 treatment for under-55s is an angiotensin-converting-enzyme (ACE) inhibitor (drugs ending in -pril), and if that is not tolerated (e.g. because of cough) an angiotensin-II receptor blocker (drugs ending in -sartan) should be used. These should not be combined.

Step 1 treatment for over-55s and those of African or Caribbean family origin is a calcium-channel blocker (e.g. Verapamil, Diltiazem, drugs ending in -dipine) or if that is not tolerated (eg. because of oedema) a thiazide-like diuretic (e.g. Chlortalidone, Indapamide) should be used.

Those who remain stable on thiazides (e.g. Bendroflumethiazide) should be left on them. Beta-blockers should not be the initial treatment of choice, but may be added, and Step 2, 3 and 4 treatment involve different combinations of the above, with details in the NICE guidelines. Approximately 70% of individuals will need two or more drugs to achieve control.

121 Newcastle Guideline Development and Research Unit. Hypertension: clinical management of primary hypertension in adults. NICE clinical guideline 127. National Institute of Clinical Excellence. 2011.

Side-effects of Treatment:

ACE Inhibitors:

Generally well-tolerated, the classic side-effect is a persistent dry cough. This is said to affect about 10% of patients, but in practice this side effect seems more common. They would not be expected to affect performance as a firefighter although the cough may affect use of breathing apparatus.

Angiotensin-II Receptor Blockers:

Side effects are generally mild, although hypotension may arise in conjunction with hypovolaemia. Firefighters should ensure adequate fluid intake if sweating while working for prolonged periods.

Calcium-channel Blockers:

Most can cause vasodilatation, headache, fatigue and oedema. These may interfere marginally with physical capability including performance in fitness tests, but the effect would not be expected to be significant.

Thiazide-like Diuretics:

Thiazide-like diuretics are generally well-tolerated. Postural hypotension may be an issue.

Beta-blockers:

Beta-blockers inhibit the normal cardiovascular response to effort and exercise. This may reduce maximum physical capability although this is unlikely to significantly affect operational capability. The effect on heart rate will render meaningless any exercise test using heart rate as a factor. Firefighters taking beta-blockers should discuss alternative treatments with their GP or specialist.

Cardiac Tumours

If a cardiac tumour is found, or is declared, a specialist opinion should be sought. Malignant cardiac tumours are rarely successfully managed by surgical excision. Myxoma responds well to complete excision, with a 1-5% recurrence rate.

Peripheral Vascular Disease

Claudication

The symptoms of claudication are likely to limit the effectiveness of firefighters. They are unlikely to reach the fitness standards required to serve operationally. Claudication is also associated with other significant cardiovascular disease and a full assessment should be conducted with specialist opinion sought on any positive findings.

In some rare cases claudication will be due to a congenital lesion which can be successfully treated. Specialist advice should be sought in each case and the nature of intervention (medical, angioplasty and surgical), together with the extent of the disease will need to be considered.

Varicose Veins

Asymptomatic varicose veins do not usually result in significant morbidity. Provided individuals are able to pass the relevant physical tests there should be little cause for concern.

Very prominent veins could give rise to traumatic haemorrhage. If individuals have symptoms that affect their physical ability, advice on employment should be deferred until after treatment.

Pulmonary Hypertension

There are numerous underlying causes of pulmonary hypertension. The condition generally indicates significant heart and/or lung pathology with serious risk of sudden incapacitating events and long term morbidity. Specialist reports are essential.

Pacemakers

Pacemakers may be affected by either electromagnetic interference or direct trauma. An expert opinion should be sought from the manufacturer before advice is given on employment.

Electromagnetic radiation is extremely unlikely to cause permanent damage to the unit, but it may inhibit output or in some cases cause a variable rate pacemaker to change to fixed rate. The effects are usually temporary while in close proximity to the source of interference. As a rule of thumb some manufacturers recommend that individuals should remain around 1m per 10kV distant from sources of high voltage.

The evidence for interference from radio transmitting equipment such as mobile phones and personal radio communication equipment shows a very low risk, probably around 1:100,000, of adverse events. The advice from most studies suggests the handset should be kept between 10 and 50 cm away from the pacemaker although the risk may be effectively zero for many modern pacemakers [124](#) [125](#) [126](#).

There is a risk of damage to the pacemaker or pacemaker site from direct trauma. Individuals should therefore avoid contact sports, and any firefighting duties should be assessed depending on the location of the pacemaker and the expected activity. Fracture of a pacemaker lead as a result of wearing or carrying equipment may pose a threat. Individuals who are pacemaker-dependent face real risk from pacemaker malfunction which could lead to disabling symptoms and this aspect must also be considered. An expert opinion should be sought from a cardiologist on both risk of pacemaker failure and risk of trauma to the leads.

Anticoagulants and Antiplatelet Therapy:

Anticoagulants and antiplatelet drugs are prescribed for a number of conditions and have proved lifesaving. Common reasons include atrial fibrillation and clotting disorders.

There is an inherent risk from anticoagulant use that any internal or external bleeding may be prolonged. External bleeding can generally be controlled with simple pressure bandaging, and the blood loss in someone on normal therapeutic doses of anticoagulant is unlikely to be significant. Internal bleeding may be an issue, but where there is a substantial risk of haemorrhagic shock the underlying cause is likely to be major trauma or pathology where the additional risk from anticoagulant medication will be only marginal.

The most obvious and insidious risk is from intracranial bleeding where only a relatively small amount of bleeding can have catastrophic effects on brain tissue. The primary concern from anticoagulant use is therefore intracranial bleeding from head injury, where operational firefighting may represent an increased risk. It is important to ensure that a proper risk assessment is undertaken before deciding whether the risk is acceptable, or whether the employer's duty of care overrides the right of the individual to remain in employment as an operational firefighter. Any risk

assessment should consider how frequently firefighters have sustained a head injury on operations, and whether they would have been at greater risk had they been taking anticoagulant or antiplatelet therapy. This can be readily assessed from accident and injury reports held by the Fire and Rescue Service. There will be a substantial risk reduction from wearing helmets.

Clotting involves two processes: platelet aggregation and the formation of fibrin. Arterial thrombus formation usually occurs on the surface of atheroma, and the thrombus is mainly platelets. The primary mechanism is platelet adherence to the damaged endothelium or contents of ruptured atheromatous plaque leading to a white platelet thrombus. Venous thrombus formation generally arises where blood is static, often where there is increased coagulability, where the resulting thrombus is primarily fibrin with red blood cells trapped between (red clot). Thus, because the mechanisms of clot formation are different, the treatments required are different. Antiplatelet drugs are used successfully to prevent arterial but have minimal effect on venous thrombus formation where anticoagulants are efficacious.

[Antiplatelet Drugs](#)

[Thrombin Inhibitors](#)

[Anticoagulants likely to be used by firefighters](#)

[Conclusions](#)

Antiplatelet Drugs:

The main antiplatelet drugs in use are aspirin and clopidogrel. These are effective in reducing arterial thrombus formation but will increase bleeding risk particularly when taken at high doses.

Aspirin irreversibly inhibits cyclo-oxygenase, preventing platelet production of thromboxane. As it is an irreversible inhibitor, its effects will last up to 10 days, i.e. until new platelets have formed. A number of new drugs have been identified which interact with other receptors on the platelet surface, inhibiting platelet aggregation. Clopidogrel, prasugrel and tegralor inhibit the P2Y₁₂ receptor while others such as abciximab, eptifibatid and tirofiban block glycoprotein IIb/IIIa, the receptor for fibrinogen. The latter can currently only be administered parenterally.

Thrombin Inhibitors:

Over the past sixty years the main approach to long-term anticoagulation has been the use of Vitamin K antagonists, primarily warfarin. While very successful, there are significant bleeding risks inherent in warfarin treatment. A careful balance is required to ensure that the INR is not excessively extended through regular INR assessment by the GP, Anticoagulant Clinics or home monitoring.

While this may appear to be well managed in most patients, there are bleeding risks in warfarin because of interactions between warfarin, Vitamin K (chiefly in green vegetables) and other drugs, foods and medical conditions. The risk of intracranial bleed may be sufficiently small to allow a firefighter on warfarin to return to operational duty, but the risk may rapidly increase due to inadvertent use of other medication or dietary change. It is partly this additional risk that makes it difficult to decide whether a firefighter on anticoagulant medication should be allowed to return to operational duty. Any patient on warfarin who has a new medication that can interfere with the action of warfarin should have an INR check soon after starting the new drug.

Heparin is another longstanding anticoagulant, that can only be administered parenterally. It works by potentiating the effect of antithrombin. Antithrombin had a direct anti-thrombin effect as its name suggests, but also inhibits other factors particularly Xa, i.e. it has an anti-Xa effect. Unfractionated heparin contains a group of polysaccharides and fractionation can separate these to produce low molecular weight heparin (LMWH such as enoxaparin, dalteparin and tinzaparin) which has much more activity against factor Xa and less against factor IIa, a longer half-life and most importantly of all, predictable pharmacokinetics so that it does not normally require monitoring. Selectively targeting factor Xa leads to less risk of bleeding and less inhibition of platelet function.

Heparin and its various forms can only be given by injection, are infrequently used long-term and are not likely to be relevant to firefighters. Fondaparinux is a synthetic form of the pentasaccharide in the heparin molecule that is responsible for anticoagulant effect; it has a pure anti-Xa action. Fondaparinux is safer than other heparins as it rarely causes allergy and does not cause heparin induced thrombosis or osteoporosis.

The major advance on oral anticoagulation is the production of oral anticoagulants that have predictable pharmacokinetics. This means they do not need monitoring. They also have little interaction with food and limited interaction with other drugs. They included synthetic factor Xa inhibitors such as rivaroxaban, apixaban and endoxaban. Dabigatran is a direct thrombin inhibitor.

Dabigatran has been shown to be more efficacious and safer (a lower intracranial bleed rate) than warfarin in the prevention of stroke in patients with atrial fibrillation **127**. Most of these new oral anticoagulants have licenses for the prevention of thrombosis after hip and knee replacement. Dabigatran and rivaroxaban have licenses for the prevention of stroke in atrial fibrillation, and rivaroxaban has a license for the management of acute deep vein thrombosis and the prevention of recurrent venous thromboembolism.

127 Albers GW et al. Stroke prevention in atrial fibrillation: pooled analysis of SPORTIV III and V trials. *Am J Manag Care*. 2004;10(14 Suppl):S462-9.

Anticoagulants likely to be used by firefighters:

It is important to be aware of current developments in anticoagulation therapy, especially as there will be increasing patient demand for the new oral anticoagulants that don't require attending an Anticoagulant clinic **128**. However, we are awaiting NICE approval for many indications.

[Aspirin](#)

[Clopidogrel](#)

[Warfarin](#)

[Dabigatran and Rivaroxaban](#)

128 Breen KA, Hunt BJ. The new oral anticoagulants. Clin Med. 2011 Oct;11(5):467-9.

Aspirin:

The benefits of reducing the risk of recurrent stroke and myocardial thrombosis in those with previous arterial events far outweigh the increased risk of haemorrhagic stroke in those on long-term aspirin treatment **129 130**. However the long-term risk of intracranial haemorrhage from aspirin use has prohibited the use of aspirin in the primary prevention of stroke and myocardial infarction in those under the age of 50. Indeed, a review of 399 patients admitted with head injury who were on anticoagulant therapy found 19 of 271 patients on aspirin with traumatic haemorrhage. Four out of 89 patients on warfarin had traumatic haemorrhage **131**.

A Cochrane review of the efficacy of antiplatelet therapy in atrial fibrillation (AF) concluded there was no increase in intracranial haemorrhage or major extracranial haemorrhage **132**. Another large review concluded that there was an increased risk, quantified as 0.2 events per 1000 patient years; for every 1000 patients treated for a five-year period there would be one excess haemorrhagic stroke but 14 fewer myocardial infarctions for those at moderate risk. The cause of haemorrhagic stroke was not, however limited to trauma but was most likely to be related to other pathology such as hypertension, and age was a significant factor **133**.

Aspirin combined with clopidogrel further increases the risk of bleeding **134**. A study of trauma patients found the increased risk of intracranial bleeding with aspirin and clopidogrel was 30.5% but there was no increased mortality **135**. It is unlikely however that a firefighter should need to be prevented from working operationally while on treatment with aspirin, particularly low dose aspirin (75-100mg), unless there were obvious complicating factors or a previous history of significant bleeding.

129 Borklund L et al. Aspirin in cardiology - benefits and risks. *Int J Clin Pract.* 2009;63(3):468-77.

130 Sakr M, Wilson L. Best evidence topic report. Aspirin and the risk of intracranial complications following head injury. *Emerg Med J.* 2005;22(12):891-2.

131 Major J, Reed MJ. A retrospective review of patients with head injury with coexistent anticoagulant and antiplatelet use admitted from a UK emergency department. *Emerg Med J.* 2009;26(12):871-6.

132 Aguilar M, Hart R. Antiplatelet therapy for preventing stroke in patients with non-valvular atrial fibrillation and no previous history of stroke or transient ischemic attacks. *Cochrane Database Syst Rev.* 2005;19(4):CD001925.

133 Gorelick PB, Weisman SM. Risk of hemorrhagic stroke with aspirin use. *Stroke.* 2005;36(8):1801-7.

134 Chong JY, Mohr JP. Anticoagulation and platelet antiaggregation therapy in stroke prevention. *Curr Opin Neurol.* 2005;18(1):53-7.

135 Bonville DJ et al. Impact of preinjury warfarin and antiplatelet agents on outcomes of trauma patients. *Surgery*. 2011;150(4):861-8.

Clopidogrel:

Compared to aspirin, clopidogrel when taken alone causes less severe bleeding and less intracranial haemorrhage **136**.

136 Mangalpally KK, Klieman NS. The safety of clopidogrel. *Expert Opin Drug Saf*. 2011;10(1):85-95.

Warfarin:

There is a significant increase in the risk of deep and superficial bruising with associated morbidity although there does not appear to be an increase in risk of fatal bleeding following trauma without head injury **137**. There is a small but devastating risk of brain haemorrhage following head trauma. A review of 3,436 patients admitted with trauma found that those with intracranial haemorrhage on warfarin were 3.1 times more likely to die and had an increased risk of intracranial haemorrhage compared to those on aspirin and clopidogrel of RR 1.6 and an overall increased risk of intracranial haemorrhage of 49.8% **138**.

There does not appear to be a significant risk below an INR of 4, however the risk rises about ten-fold with a higher INR with risk increasing as INR rises further **139**. The risk of mortality in intracranial haemorrhage with oral anticoagulant therapy is in excess of 50%, with the risk increased with elevated systolic blood pressure and previous cerebral ischaemia **140** although this compares with an overall mortality risk for those not on oral anticoagulants of around 40%.

A study of all anticoagulated patients admitted to trauma centres in Pennsylvania from 1995-2000 found no clinically significant difference in functional status at discharge between those on warfarin and controls in both head and non-head injured groups, suggesting that anticoagulation with warfarin does not adversely affect mortality or length of stay in patients with head or other injuries **141**.

Anticoagulant-associated intracerebral haemorrhage accounts for nearly 20% of all intracranial haemorrhage, and among patients using warfarin for AF, the annual risk of intracranial haemorrhage is 0.3-1%. This includes other factors such as hypertension and age, and the percentage arising from trauma was not noted **142**. A Cochrane review comparing antiplatelet therapy to anticoagulation for non-valvular atrial fibrillation concluded that intracranial haemorrhages were increased (OR 1.98, 95% CI 1.20-3.28) **143**.

Overall, there is sufficient evidence to suggest that mortality is significantly increased in head-injured patients on warfarin, and this risk is directly related to INR level. Any

decision on fitness for operational firefighting should take into account the likely risk of head injury in a role where it is standard procedure to wear protective helmets.

137 Mina AA et al. Complications of preinjury warfarin use in the trauma patient. *J Trauma*. 2003 May;54(5):842-7

138 Bonville DJ et al. Impact of preinjury warfarin and antiplatelet agents on outcomes of trauma patients. *Surgery*. 2011;150(4):861-8.

139 Hylek EM, Singer DE. Risk factors for intracranial haemorrhage in outpatients taking warfarin. *Ann Intern Med* 1994 Jun1;120(11):897-902.

140 Cavallini A et al. Warfarin-associated cerebral haemorrhage. *Neurol Sci*. 2008;29(Suppl 2):S266-8.

141 Wojcik R et al. Preinjury warfarin does not impact outcome in trauma patients. *J Trauma*. 2001;51(6):1147-52.

142 Flaherty ML. Anticoagulant-associated intracerebral haemorrhage. *Semin Neurol*. 2010;30(5):565-72.

143 Aquilar M, Hart R, Pearce LA. Oral anticoagulants versus antiplatelet therapy for preventing stroke in patients with non-valvular atrial fibrillation and no history of stroke or transient ischemic attacks. *Cochrane Database Syst Rev*. 2007;18(3):CD006186.

Dabigatran and Rivaroxaban:

In the RE-LY trial, approximately 18,000 patients with AF were randomised to warfarin or dabigatran. The rate of major bleeding was lower with dabigatran (2.7%) versus warfarin (3.36%, $p=0.003$) The rate of intracranial bleeding was 0.74% on Warfarin, 0.30% on Dabigatran 150mg and 0.23% ($p<0.001$) on Dabigatran 110mg **144 145**. There is, however, unlike warfarin with Vitamin K, there is yet no known antidote if an intracerebral haemorrhage occurs. A similar trial of rivaroxaban versus warfarin in the prevention of stroke in AF patients showed a significant reduction in intracranial haemorrhage ($p=0.02$) and fatal bleeding ($p=0.003$). The anticoagulant effects of rivaroxaban have been shown to be reversed in small studies by Prothrombin complex concentrates and recombinant VIIa.

As the evidence suggests that the risk from dabigatran and rivaroxaban is significantly lower than for warfarin, any decision on operational firefighting may well conclude that a change from warfarin to dabigatran or rivaroxaban should be considered if they are shown to be cost-effective in NICE single technology assessments.

144 Connolly SJ et al. Dabigatran versus warfarin in patients with atrial fibrillation. *N Engl J Med.* 2009;361:1139-1151.

145 Patel NR et al. Rivaroxaban versus warfarin in nonvalvular atrial fibrillation. *N Engl J Med* 2011; 365:883-891.

Conclusions:

The field of anticoagulation is fast moving, with many more new anticoagulants coming into practice. Indeed, by the time this article is printed it will be out of date, as rivaroxaban and dabigatran usage in AF patients will have been reviewed by NICE. Decision making around the best anticoagulation for thrombotic indications will doubtlessly become increasingly complex as we learn more about the new oral anticoagulants from post marketing surveillance.

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Endocrine

Diabetes Mellitus

Diabetes has an overall prevalence of about 3% in the United Kingdom, though the rates are much higher in certain groups – notably Asian immigrant populations, the elderly, and those from socio-economically deprived areas. The disease has a serious impact on mortality and morbidity because of its association with long-term small and large blood vessel disease. It is the most expensive single disease in health care costs, consuming about 10% of the UK National Health Service (NHS) budget [1](#).

[Classification](#)

[Diabetic Complications](#)

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[Diabetic Treatment](#)

[Hypoglycaemia](#)

[Diabetes and Hazardous Occupations](#)

[Guidelines for Consideration](#)

[Diabetic Firefighters Coping Strategies](#)

1 Williams R. Prevalence and costs of diabetes in the UK. *Modern Diabetes Management* 2001; 2: 2-4.

Classification of Diabetes

The terms 'type 1' and 'type 2' have now replaced those of 'insulin-dependent diabetes mellitus' (IDDM) and 'non-insulin-dependent diabetes mellitus' (NIDDM) respectively. Type 1 diabetes predominantly affects the young and is characterised by auto-immune beta-cell destruction. These patients have effectively no endogenous insulin secretion, and are dependent on externally-delivered insulin for survival. Type 2 diabetes occurs in older individuals and is due to a combination of reduced insulin secretion and peripheral insulin resistance. Such patients are usually controllable initially on dietary adjustment alone, though later oral hypoglycaemic agents (OHAs) may be needed, and often eventually insulin.

In Europe, about 15% of the total diabetic population have type 1 disease, and the rest have type 2 diabetes. The incidence of type 1 diabetes in the UK is about 20/100,000 per year [2](#).

Nowadays, a large number of type 2 diabetic patients are on insulin treatment, and from an occupational point of view it is often more useful to classify patients as 'insulin-treated' (i.e. type 1 plus type 2 on insulin) and 'non-insulin treated'. The most

important diabetic complication from a work point of view is hypoglycaemia, and this is almost always (though not exclusively) associated with insulin treatment.

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Diabetic Complications

These can be divided into acute and chronic. Acute complications are those of metabolic decompensation – hypoglycaemia, ketoacidosis (DKA), and hyperglycaemic non-ketotic coma or pre-coma (HNK). DKA occurs almost always in type 1 diabetes, and HNK in type 2. Hypoglycaemia will be dealt with separately later, because of its important relation to hazardous occupations.

Chronic diabetic complications are due to either large or small vessel damage. Large vessel disease (macroangiopathy) comprises coronary artery disease, cerebrovascular disease, and peripheral vascular disease. The major cause of death in diabetes is coronary artery disease, which carries 2 to 4 times the mortality risk than in non-diabetic individuals [3](#). Small vessel disease (microangiopathy) affects predominantly the eyes (diabetic retinopathy), the kidneys (diabetic nephropathy), and the peripheral nerves (diabetic neuropathy).

Types Include:

[Retinopathy](#)

[Nephropathy](#)

[Neuropathy](#)

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Retinopathy

Retinal changes include microaneurysms, haemorrhages, exudates, macular oedema, and new vessel proliferation (with a risk of bleeding). Retinopathy occurs in both type 1 and 2 diabetes. In the early stages this will be an incidental finding on fundoscopy. However some effect on visual acuity may occur during the pre-proliferative stages as haemorrhages and cotton-wool spots appear, and proliferative retinopathy often results in significant visual impairment. Visual acuity standards for firefighting will restrict most individuals with proliferative retinopathy to non-operational duties.

In older onset individuals with type 2 diabetes there is a higher initial prevalence of retinopathy, with 39% of men and 35% of women having some retinopathy in at least one eye on diagnosis [4](#). In type 1 disease, retinopathy is rare before 5 year's duration of disease, but rates rise thereafter (dependent on glycaemic control). Some

degree of background retinopathy may be present in most diabetic subjects by 20 years duration. Proliferative retinopathy and maculopathy are the most important forms of retinopathy as they can reduce visual acuity and threaten sight. Some degree of these complications can be present in up to one-third of diabetic patients by 14 years disease duration [5](#) [6](#).

Treatment of proliferative retinopathy with laser photocoagulation is very successful at slowing the disease progression, but cannot reverse the visual loss. There is a 50% reduction of severe visual loss at two and five years in those with high risk factors and a 70% reduction in those with moderate risk. Severe visual loss is defined as an acuity of 1/60 or worse. High risk factors are new vessels at the disc covering at least a quarter of the disc area, new vessels at the disc with vitreous or pre-retinal haemorrhage, or new vessels elsewhere greater or equal to half the disc area with vitreous or pre-retinal haemorrhage [7](#). Full pan-retinal photocoagulation can reduce visual fields by 40-50% bringing individuals below DVLA standards for Group 1 driving [8](#).

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Nephropathy

Diabetes-related renal disease affects about one-third of patients, though the severity is very variable [9](#). Although in many cases there is little direct occupational relevance of diabetic nephropathy its presence is an indicator of overall disease severity. Nephropathy risk rises up to about 15-20 years of disease duration, after which rates remain stable. As well as disease duration, glycaemic control affects the risk of nephropathy developing, but there is also familial clustering suggesting genetic susceptibility [10](#).

Nephropathy is characterised by initially intermittent followed by persistent proteinuria in the absence of other non-diabetic causes. Retinopathy is almost invariably present. Later, renal function declines, leading eventually to end stage renal failure. The natural history can, however, be very long, and many patients die of cardiovascular disease before dialysis or transplantation is necessary.

Treatment of nephropathy includes optimising glycaemic control, strict blood pressure control, and the use of angiotensin converting enzyme (ACE) inhibitors, or angiotensin receptor blockers. These drugs have a reno-protective effect separate from their action on lowering blood pressure. These therapeutic strategies delay progression to end stage renal failure, and are also effective in patients with microalbuminuria. Microalbuminuria is a pre-clinical phase of diabetic renal disease, when urine protein excretion is abnormal, but not sufficient to cause dipstick-positive proteinuria (levels are about 30-300 mg/l).

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Neuropathy

About 30-50% of diabetic patients have some degree of peripheral nerve damage. This is usually a symmetrical distal sensory loss, but many other patterns can occur. These include sensori-motor, motor (e.g. amyotrophy), mononeuritis simplex and multiplex, spinal radiculopathies and autonomic loss. The latter can cause a variety of syndromes including nocturnal diarrhoea ('diabetic diarrhoea'), profuse vomiting (gastropathy), sweating, bladder dysfunction and erectile impotence. Sensory neuropathy can sometimes be painful, which can be difficult to treat. Drugs such as tricyclic antidepressants, carbamazepine and gabapentin can help as well as good glycaemic control. Some of these patients however are resistant to treatment, and may continue with long-term debilitating symptoms [11](#).

Besides being an indicator of other disease processes, neuropathy can have a significant occupational impact. This may include a reduction in fine motor skills and reduced positional awareness leading to balance problems when visual mechanisms are impaired (such as in dense smoke). Sensory loss may also facilitate secondary damage to peripheral tissues and is a common complication in individuals with long-term diabetes; avoidance of occupationally-related trauma is important in these circumstances.

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Glycaemic Control and Complications

In the last decade, 2 major studies (one in type 1 and the other in type 2 diabetes) have confirmed the long-held belief that good blood glucose control reduces complication risk. The Diabetes Control and Complications Trial (DCCT) was a US study in type 1 diabetes, published in 1993 [12](#). The United Kingdom Prospective Diabetes Study (UKPDS) was a similar trial in type 2 diabetes, reported in 1998 [13](#). Both studies utilised measurement of whole blood glycosylated haemoglobin (HbA 1c) as the 'gold standard' parameter of glycaemic control (HbA 1c reflects mean glycaemia over the preceding 2 months).

Coincidentally, the intensively controlled group in both the UKPDS and DCCT studies had a mean HbA 1c of about 7.0%. The non-intensively controlled groups had mean HbA 1c levels of 8.0% in the UKPDS (type 2), and 9.0% in the DCCT (type 1). Long-term surveillance in both studies showed significant separations in complication development, strongly in favour of the 'tightly' controlled cohort.

In the UKPDS study, the intensively controlled group had a 10% reduction in diabetes related deaths, a 6% reduction in all-cause mortality, and 15% reduction in microvascular complications. There was an insignificant reduction in large vessel disease. This study also showed the benefit of tight (<140/85) BP control; a 32% reduction in mortality, 44% reduction in stroke, and 37% reduction in micro-vascular disease [13](#).

The DCCT study demonstrated in their intensively controlled group a 34% reduction in retinopathy, and 60% reduction in nephropathy [12](#). Again large vessel disease prevalence was not affected. Both studies achieved these results over an approximate 10 years of follow-up.

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Diabetic Treatment

Oral Agents

Relatively few patients are nowadays on dietary treatment alone. The range of available drugs has greatly increased in recent years:

Sulphonylureas (e.g. gliclazide, glibenclamide, etc)

Biguanides (metformin)

Glucosidase inhibitors (acarbose)

Insulin secretagogues (repaglinide, nateglinide)

Thiazolidinediones (pioglitazone, rosiglitazone)

Sulphonylureas and metformin remain the commonest oral agents, but the recently introduced 'glitazone' drugs (pioglitazone and rosiglitazone) are in increasing use. They work by increasing insulin receptor sensitivity, and can be very effective [14](#). The insulin secretagogues are also relatively new, and act similarly to sulphonylureas (increasing pancreatic insulin secretion), but are relatively little used [15](#). Acarbose has been available for some time, but its use is limited by significant gastro-intestinal side-effects.

From an occupational point of view the important oral hypoglycaemic agents (OHA) are those which may directly cause hypoglycaemia. These are the sulphonylurea group, and the insulin secretagogues.

Insulins

Twice-daily mixtures of short and intermediate-acting insulins remain popular – usually given as a 30/70 mixture (e.g. Mixtard 30, Humulin M3). However, there is more flexibility with a multiple (usually 4) daily injection system and this is appropriate for shift workers and/or those with unpredictable and potentially hazardous occupations, such as firefighters.

Important recent additions to the insulin formulary are the insulin analogues, or 'designer insulins', where the amino acid chain of the insulin molecule has been altered to affect absorption characteristics. The short-acting insulin analogues (Lispro and Aspart) mimic more closely physiological insulin secretion post-prandially [16](#). The long-acting analogue Glargine has a smooth 24 hour absorption profile [17](#).

The insulin analogues do not usually improve overall glycaemic control as measured by HbA 1c levels, but they have been shown to reduce hypoglycaemic episodes – particularly post-prandially (Lispro and Aspart) [16](#), and nocturnally (Glargine) [17](#). They are therefore potentially important advances from an occupational viewpoint.

Achieving good control on insulin

Good glycaemic control on insulin treatment requires the following -

Motivation and education

Structured care [18](#) [19](#)

Regular blood glucose self-monitoring

2-4 daily injection regimens

Achieving good control is however a double-edged sword. Though there are definite longterm benefits of protection from complications, there is also an increased hypoglycaemic risk (2-3 times the 'non-intensive' group in the DCCT study [12](#)).

However, such hypoglycaemic excess in reported studies are mean effects, and inside these groups (and indeed in clinical practice) are a number of individuals who do succeed in achieving excellent glycaemic control with no hypoglycaemia.

12 Diabetes Control and Complications Trial Research Group (DCCT). The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *New England Journal of Medicine* 1993;329:977-86.

14 Aljabri K, Kozak SE, Thompson DM. Addition of pioglitazone or bedtime insulin to maximal doses of sulphonylurea and metformin in type 2 diabetes patients with poor glucose control: a prospective, randomised trial. *Am J Med* 2004; 116: 230-5.

15 Dornhorst A. Insulinotropic meglitinide analogues. *Lancet* 2001; 358: 1709-16.

16 Bolli GB, Marchi RDD, Park GD, Pramming S, Koivisto VA. Insulin analogues and their potential in the management of diabetes. *Diabetologia* 1999; 42: 1151-67.

17 Younis N, Soran H, Bowen-Jones D. Insulin Glargine: a new basal insulin analogue. *QJM* 2002; 95: 757-61.

18 Griffin S, Kinmonth AL. Systems for routine surveillance for people with diabetes mellitus (Cochrane Review) In: *The Cochrane Library*, Issue 1, 2004. Oxford: Update Software.

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Hypoglycaemia

Hypoglycaemic usually results in symptoms when the blood glucose is below 4.0mmol/l. Symptoms are generated both by catecholamine release and reduction in glucose to the brain. Adrenergic signs and symptoms are pallor, anxiety, sweating, tachycardia, nausea and hunger. Low brain glucose levels results in headache, blurred vision, cognitive impairment, and eventually collapse, fits and coma. Significant changes in brain function have been found to occur at plasma glucose concentrations of less than 3.0mmol/l.

Hypoglycaemia in diabetes occurs in patients on insulin or sulphonylurea (including the new secretagogues) treatment. Other medications do not cause hypoglycaemia, though when added to insulin or sulphonylureas, they may increase the risk. Attacks of hypoglycaemia are considered 'mild' if they can be self-corrected and 'severe' if they need third party assistance.

Risk factors for hypoglycaemia include poor education and compliance, erratic dietary habits, exercise (especially when brisk and unpredictable), alcohol, renal failure, and intensification of treatment. In both the DCCT [12](#) [20](#) and UKPDS [13](#) studies there was a two to three times increase in severe hypoglycaemic

episodes in the intensively treated groups, compared to those on 'routine' therapy. This effect has been found in other studies [21](#). It remains to be seen whether intensification of control using the recently-introduced analogue insulins can reduce the attendant hypoglycaemic risks.

A major problem increasing the hazard of hypoglycaemia in insulin-treated diabetes (and specifically type 1 diabetes) is 'hypoglycaemia unawareness' or 'reduced hypoglycaemia awareness'. This is usually due to a reduction in the usual counter-regulatory hormone response to early hypoglycaemia, such that patients do not experience their usual premonitory warning signs (e.g. hunger, sweating, dizziness etc). This problem can occur in patients with long-duration type 1 diabetes, and also when glycaemic control is rapidly and significantly improved (though the degree of effect is variable) [22](#) [23](#) [24](#).

Frequent hypoglycaemia itself can lead to reduced awareness [25](#), and can be reversed by insulin-dose reduction to raise blood glucose levels and prevent hypoglycaemia [26](#). Whatever the mechanism, absent or reduced hypoglycaemic awareness is a significant problem, increasing the frequency of hypoglycaemic attacks and making them potentially more serious [27](#).

Hypoglycaemia in type 2 diabetes may be due to sulphonylurea or secretagogue drugs or insulin, depending on the therapy used by an individual patient. Attacks are much less frequent than in type 1 diabetes, even when insulin is used. In one study severe hypoglycaemia was 10 times less frequent in insulin-treated type 2 patients (even when undergoing intensification of treatment), compared with type 1 patients [13](#) [28](#). This is an important point occupationally, since a number of diabetic firefighters have insulin-treated type 2 (rather than type 1) diabetes.

For patients on sulphonylurea treatment, risks vary with the type of drug used. Chlorpropamide and glibenclamide appear to carry higher risks than the newer shorteracting drugs (such as gliclazide and glipizide).

12 Diabetes Control and Complications Trial Research Group (DCCT). The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *New England Journal of Medicine* 1993;329:977-86.

13 UK Prospective Diabetes Study Group (UKPDS). Intensive blood glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998;352:837-53.

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21 Bott S et al. Intensified insulin therapy and the risk of severe hypoglycaemia. *Diabetologia* 1997;40:926-32.

22 Amiel SA et al. Defective glucose counterregulation after strict control of insulin-independent diabetes mellitus. *N Eng J Med* 1987;316:1376-83.

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- 28 Miller CD, Phillips LS, Ziemer DC et al. Hypoglycaemia in patients with type 2 diabetes mellitus. *Arch Int Med* 2001; 161:1653-9.

Diabetes and Hazardous Occupations

Hypoglycaemia is the major problem affecting the safety of persons with diabetes in potentially hazardous occupations. Obviously, many other complications of diabetes will affect the capacity to work safely and effectively (e.g. reduced visual acuity due to retinopathy, stroke, myocardial infarction, amputation, etc), but these are generally easy to detect or screen for medically. The difficulty with hypoglycaemia is that its detection usually rests on self-reporting, unless witnessed significant attacks occur in the workplace. This also means that there is the possibility of deception on the part of the diabetic worker responding to medical enquiries.

Hypoglycaemia in hazardous occupations has obvious dangers, both to the individual and his or her colleagues. In firefighting, the potential dangers are obvious, particularly during rescue operations at heights, and using breathing apparatus (BA). As previously mentioned, diabetic workers at risk are those on sulphonylureas, secretagogues or insulin. There is no risk for those on diet alone, or on treatment with non-sulphonylurea or secretagogue drugs (e.g. metformin, acarbose and glitazones). Hypoglycaemic risks are much greater for those on insulin compared with sulphonylureas, and amongst insulintreated diabetic persons the risk is greater with those with type 1 disease, than those with insulin-treated type 2 diabetes.

Formulating guidelines for the safe employment of diabetic persons in the firefighting profession is difficult, as there is essentially no directly relevant evidence-base. There are, however, some studies involving other occupations, and particularly driving, which are worth reviewing.

Studies of employment suggest that people with diabetes are no more likely than others to be unemployed [29](#). For those in work, there is an excess of time off due to sickness, but the excess is small or non-existent in those whose diabetes is well-controlled [30](#) [31](#) [32](#) [33](#). A small excess of problems during shift work has been reported [30](#), but this study is now rather dated and has not been repeated. With modern multiple insulin injection treatment and sensible self-blood glucose monitoring, few insulin-treated diabetic persons experience significant problems with shift work [34](#).

Motor vehicle driving has been studied in relation to diabetes-related hypoglycaemia. A study in Scotland of type 1 diabetic drivers [35](#) revealed a crash rate of 5.4 per 100,000 miles driven, compared with 9.5 in a comparative non-diabetic group. A similar study on insulin-treated diabetic drivers in Belfast [36](#) gave figures of 4.9 and 4.8 for the diabetic and non-diabetic groups respectively. Both studies showed no statistical difference between diabetic and non-diabetic crash rates. Similar negative results have been reported in 3 separate studies in the USA [37](#) [38](#) [39](#). Only one report has shown a slight excess of accidents in the diabetic group [40](#). Many of these studies are now rather dated, and have a number of design faults. However, the available evidence is that there is no convincing excess of accidents amongst diabetic drivers on insulin treatment. Accidents due to hypoglycaemia certainly do occur, but they are relatively infrequent, and are presumably offset by the majority of drivers acting in a particularly careful and responsible manner [41](#) [42](#).

The evidence-base concerning diabetes, employment and driving is thus limited and incomplete, but does not give definite evidence of a significant excess risk due to diabetes. Legislation in relation to diabetes varies widely [43](#). In the UK, diabetic persons on insulin cannot drive 'Group 2' vehicles (large goods vehicles and trucks, and large passenger carrying vehicles). This excludes firefighters with insulin-treated diabetes from driving fire appliances, for example. In a number of countries however (notably many states in the USA), insulin treated drivers can drive trucks, provided there is supportive medical evidence. Even flying planes in the USA and Canada has recently been allowed for pilots on insulin, though a total ban remains in the UK and the rest of Europe.

29 Ardron M, MacFarlane I, Robinson C. Educational achievements, employment and social class of insulin-dependent diabetics: a survey of a young adult clinic in Liverpool. *Diabetic Medicine* 1987; 4: 546-8.

30 Robinson N, Yateman NA, Protapapa LE, Bush L. Employment problems and diabetes. *Diabetic Medicine* 1990; 7: 16-22

31 Griffiths RD, Moses RG. Diabetes in the workplace. Employment experience of young people with diabetes mellitus. *Med J Aust* 1993; 158: 169-71.

32 Poole CJ, Gibbons D, Calvert IA. Sickness absence in diabetic employees at a large engineering factory. *Occup Environ Med* 1994; 51: 299-301.

- 33 Waclawski ER. Sickness absence among insulin-treated diabetic employees. *Diabetic Medicine* 1990; 7: 41-4.
- 34 Waclawski ER, Gill GV. Diabetes mellitus and other endocrine disorders. In: 'Fitness for Work – the medical aspects', Eds Cox RAF, Edwards FC, Palmer K. *Publs Oxford University Press* 2000, pp 322-34.
- 35 Eadington DW, Frier BM. Type 1 diabetes and driving experience: an eight year cohort study. *Diabetic Medicine* 1989; 6: 137-41.
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- 39 Waller JA. Chronic medical conditions and traffic safety. Review of the California experience. *N Engl J Med* 1965; 273: 1413-20.
- 40 Hansotia P, Broste SK. The effect of epilepsy or diabetes mellitus on the risk of automobile accidents. *New Eng J Med* 1991; 324: 22-6.
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- 42 Macleod KM, Johnston RV. Should there be driving and employment restrictions for people with diabetes? In: 'Difficult Diabetes'. Eds Gill GV, Pickup JC, Williams G. *Publ Blackwell Science* 2001, pp 237-57.
- 43 Mawby M. Time for the law to catch up with life. *Diabetes Care* 1997; 20: 1640-1.

Guidelines for Individual Considerations

In the light of the evidence and experience discussed above, Diabetes UK (formerly the British Diabetic Association (BDA)) and the American Diabetic Association both promote a policy of individual considerations for insulin treated diabetic drivers being considered for potentially hazardous employment (including firefighting). In 1996 the BDA produced the following guidelines for the acceptance of insulin-treated diabetic persons into potentially hazardous occupations [44](#). These were produced by the BDA Driving and Employment Working Party after considerable scrutiny of the literature, and in close consultation between diabetologists, occupational physicians and persons with diabetes.

Diabetes UK Guidelines for Employment of Insulin-Treated Diabetic Persons in Potentially Hazardous Occupations

People should be physically and mentally fit in accordance with non-diabetic standards

Diabetes should be under regular (at least annual) specialist review

Diabetes should be under stable control

Diabetic persons should monitor their blood glucose and be well educated and motivated in diabetes self-care

There should be no disabling hypoglycaemia and normal awareness of individual hypoglycaemic symptoms

There should be no advanced retinopathy or nephropathy, nor severe peripheral or autonomic neuropathy

There should be no significant coronary heart disease, peripheral vascular disease or cerebrovascular disease

Suitability for employment should be re-assessed annually by both an occupational and diabetes specialist physician, and should be based on the above criteria.

It can be seen that these criteria are strict and stringent, emphasise motivation and selfcare, and support the involvement of both occupational physicians and diabetologists. The guidelines have been widely accepted, and have been used for the individual consideration of insulin-treated diabetic firefighters for operational duties. At present there are 63 firefighters in the UK with diabetes on insulin who are fully operational (including BA use). To date there have been no hypoglycaemia-related incidents in over 600 man-years of operational duties by insulin-treated diabetic firefighters [45](#).

The Diabetes UK 1996 guidelines were also adapted for use by the UK Driver Vehicle Licensing Agency (DVLA) in 1999, when the licensing of C1 vehicles (small lorries and vans) for diabetic drivers on insulin was allowed by law. This system also has so far worked well.

The guidelines are specifically for those on insulin, but can be adapted for non-insulin treated individuals with diabetes. Those on sulphonylureas or insulin secretagogues have a small risk of hypoglycaemia, and the guidelines should be broadly adopted. For those on diet only, or drugs not associated with hypoglycaemia (metformin, acarbose and glitazones), the 4th and 5th requirements can be omitted (relating to hypoglycaemic attacks and hypoglycaemia awareness, and the requirement for self-monitoring of blood glucose). The 8th requirement (joint annual assessment by occupational physician and diabetologist) can also be discretionary for those not on insulin.

44 British Diabetic Association. Diabetes and Potentially Hazardous Occupations. London. BDA; 1996.

45 International Register of Firefighters with Diabetes (IRFD), 2004. <http://welcome.to/irfduk>

Coping Strategies for Diabetic Firefighters

The experience of the last decade, in which several diabetic firefighters on insulin treatment have been allowed to be fully operational (subject to assessment based on the above guidelines), has given useful insights into the specific coping strategies adopted by these individuals to safely maintain a normal work pattern. Different firefighters may use different systems, but there are some common methods used by most, which are listed below:

In depth knowledge of diabetes and self-care strategies

Commitment and motivation

Frequent and sensible self-blood glucose monitoring

The ability to react appropriately to particular blood glucose levels

Multiple insulin injection treatment – usually short-acting insulin 3 times daily and a medium or long-acting insulin at bed time

Use of analogue insulins (eg. Lispro, Aspart, Glargine) which reduce hypoglycaemic risks

Available supply of short-acting and long-acting carbohydrate food on person

'Running high' (in terms of blood glucose) on duty eg perhaps 4-10 mmol/l off duty, but 6-12 mmol/l on duty

Injecting short-acting insulin after a meal when on duty (in case of a 'shout' immediately after injecting)

Taking carbohydrate food in the appliance on the way to an incident.

These techniques and systems of self-care can be usefully suggested or advised to firefighters recently treated with insulin who, after individual assessment as suggested above, are considered fit for operational duties.

New section for 2012

Obesity

It is difficult to avoid the issue of obesity in society and particularly in the workplace; it is so common practitioners often fail to notice, let alone raise the subject of, obesity among patients in the occupational health clinic. Some consider that discrimination is a problem for obese people and therefore feel reluctant to mention it at all. To some patients, the very term 'obese' is considered insulting. Others regard the body shape associated with obesity as normal and 'healthy'. It is common to see clinical notes and reports from GPs and other specialists which are remarkable because they don't mention a patient's weight or BMI when this is the primary cause and the primary reason for persistence of a clinical problem.

Obesity among firefighters is often a disaster for their long-term health and long-term career. In an ideal world it would never arise; a culture of physical fitness and health would prevent any firefighter from approaching a point where they are clinically obese. Unfortunately, such a culture is neither universal, nor held up by all as an appropriate behaviour to be encouraged. A high price is paid every year by firefighters who can no longer meet the physical requirements of the job, and by firefighters who develop serious, permanent health problems because of their obesity. In the process they also put colleagues at risk and cost every fire service highly from sickness absence and all the associated costs of the loss of experienced senior members.

Medical Advisers must play a role in addressing this issue, but so must line management, unions and most importantly firefighters themselves.

Epidemiology

There has been a relentless increase in prevalence of obesity worldwide over the past half-century. In the latest figures for the UK [46](#) in 2009 22% of men and 24% of women were obese. 66% of men and 57% of women were overweight. 44% of women had a waist circumference over 99cm and 32% of men had a waist circumference over 102cm. In 2009/10 there were 10,571 Finished Admission Episodes in NHS hospitals where the primary diagnosis was obesity, up from 954 in 1998/9 and 5018 in 2006/7. 1.45million prescription items were dispensed for the treatment of obesity in 2009, compared to 127 thousand in 1999.

In 1993 13% of men and 16% in England were obese. In 2009 this had risen to 22% of men and 24% of women. Morbid obesity rose from 0.2% of men to 1.1% of men and from 1.4% of women to 2.8% of women in the same period. It is predicted that by 2015 36% of men and 28% of women in England will be obese, and by 2025 this will have risen to 47% of men and 36% of women [47](#).

46 Statistics on obesity, physical activity and diet: England, 2011. The Health and Social Care Information Centre. NHS: London. 2011.

47 Health Survey for England. Information Centre for Health and Social Care. NHS: London. 2009.

Defining Obesity

Obesity is a clinical concept and must have a clear clinical definition. The issue is excessive body fat, so it is natural for the Royal College of Physicians to define obesity as 'a disorder in which excess fat has accumulated to an extent that health may be adversely affected' [48](#). Overweight is simply an excess of body weight for height.

Body fat ranges for standard adults 49			
	Healthy	Excess fat	Obese

	Male	Female	Male	Female	Male	Female
20-39 years	8-21%	21-33%	21-26%	33-39%	>26%	>39%
40-59 years	11-23%	23-35%	23-29%	35-40%	>29%	>41%
60 plus years	13-25%	25-38%	25-31%	38-43%	>31%	>43%

Measuring body fat is difficult to achieve in the clinic setting. It can be estimated by a number of methods. Currently, hydrostatic or underwater weighing is considered the most accurate method and is recognised as the gold standard of body composition analysis. However, this method is costly, time consuming and can be uncomfortable for the subject. The most convenient and cost effective methods include height, weight, circumferences, skinfold measurements and bioelectrical impedance analysis (BIA). Although skinfold measurements are more difficult than other anthropometric procedures, as a technique, it provides a better estimate of body fatness than those based solely on height, weight, and circumferences [50](#). However it should be noted that adequate training and regular practice is essential to obtain accurate results.

For this reason, BIA is sometimes used as an alternative, and as long as stringent protocols are followed and valid equations are used, the accuracy of BIA testing is similar to that of skinfolds [51](#). The American College of Sports Medicine's (ACSM) Resource Manual for Guidelines for Exercise Testing and Prescription (Sixth Edition) provides a comprehensive summary of ratings for the validity and objectivity for various body composition methods [52](#).

Where these methods of assessment are not available, the simplest measure is a surrogate calculation using body weight and height, the Body Mass Index (BMI).

BMI = weight/height² (also known as the Quetelet index)

A more accurate estimation of body fat percentage can be calculated from the BMI using the Deurenberg equation:

Body fat % = 1.2(BMI) + 0.23(age in years) - 10.8(sex) - 5.4 where sex = 1 for male and 0 for female

Nevertheless, BMI is not a particularly good surrogate for body fat. A recent large study showed BMI had a high specificity for identifying obesity against % body fat (men = 95%, women = 99%) but a poor sensitivity (men = 36%, women 49%) [53](#). So you can be pretty certain that someone with a BMI over 30 is obese, but many of those under BMI 30 will have obese levels of body fat. This probably reflects a combination of overweight with very low activity levels, so there is less muscle but obese levels of fat. Individuals in this group will not only have the risk factors associated with excess fat, but also the risk factors associated with lack of cardiovascular fitness. They are likely to be identified by low scores in fitness tests.

The actual relationship between obesity and VO2 Max is complex, as fat mass does not significantly affect the maximal aerobic capacity but it does significantly reduce the sub-maximal aerobic capacity, with time to exhaustion significantly lower in obese subjects [54](#). Surrogate measures of VO2 Max such as the step test will be influenced by early time to exhaustion, so those with low BMIs with high body fat are likely to get lower scores in these surrogate tests.

Since much of the research into obesity-related disease uses BMI, it is reasonable to measure BMI in order to identify those at risk of obesity co-morbidity. It is also one of the simplest tests to undertake.

It is not uncommon for athletic men with a high BMI to claim that their high muscle mass distorts the calculation. As the specificity is 95% for men, this implies 5% will be incorrectly considered obese. These individuals are obvious; they will clearly be fit and muscular, and it is appropriate to use waist measurement as a simple alternative to demonstrate the lack of excess body fat. There is a general consensus that waist circumference is a more accurate predictor of the existence of co-morbidities such as diabetes.

WHO classifies overweight and obesity against BMI as follows:

WHO classification	Surgical classification	European, Afro-Caribbean	Asian
Underweight		<18.5	
Normal weight		18.5-24.9	
Overweight	Pre-obese	25-29.9	18.5-22.9
Obese class I		30-34.9	23-24.9
Obese class II		35-39.9	>25
Obese class III	Morbidly obese	>40	
	Super-obese	>50	

48 Storing up problems: the medical case for a slimmer nation. Report of working party. London:RoyalCollege of Physicians; 2003.

49 Gallagher D et al. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. Am J Clin Nutr 2000;72(3):694-701.

50 Lohman, T.G., Houtkooper, I. & Going, S.B. (1997). Body fat measurement goes high tech. ACSM's Health & Fitness Journal, 1(1); 30-35.

51 Hendel, H.W, Gotfredsen, A, Hojgaard, I et al. (1996). Change in fat-free mass assessed by bio-electrical impedance, total body potassium and dual x-ray absorptiometry during prolonged weight loss. Scandinavian Journal of Clinical Laboratory Investigation. 56: 671-679.

52 American College of Sports Medicines (2010). Resource Manual For Guidelines for Exercise Testing and Prescription. Sixth Edition. Lippincott, Williams & Wilkins, Philadelphia.

53 Romero-Corral A, Somers VK, Sierra-Johnson J et al. Accuracy of body mass index in diagnosing obesity in the adult general population. Int J Obes (Lond). 2008;32(6):959-66.

54 Goran M et al. Total body fat does not influence maximal aerobic capacity. Int J Obes Relat Metab Disord. 2000;24(7):841-8.

Waist Measurement and Fat Distribution

Waist measurement can also be used as a surrogate measure of obesity, and obesity is defined as follows [55](#):

Waist measurement related to risk of metabolic syndrome				
	Increased Risk Europid	Substantial Risk Europid	Increased Risk Asians	Substantial Risk Asian
Men	>94cm (37")	>102cm (40")	>78cms	>90cm (36")
Women	>80cm (32")	>88cm (35")	>72cms	>80cm (32")

It is important to measure waist circumference halfway between ribs and iliac crest rather than around top of iliac crest with the tape measure parallel to the floor and not compressing the skin. The individual should relax and exhale. This does not necessarily represent trouser waist size when the waist of the trouser is pulled under the abdomen.

High abdominal fat content is strongly associated with obesity co-morbidities. The 'apple' shape of male-type obesity is therefore a higher risk factor than the 'pear' shape of female-type obesity. This reflects the specific role of visceral fat in energy storage and energy balance associated with stress and nutrient change.

55 Misra A et al. Waist circumference cutoff points and action levels for Asian Indians for identification of abdominal obesity.

Causes of Obesity

Being overweight is in most cases a result of an imbalance between the energy taken in (food & drink) and energy used (activity) [56](#). However, there are clear genetic factors affecting natural weight levels, but these only explain at most 50% of weight variation. Environmental factors play a large, and increasingly important, part. Studies of populations that have experienced famine such as those of Dutch children born in 1943/4 show that nutrition levels in-utero and shortly after birth can have a significant effect on both future obesity and separately on cardiovascular risk and metabolic syndrome. While this means that an obese person can to some extent blame their genes and their early life, there is scope to address their obesity through behaviour modification.

The physiology of obesity has become much better understood over the past decade. The simplistic view of energy imbalance, intake v output, remains valid, particularly the relevance of profound lack of activity in Western societies compared to the natural human state, but there are many more factors affecting the predisposition to obesity, its development, and the likelihood of co-morbidities.

The hormone leptin was first discovered in 1994, a protein produced mainly by white adipose tissue but also by the stomach fundus. Leptin acts on the hypothalamus to signal satiety but also has a role in general carbohydrate, bone and reproductive metabolism. Leptin levels are strongly correlated with BMI, and with co-morbidities. Studies suggest that the reason for increased leptin levels as BMI increases is leptin resistance. Leptin is not, however, the cause for most cases of obesity. It is one of many hormones under investigation but leptin as a cause of obesity is very rare and occurs in families.

There are specific pathological causes of obesity that should not be forgotten. Thyroid insufficiency is common and easily identified. A variety of rare hormone disorders can predispose to obesity and there are psychological disorders, particularly 'comfort eating' and 'binge-eating' disorders. There are also disorders related to obesity where it remains unclear whether obesity is cause or effect, such as polycystic ovary syndrome. There are likely to be other symptoms and signs found in these conditions and it would be very unusual for an occupational physician to be the first to make a diagnosis; the GP is likely to be investigating and treating before the individual presents to the occupational health department. A more common contributor for obesity is prescription of medication such as anti-depressants, anti- psychotics and steroids.

The primary cause of obesity in firefighters is likely to be lack of regular exercise combined with poor diet. This can be a particular problem for retained firefighters who may well get much of their exercise away from Brigade activity. Many will be in physically demanding jobs when they become retained firefighters, and these primary jobs may well offer an active lifestyle keeping them fit and strong, while allowing them to consume high calorie diets. It is not unusual for a retained firefighter to change primary jobs during their late 30s and 40s, either through promotion to a

managerial or administrative role, or because they can no longer cope with the physical demands. The fire service will only become aware of this when the firefighter becomes substantially heavier over a relatively short space of time.

A classic example is outlined below:

A young man had applied to join the service as a regular firefighter age 18 but had a BMI of 28 and was advised that he would struggle to meet the fitness criteria. He changed lifestyle, did more physical activity and started his primary role as a mechanic. His BMI dropped to 26 and he became significantly fitter and stronger, joining the fire service as a retained firefighter age 20. His BMI remained constant from age 25 to 30, then increased by 0.5 per year to age 35, but he managed to cope with his firefighting role without difficulty. At age 35 when his BMI was 29 he was promoted to manager, a mostly sedentary job. By age 36 his BMI had risen to 33, and he was unable to meet the fitness standard, needing remedial training. He passed the test after two months with a BMI of 32, but then developed back pain and was off for three months, by which time his BMI had increased to 34. He returned to the gym, struggled to cope and became depressed. Three months later his BMI had increased to 35. After a total of a year sickness absence with depression he was dismissed on capability grounds with a BMI of 37, and was not considered permanently unfit so did not qualify for ill health retirement and early payment of pension. Had his line manager noted his change in primary role, and encouraged lifestyle adjustments to maintain his weight and fitness, he would still be actively firefighting now.

56 [National Obesity Forum. Obesity Care Pathway Toolkit, 1995.](#)

The Effects of Obesity

Obesity has a number of different but related effects on the firefighter. These can be considered as physical, physiological and psychological.

The physical effects are those of carrying excess weight. The immediate impact of this is the physical demand, making the firefighter slower, use more air per minute from a BA set, prevent them from manoeuvring through the fireground, climbing ladders or carrying casualties. The long-term effect is increased wear on the joints. A recent study of Americans aged 50-84 showed that reversing the obesity prevalence levels to those of a decade previously would avert 111,206 total knee replacements [57](#). Obesity is a stronger predictor of bilateral knee osteoarthritis (odds ratio 6.6) than knee injury (3-3.5) [58](#). The odds ratio of developing knee arthritis increases from 1 in the first tertile of BMI to 3.79 in the third tertile of Americans from the NHANES study from 1988-94 [59](#). A follow-up of male medical students showed a threefold increase in knee arthritis 36 years later for those with a BMI 24.7-37.6 compared to those with a BMI 15.6-22.8 at the start of the study [60](#), and BMI at age 20-29 was more predictive of future osteoarthritis than BMI at ages 30-39 or 40-49.

The physiological effects are those related to altered metabolism, and the associated lack of fitness. Obesity represents a permanent state of low-grade inflammation. There is a close association between adipose tissue and macrophages, with raised levels of inflammatory cytokines [61](#). These macrophages are 'classically activated' M1 macrophages and appear to play a key role in generating inflammatory molecules, causing adipocyte hypertrophy and maintaining obesity, causing insulin resistance and causing cardiovascular disease. Macrophages found in adipose tissue in lean individuals are 'alternatively activated' M2 macrophages which play a key role in wound healing and immunoregulation [62](#).

In the long term problems associated with metabolic syndrome, diabetes, hypertension and cardiovascular disease, will take their toll. An obese individual has a life expectancy reduced by seven years compared to someone of normal weight [63](#). The relative risk of women developing type 2 diabetes over 14 years in relation to BMI at age 30-50 rises to 8.1 in those with BMI 25-26.9, 40.3 in those with BMI 31-32.9 and 93.2 in those with BMI over 35 [64](#). In men the relative risk of developing type 2 diabetes is 42.1 in those with BMI over 35 compared to those with a BMI less than 23 [65](#).

Many people regard type 2 diabetes as a readily treatable disorder and have few concerns. People with type 2 diabetes have three times the mortality rate of the general population, the risk of cardiovascular disease increases five-fold for men and eight-fold for women. Most significantly, the average life expectancy is reduced by 5-10 years [66](#).

Obesity is also a significant psychological problem for many. They may be embarrassed about their shape and lack of fitness, they may feel low or depressed because of their failure to perform at work. Lack of exercise will reduce levels of circulating endorphins contributing to the sense of low mood. Or obesity may represent the result of an episode of depressive illness, with lack of motivation leading to lack of fitness coupled with comfort eating. This must be recognised by all involved, so that a supportive approach is taken rather than negativity and blame. This does not mean that the issue should not be addressed at all; it is essential to address it, but with empathy and understanding.

57 Losina E, Walensky RP, Reichmann WM, Holt HL, Gerlovin H, Solomon DH, et al. Impact of obesity and knee osteoarthritis on morbidity and mortality in older Americans. *Ann Intern Med.* Feb 15 2011;154(4):217-26.

58 Davis MA, Ettinger WH et al. The association of knee injury and obesity with unilateral and bilateral osteoarthritis of the knee. *Am J Epidemiol.* 1989;130(2):278-88.

59 Janssen I, Mark AE. Separate and combined influence of body mass index and waist circumference on arthritis and knee osteoarthritis. *International Journal of Obesity* 2006;30:1223-8.

60 Gelber AC, Hochberg MC et al. Body mass index in young men and the risk of knee and hip osteoarthritis. American Journal of Medicine 1999;107(6):542-8.

61 Cancellor R, Clement K. Is obesity an inflammatory illness? Role of low-grade inflammation and macrophage infiltration in human white adipose tissue. BJOG 2006;113(10):1141-7.

62 Harford KA, Reynolds CM, McGillicuddy FC, Roche HM. Fats, inflammation and insulin resistance: insights to the role of macrophage and T-cell accumulation in adipose tissue. Proc Nutr Soc 2011;12:1-10.

63 Peeters A, Berendregt JJ, Willekens F et al. NEDCOM, The Netherlands Epidemiology and Demography Compression of Morbidity Research Group. Obesity in adulthood and its consequences for life expectancy: a life table analysis. Ann Intern Med. 2003;138:24-32.

64 ColditzGA, Willett WC, Rotnitzky A et al. Weight gain as a risk factor for clinical diabetes mellitus in women. Ann Intern Med 1995; 122:481-486

65 Chan JM et al. Obesity, fat distribution, and weight gain as risk factors for clinical diabetes in men. Diabetes care 1994;17(9):961-9.

66 Clarke PM et al. A model to estimate the lifetime health outcomes of patients with Type 2 diabetes: the United Kingdom Prospective Diabetes Study (UKPDS) Outcomes Model (UKPDS no. 68). Diabetologia 2004;47:1747-59.

Obesity and Work

Obesity is not conducive to regular and effective working. Obese men have 1.47 sickness absence episodes a year compared to 1.01 for those with normal weight. In women the figures are 2.08 compared to 1.64. For long-term absence (over 4 weeks) men and women with normal weight have respectively 0.1 and 0.19 episodes of absence a year, while obese men and women have 0.19 and 0.4 episodes [67](#). Obese employees typically have 9.5 days sick leave a year compared to six for normal weight employees, while very obese employees have eleven days [68](#). Individuals with higher levels of fitness produce a better quality of work, perform better, have greater output and reduced effort, while obesity is associated with more difficulty getting along with co-workers [69](#).

A study of US firefighters found that raised BMI was an independent predictor of absence due to injury, and those with class II and III obesity had nearly five times the number of missed work days due to injury compared to normal weight counterparts [70](#).

There will be a number of significant ergonomic issues relating to size and shape, including the requirement for special uniform, difficulties with PPE fit, strength and size of chairs and vehicle seating and the challenge of working in small or tight spaces.

67 Ferrie JE et al. BMI, Obesity, and Sickness Absence in the Whitehall II study. *Obesity* (2007) 15:1554-1564

68 Harvey SB et al. Obesity and sickness absence: results from the CHAP study. *Occ Med* (2010) 60(5):362-8.

69 Pronk NP et al. The association between work performance and physical activity, cardiorespiratory fitness and obesity. *J Occup Environ Med*. 2004; 46(1):19-25

70 Poston-Walker SC et al. Obesity and injury-related absenteeism in a population-based firefighter cohort. *Obesity*. 2011;19(10):2076-81.

Tackling Obesity

Perhaps the best role models for overcoming obesity are those who have done so themselves. Maintaining an approach of positive support and encouragement will help create these role models, and enable them in turn to help others who are progressing towards obesity to turn around.

There are a variety of treatment options, with many new pharmacological approaches under development as well as surgical options. These do all have significant side effects, so should only be considered when diet and exercise have been seriously attempted without success. The main factors contributing to obesity will usually be an excess consumption of calories and lack of physical activity. The first line approach should be to change eating habits and to increase regular physical activity.

Ways to tackle obesity include:

[Diet](#)

[Pharmacological Treatments](#)

[Surgical Treatments](#)

[Physical Activity](#)

[Physical Fitness](#)

Diet

Individuals who are already significantly overweight or obese may well need to address eating habits as well as exercise in order to achieve significant improvements in physical fitness. There are numerous approaches to weight loss through dieting, and many commercially available approaches may be very successful in achieving short-term weight loss. They often do so through special diets which cannot be readily maintained in the long term.

Maintaining weight loss generally requires a lifestyle change, with a healthy diet that avoids excess or unnecessary calories. There are many good sources of advice on healthy diets. Avoiding excess calories simply means eating less. This is often a

difficult message to accept, as it leads to individuals feeling hungry, and combining hunger with exercise is often particularly uncomfortable. The response from many patients seen in clinic when advised to eat less is often 'if I ate any less I would starve'. In order to persuade the body to use up stored fat instead of just using energy from the diet, the body needs to be put in a situation of relative starvation, briefly summarised in the reply 'yes you would, that is how diets work'. A simple approach that can be helpful is to use a side plate instead of a dinner plate for meals to ensure smaller portions, and to avoid all snacking between meals. People often fail to appreciate the calorific value of drinks such as popular fizzy drinks, which can easily contribute a thousand or more calories a day to intake when consumed in large quantities. Water is a good alternative that contains no calories, tap water is very cheap and often contains fewer 'impurities' than bottled water.

Simple guidelines are available in the NICE guide on obesity [71](#):

Base meals on starchy foods such as potatoes, bread, rice and pasta, choosing wholegrain where possible.

Eat plenty of fibre-rich foods – such as oats, beans, peas, lentils, grains, seeds, fruit and vegetables, as well as wholegrain bread, and brown rice and pasta.

Eat at least five portions of a variety of fruit and vegetables each day, in place of foods higher in fat and calories.

Eat a low-fat diet and avoid increasing your fat and/or calorie intake.

Eat as little as possible of:

- fried foods
- drinks and confectionery high in added sugars
- other food and drinks high in fat and sugar, such as some take-away and fast foods

Eat breakfast

Watch the portion size of meals and snacks, and how often you are eating

For adults, minimise the calories you take in from alcohol

71 National Collaborating Centre for Primary Care and the Centre for Public Health Excellence. Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children. CG43. National Institute for Health and Clinical Excellence 2006

Pharmacological Treatments

There are currently only two obesity medications available on prescription, one a bulking agent called methylcellulose and the other, orlistat, which acts as a lipase inhibitor and which is also available both on prescription and over the counter after a consultation with a pharmacist.

Orlistat (trade name Xenical) is taken as a 120mg capsule before, with or within one hour after food. The lipase inhibitor acts in the gut preventing the absorption of fat. This reduces the calorie load entering the body with an estimated effect of the loss of an additional pound of weight for each two pounds lost by the accompanying low fat diet. It is key that any potential user realises that orlistat must be taken in conjunction with a low fat diet (and increased physical exercise) and that if fatty food is consumed at the same time it will result in unpleasant symptoms such as orange oily diarrhoea, flatus and abdominal pain. These are referred to as drug side effects but it is not the drug which causes the symptoms but the lack of adherence to a proper diet.

Orlistat can be obtained via the pharmacist and is taken at a dose of 60mg three times a day. Indications for orlistat are included in NICE guidelines as suitable for people with body mass index in excess of 30 mg/kg² or more than 28kg/m² if there are co morbidities present [72](#). There is a theoretical risk of developing fat soluble vitamin deficiency but this is rare during the usual 12 months that the drug is taken.

72 National Collaborating Centre for Primary Care and the Centre for Public Health Excellence. Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children. CG43. National Institute for Health and Clinical Excellence 2006.

Surgical Treatment

There are now a number of obesity surgery options. The commonest is insertion of a gastric band into the top of the stomach which produces a small pouch and so leads to a sensation of fullness when smaller portions of food are eaten.

Criteria for eligibility for surgery have been published by NICE but funding for such surgery is restricted in certain parts of the country. The operation is safe with a low mortality and morbidity rates and weight loss is achieved over an 18-24 month period after which further plastic surgery maybe needed to remove folds of excess skin . More invasive surgery with higher risks of complications include gastric bypass surgery, which produces a greater weight loss than the laparoscopic band.

Physical Activity

Physical exercise is often described in subjective terms, such as 'moderate activity'. This can sometimes be unhelpful when trying to quantify physical activity. A key factor in failure to control weight is a lack of understanding of exercise levels. Any visit to a gym will demonstrate this point. There are always some participants who

will mount a piece of cardiovascular training equipment and just start exercising without applying any specific setting, and without paying any attention to what they are actually doing. This often means they are exercising at minimal resistance, and they may only exercise for ten or fifteen minutes. A simple assessment of their exercise levels may show they have expended more energy walking from the car park to the gym than they have cycling for fifteen minutes at level 1. They may also have expended more energy pushing a trolley around the local supermarket.

An essential principle when encouraging firefighters to exercise is to encourage them to measure and understand what they are doing, recording each session so they can see improvement and relate fitness gains to weight loss. Because of this, it is important that firefighters have access to professional advice on fitness and weight loss.

There are many guidelines for 'healthy exercising' and there are significant differences often because they have different end-points. Most aim to improve cardiovascular fitness to reduce the incidence of cardiovascular disease. Studies suggest that exercising for less than thirty minutes a day, or 150 minutes a week at moderate level does not show statistically significant improvements in cardiovascular fitness, so 150 minutes a week of moderate exercise is generally the minimum recommended for cardiovascular benefit. However, achieving weight reduction may require more than 300 minutes of physical activity a week. Moderate exercise is defined as equivalent to brisk walking, and this for most is around 4 miles an hour [73](#) [74](#).

It is also recognised for most individuals exercising above these levels brings greater benefits. Alternatively, it is possible to exercise twice as hard for half as long to achieve roughly the same health goal. There is a direct link between exercise levels and energy expenditure, and a simple way to consider this is the Metabolic Equivalent Task (MET) where 1 MET is the energy expended at rest. Tables have been compiled for a very large variety of tasks with their MET value, including exercising, work activity and home activity. The US Center for Disease Control and the American College of Sports Medicine have collaborated on these, and a comprehensive list has been published [75](#). For example, brisk walking is 4 MET, jogging is 7 MET, running at 5mph is 8 MET, running at 7mph is 11.5 MET, running at 9mph is 15 MET and running at 10.9mph is 18 MET. Exercise can be measured in 'MET minutes', and a reasonable goal for weight control might therefore be 1500 MET minutes per week of exercise, and for weight loss 2000+ MET minutes per week. Where training time is limited, increasing the MET value of the activity allows a reduction in time spent exercising.

It should be relatively straightforward to develop a training programme with professional physical training instructors, combining aerobic activities such as jogging, cycling, swimming with appropriate resistance training. The aim should be to produce the most suitable programme for the individual, including activities they enjoy and excluding activities they don't enjoy so they have a positive experience while they improve their fitness.

73 2008 Physical Activity Guidelines for Americans. US Department of Health and Human Services.

74 reference removed

75 Ainsworth BE, Haskell WL, Whitt MC et al. Compendium of physical activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise* 2000;32(Suppl):S498-504.

Physical Fitness

Whilst encouraging firefighters to increase their level of physical activity for weight loss purposes or for general health benefits will be beneficial to the individual and the organisation, medical advisers and firefighters need to understand the importance of maintaining a level of physical fitness that is directly associated with safe and effective firefighting. Failing to ensure fitness levels can pose significant risks to the firefighter themselves, their colleagues, and ultimately to the public to which they serve.

Cardiorespiratory fitness, muscular strength, muscular endurance, and flexibility are major determinants of firefighter fitness and maintaining appropriate fitness levels in all of these areas is key to ensuring safe and effective performance [76](#). Unfortunately, the physical demands of the job appear to be insufficient to enhance or maintain role-specific fitness levels and so it is important that firefighters engage in regular physical exercise to maintain their physical competencies [70](#). Medical advisers should encourage physical activity both in and out of the workplace to reduce the risk associated with a number of chronic health conditions, improve work performance, reduce operational risk and to help improve help reduce sickness absence rates within the organisation.

70 Poston-Walker SC et al. Obesity and injury-related absenteeism in a population-based firefighter cohort. *Obesity*. 2011;19(10):2076-81.

76 Office of the Deputy Prime Minister (2004). *Operational Physiological Capabilities of Firefighters: Literature Review and Research Recommendations*. Fire Research Technical Report. Optimal Performance on behalf of the Office of the Deputy Prime Minister:London.

The measurement of physical fitness - VO2 Max

Maximal oxygen uptake (VO₂max), commonly referred to as 'aerobic capacity', is a measure of cardiorespiratory fitness and has been consistently shown to be the best predictor of performance in simulated fire-fighting tasks [77](#) [78](#) [79](#). Numerous international scientific studies have assessed the energy costs of firefighting and values ranging from 32 - 57 ml.kg⁻¹.min⁻¹, with mean values around 35 ml.kg⁻¹.min⁻¹. However as it is not generally physiologically possible for individuals to perform maximally for longer than about 90 seconds, and typically, firefighting tasks last significantly longer than this (i.e. up to 30 min). It is therefore estimated that a firefighter, undertaking a typical operational task at an energy cost of 35 ml.kg⁻¹.min⁻¹

1, would therefore need a VO₂max of ~42 ml.kg⁻¹.min⁻¹ in order to be able to perform their role safely and effectively. This figure is in line with previous studies, where the fitness standard for fire-fighters is recommended at 40-45 ml.kg⁻¹.min⁻¹. Indeed, a comprehensive literature review on the physiological capabilities of firefighters was commissioned by the ODPM and published in 2004. Within this document it was suggested that “UK fire-fighters have a mean VO₂max of 43 ml.kg⁻¹.min⁻¹.²⁵ In 2009, the FireFit Steering Group in conjunction with Professor Kevin Sykes from Chester University published its guidelines on the safe, accurate, reliable and cost effective methods of assessing firefighter fitness levels. Within this report, it recommended (based on the available research) that firefighters should demonstrate an aerobic capacity of 42 ml.kg⁻¹.min⁻¹ for safe and effective firefighting [80](#).

When assessing physical fitness for firefighters, it is important to remember that fitness incorporates cardiorespiratory fitness, muscular strength, muscular endurance, and flexibility. However, as cardiorespiratory fitness has been shown to be the best predictor of firefighting performance and correlates most highly with cardiac risk, it is sensible that Fire & Rescue Services focus their resources most heavily on managing this crucial component of physical fitness. Indeed, a study commissioned by the National Fire Protection Association (NFPA) in America reported that between 1995-2004 coronary heart disease accounted for 45% of all on-duty firefighter deaths. The authors of the study reported that the risk of death may be increased because many firefighters lack physical fitness and have underlying cardiovascular risk factors such as being overweight / obese [81](#).

Cardiorespiratory fitness can be measured either directly or indirectly. The direct assessment of cardiorespiratory fitness or maximal oxygen uptake as it is sometimes known (VO₂max) requires expensive equipment and trained users, and is generally only used in laboratory settings. However with the development of technology, cheaper and more portable systems are now widely available. Because of the issues around cost and technical expertise, many FRS choose to administer a more simple surrogate test to assess cardiorespiratory fitness.

Surrogate tests have all been developed scientifically and are reasonably objective and reproducible, but as they usually depend on changes in heart rate over time they can be influenced by anxiety during the test, and by drugs that affect heart rate. In these instances, tests that rely on heart rate may not be the most appropriate way of assessing fitness for role. There are in general terms two different types of test, maximal tests which are more accurate, and sub-maximal tests which usually test up to 80% maximum heart rate, which are safer by avoiding the small but significant risk of a heart rhythm anomaly in those susceptible. Common maximal tests are the Harvard Step Test and Multistage Fitness Test (Beep Test) and common sub-maximal tests are the Chester Step and Treadmill Tests, and the Astrand 6 Minute Cycle Test.

Pure physical fitness is important, but it too is only a surrogate measure of a firefighter's actual ability to perform the job. The alternative approach to fitness assessment and arguably the best test would be one that closely mimics the role

itself, such as a direct task simulation. Such tests have considerable ecological validity and are widely used in the selection of new personnel across a range of occupational groups, including the Fire Service. However, whilst such approaches lend themselves to mass testing in controlled environments within regional/national selection centres, they are associated with significantly greater risks of injury and illness to personnel as the intensity at which the testees exercise cannot be controlled. Additionally, these tests often require access to specific equipment and apparatus, including the wearing of personal protective equipment and the carriage of heavy items. These tests are also time-consuming, and as such controlled, 'clinical' sub-maximal assessments of cardiorespiratory fitness are often safer and easier to manage and administer on a large scale.

It is important to remember however, that there are limitations to these types of tests. These surrogate tests measure cardiorespiratory fitness only are an important tool for management when assessing a firefighter's physical potential, cardiovascular risk and ultimately their suitability for operational duties. These tests however cannot ensure that a firefighter has the ability to perform recognised firefighting tasks that include carrying of external loads such as equipment. The other factors of physical fitness (muscular strength, muscular endurance, and flexibility) need to be recognised and may be better assessed on the job during drill exercises than during an annual or bi-annual fitness assessment. Whilst it is recognised that stronger firefighters may complete certain tasks more easily, a minimum level of cardiovascular fitness is still essential for a firefighter to carry his/her bodyweight over distances and as such, cardiovascular fitness tests that report relative scores of fitness (VO₂max in ml/kg/min) still have a high degree of relevance to firefighting.

77 Hayman VL. (2002). Advanced Fitness Assessment and Exercise Prescription. Fourth Edition. Champaign, Illinois. Human Kinetics.

78 Sykes K. (2002). Determining Fire fighter Fitness. Fire International, Sept p22.

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80 Stevenson, R.D.M., Wilsher, P. & Sykes, K. (2009). FireFit Steering Group. Fitness for Fire & Rescue. Standards, Protocol and Policy.
<http://www.firefitsteeringgroup.co.uk/firefitreport.pdf>

81 Kales, S. et al. (2007). Emergency Duties and Deaths from Heart Disease among Firefighters in the United States. The New England Journal of Medicine. 356(12); 1207-1215.

Fitness and Age

In the general population, fitness decreases significantly with age, and it is important to understand how this relates to a standard fitness test. Most young men will be as fit or fitter than the required standard of 42mls/kg/min, but above the age of 45 only around a quarter of men in the general population will meet this standard and above 55 less than 10% will meet this standard. More significantly, only a quarter of young women in the general population will meet this standard, and very few over the age of 45 achieve it [82](#). This does not mean that the standard of the test itself is difficult or that it is unachievable, it merely reflects the levels of fitness (or lack of it) in Western populations.

The context for these figures is a population where, in 2008, only 39% of men and 29% of women meet the Government's minimum recommendations of at least 30 minutes of moderate intensity physical activity on average five times a week [83](#). This equates to walking a total of two miles a day, a very low activity level compared to the fitness requirements for firefighters who would be expected to maintain activity levels substantially greater than this.

We all tend to compare our fitness with the 'average fitness' of those around us, rather than comparing it with a more objective measure of what humans are capable of if they exercise regularly. Humans evolved as 'running apes', developing the technique of persistence hunting where our ancestors would chase the selected prey for 15-20 miles until it dropped dead through overheating [84](#). Our ancestors did not overheat because running on two legs, having no fur and being able to sweat gave us the advantage. So humans are 'designed' to run close to a marathon several times a week as well as walk ten to twenty miles while seeking prey. Most of us don't do anything like this level of exercise these days, but that doesn't mean we can't. Those who passed the initial selection tests for the role of firefighters should be able to maintain the necessary fitness levels through regular exercise in order to continue to meet the standard throughout their career.

Aerobic fitness norms - Men 85							
Age / Years	Very low 3%	Low 8%	Fair 22%	Moderate 34%	Good 22%	Very good 8%	Elite 3%
20-24	< 32	32-37	38-43	44-50	51-56	57-62	> 62
25-29	< 31	31-35	36-42	43-48	49-53	54-59	> 59
30-34	< 29	29-34	35-40	41-45	46-51	52-56	> 56
35-39	< 28	28-32	33-38	39-43	44-48	49-54	> 54
40-44	< 26	26-31	32-35	36-41	42-46	47-51	> 51

45-49	< 25	25-29	30-34	35-39	40-43	44-48	> 48
50-54	< 24	24-27	28-32	33-36	37-41	42-46	> 46
55-59	< 22	22-26	27-30	31-34	35-39	40-43	> 43
60-65	< 21	21-24	25-28	29-32	33-36	37-40	> 40

Aerobic fitness norms - Women 86							
Age / Years	Very low 3%	Low 8%	Fair 22%	Moderate 34%	Good 22%	Very good 8%	Elite 3%
20-24	< 27	27-31	32-36	37-41	42-46	47-51	> 51
25-29	< 26	26-30	31-35	36-40	41-44	45-49	> 49
30-34	< 25	25-29	30-33	34-37	38-42	43-46	> 46
35-39	< 24	24-27	28-31	32-35	36-40	41-44	> 44
40-44	< 22	22-25	26-29	30-33	34-37	38-41	> 41
45-49	< 21	21-23	24-27	28-31	32-35	36-38	> 38
50-54	< 19	19-22	23-25	26-29	30-32	33-36	> 36
55-59	< 18	18-20	21-23	24-27	28-30	31-33	> 33
60-65	< 16	16-18	19-21	22-24	25-27	28-30	> 30

The issues relating to physical fitness capacity and aging is excellently summarised in this paragraph taken from a NATO Research & Technology Organization - Technical Report on Optimizing Operational Physical Fitness – Section 7.2 Effects of Age on Operational Physical Performance by Deiter Leyk, James Bilzon & Oliver Erley [87](#).

“Both endurance and muscular capabilities deteriorate with age. This results in a decline in both maximal attainable performances as well as in decrements in physical fitness capacity. However, it is often difficult to determine whether the observed reduction is a result of biological aging, or of lifestyle, physical inactivity, genetics, or disuse [88](#).

While the strictly age-elicited changes in maximal performance capabilities seem to be inevitable, physical exercise may still slow, delay, or reverse decrements in

physical fitness capacity. Physically active elderly individuals, such as master athletes, show a slower decline in VO₂max over time compared with their inactive peers, and it has been shown that adequate strength levels can also be maintained [89](#) [90](#) [91](#) [92](#).

Numerous studies have found that both the cardiovascular and the musculoskeletal system show remarkable plasticity late into life [93](#) [94](#). As a result, the effects of age on physical fitness capacity may be slowed, halted, or even be reversed. As seen in Leyk et al's (2006a) study, physically active elderly are able to maintain levels of performance equal to those of 20-year-old peers. This implies that endurance training can counter the age-related decrements in endurance that can be observed in less-active peers. Strength training also yields similar results as shown by Pearson et al., 2002. While maximal lifting performance decreased with age, athletes consistently showed results that were significantly better than those of their age-matched controls. Isometric strength of 80- to 89-year-old weightlifters was higher than that of the less-active control group (ages 40 – 49 years). The capacity for performance improvements for untrained subjects remains almost constant with increasing age. A roughly 10 to 20% increase in relative performance after a 3-month training regime can be derived for both strength (Baum et al., 2003) and endurance training as measured in VO₂max from age 20 to 80 years [95](#) [96](#).

Given the development of age structures in the western world, and the related impending impact on personnel in the workplace, who will have to work until an older age, physical exercise and activity may be the key to maintaining appropriate levels of fitness required both for work and everyday life. Appropriate strength- and endurance training at any age is the easiest and most effective way to counter the effects of age-related loss of performance [97](#).”

82 Shvartz E, Reibold RC. Aerobic fitness norms for males and females aged 6 to 75 years: a review. *Aviat Space Environ Med*; 61:3-11, 1990.

83 Statistics on obesity, physical activity and diet:England, 2011. The Health and Social Care Information Centre. NHS:London. 2011

84 Bramble DM,LiebermanDE. Endurance running and the evolution of Homo. *Nature* 2004;432:345-353

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86 Shvartz E, Reibold RC. Aerobic fitness norms for males and females aged 6 to 75 years: a review. *Aviat Space Environ Med*; 61:3-11, 1990

87 NATO Research & Technology Organization - Technical Report. Optimizing Operational Physical Fitness – Section 7.2 Leyk, D., Bilzon, J. & Erley, O. Effects of Age on Operational Physical Performance.

88 Rittweger, J., Kwiet, A. and Felsenberg, D. (2004). Physical performance in aging elite athletes challenging the limits of physiology. *J Musculoskelet Neuronal Interact*, 4(2): 159-160.

89 Tanaka, H. and Seals, D.R. (2003). Invited review: Dynamic exercise performance in Masters athletes: insight into the effects of primary human aging on physiological functional capacity. *J Appl Physiol*, 95(5): 2152-2162.

90 Trappe, S.W., Costill, D.L., Vukovich, M.D., Jones, J. and Melham, T. (1996). Aging among elite distance runners: a 22-yr longitudinal study. *J Appl Physiol*, 80(1): 285-290.

91 Wiswell, R.A., Jaque, S.V., Hawkins, S.A., Tarpenning, K.M., Constantino, N. and Hyslop, D.M. (2000). Maximal aerobic power, lactate threshold, and running performance in master athletes. *Med Sci Sports Exerc*, 32(6): 1165-1170.

92 Krivickas, L.S., Fielding, R.A., Murray, A., Callahan, D., Johansson, A., Dorer, D.J. and Frontera, W.R. (2006). Sex differences in single muscle fiber power in older adults. *Med Sci Sports Exerc*, 38(1): 57-63.

93 Wiswell, R.A., Jaque, S.V., Hawkins, S.A., Tarpenning, K.M., Constantino, N. and Hyslop, D.M. (2000). Maximal aerobic power, lactate threshold, and running performance in master athletes. *Med Sci Sports Exerc*, 32(6): 1165-1170.

94 Reeves, N.D., Narici, M.V. and Maganaris, C.N. (2006). Myotendinous plasticity to aging and resistance exercise in humans. *Exp Physiol*, 91(3): 483-498.

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Motivational Interviewing

What approach should Medical Advisers take with obese firefighters? Evidence shows that the style of consultation can have a major effect on the outcome. A person will only change behaviour when they are ready to do so, and this requires a combination of motivation and confidence.

Directing styles of consultation, telling the firefighter what to do, rarely result in appropriate behaviour change. A guiding style of 'reflective listening' is much more successful, using a combination of 'asking', 'informing' and 'listening' to 'nudge' the patient towards change. This process has been refined as 'Motivational Interviewing'

by Rollnick and Miller [98](#), a very successful form of psychotherapy that is increasingly used in General Practice as well as in treatment for addictive behaviours [99](#). Significant success has been found where consistent MI techniques are used for weight loss in primary care [100](#).

The first step is to assess readiness to change, a combination of the individuals views of the importance of change, and their confidence to do so.

Importance + confidence = readiness to change.

There are two very simple questions that can be asked in consultation:

'how important is it for you to lose weight on a scale of one to ten'

'how confident are you that you can lose weight on a scale of one to ten'.

If both questions score ten out of ten, the person needs almost no help, and they should be well on their way to successfully losing weight. It is those with a low score who need help. The trick in Motivational Interviewing (MI) is to get the patient to provide the answers themselves. This is assisted by reflective listening, reinforcing their approach when the answers are positive while showing empathy when the answers are negative.

If they say importance scores low, you can ask questions such as 'if you might lose your job because of your weight, would that make it more important for you to lose weight?' or 'if you had a high risk of getting diabetes because of your weight, would that make it more important to lose weight'. When tackling confidence, questions such as 'have you successfully lost weight before? What did you do that time?' can be a useful starting point.

The techniques of motivational interviewing are covered in detail elsewhere, and Medical Advisers who are unfamiliar with the technique are strongly advised to read up on the subject and start practising in clinics.

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Eyesight

(Subheadings as below)

[Problems with Vision](#)

[Refractive Error](#)

[Refractive Surgery](#)

[Colour Defects](#)

Problems with Vision:

The ability to resolve complex visual information depends on the receipt of good quality optical information, its detection by the retina and processing and modification by the brain. Clearly disease or damage to the eye or the neural pathways and visual cortex will affect an individual's ability to 'see' in the fullest range of environments. The perception of an object depends on extrinsic factors such as its size (visual angle), colour, contrast and the level of illumination, and intrinsic factors such as its visual acuity, colour perception and contrast sensitivity. Visual acuity and colour perception are discussed in some detail below.

Abnormal vision may impact on:

- Reaction time
- Mobility
- Target/casualty recognition
- Information exchange
- Spatial awareness

The assessment of an individual with poor vision requires an holistic approach with each of these areas being considered, particularly in relation to health and safety. This may preclude employment as a fire fighter yet enable the individual to be employed in fire safety or investigation.

Contrast Sensitivity, Snellen and LogMAR Charts

Contrast sensitivity is the ability to perceive an object which contrasts poorly with its background.

Contrast sensitivity is reasonably stable in 20–40-year-olds but deteriorates slightly with advancing age, certain forms of ocular pathology or in a minority (8-10%) of individuals following corneal refractive eye surgery. This deterioration is unlikely to be of significance in most occupational settings, however it becomes significant amongst safety critical workers expected to work in conditions of poor visibility such as at night or in smoke. The testing of contrast sensitivity is therefore only recommended for firefighters with a history of eye surgery or who develop eye disease.

Acuity is usually measured using a standard chart with black letters on a white background. The Snellen chart is universally used, although the logMAR chart is more accurate because it has:

- Several charts with different shading of letters to produce different contrast values.
- Geometrical progression in size between lines
- The same number of letters on each line to ensure the 'crowding effect' is the same on each line.

Scoring letter by letter, improving repeatability and reliability:

A correctly illuminated standard Snellen chart has a contrast of 94%. The most useful contrast level to test is 10%. In the normal eye, one can expect a drop of 3 lines of acuity on a 10% contrast logMAR chart compared to the 100% contrast logMAR chart. This does not apply to Snellen charts.

Status of These Guidelines for Vision

Medical Advisers must appreciate that the information below represents guidelines on medical aspects of vision. Managers may take a flexible approach appropriate to their requirements and will expect medical staff to advise appropriately when assessing the fitness of recruits.

Refractive Error:

Refractive errors are predominantly due to mismatch between the axial length of the globe of the eye and the curvature of the cornea. The cornea is responsible for two thirds of light refraction and the lens plays a smaller (but important) part in image focussing.

Standards for LGV (Group 2) driving require the driver to have a normal binocular field with an unaided acuity of 6/36 or better corrected to at least 6/9, 6/12 although this may in time be revised to 6/7.5 and 6/10 respectively 1. The Group 1 standard equates to 6/10 with both eyes together although the official test is the 'number plate test' which has no exact equivalent.

[Myopia](#)

[Hypermetropia](#)

[Astigmatism](#)

[Keratoconus](#)

1 Minutes of the Secretary of State for Transport's Honorary Medical Advisory Panel on Driving and Visual Disorders meeting. 30th April 2002.

(Subheadings as below)

Myopia:

Visually significant myopia affects about 20% of the UK population although it is more common in the Jewish population and people of Far Eastern origin 2 and is becoming more prevalent. The condition is often inherited and in the majority of cases is due to axial enlargement of the globe, manifesting itself in childhood or adolescence with progressive deterioration until mid to late 20s. Subsequent deterioration and late onset myopia is usually much more gradual. In some, early acceleration may be related to excessive use of near vision in childhood and adolescence; prolonged near-vision activity is a common feature of studying in further education and in some occupations. The percentage of the population with varying degrees of visual acuity is shown in the table below.

	(unaided) %	% Population Population (aided)
6/12	93%	
6/10	90%	
6/9	87%	
6/6	65%	89%

Myopia above a correction of -4.00D carries a slightly increased risk of retinal detachment (due to the elongation of the globe), primary open angle glaucoma and cataract. The risks increase as the myopic prescription increases and above a correction of -10D there is also an a slightly increased risk of pigment dispersion syndrome, such as compromised night vision and keractasia and serious complications of refractive surgery 3 4.

Good visual function in safety critical occupations enables vision to remain functionally adequate for as long as possible in adverse environments where vision has been compromised. Such environments include low light levels or where smoke and glare interfere with image perception. Adding significant degrees of myopia (unaided visual acuity 6/12 or worse), significant astigmatism and severe hyperopia to this environment will significantly degrade the operational effectiveness of the individual. Consideration should also be given to the risk of loss or damage to aids to vision, and the impact this would have on safety.

Ninety percent of 20-year-olds achieve Group 1 driving standard unaided. With large numbers achieving such a high standard, there is no need to reduce visual standards for recruiting purposes alone. The problem with myopia is that it advances at different rates at different ages. The general pattern is a myopic shift of about 0.75D between ages 20-50 yrs followed by a hyperopic shift (~0.25D) thereafter. A

firefighter aged 20 who is borderline for unaided vision may therefore advance over the next 5-10 years whereas a 30 yr old with a borderline vision probably won't.

An example of a key distance vision task in firefighting could include the ability to identify a gas cylinder at a distance of 20 metres. Such standards would be required at the scene of a fire where the need to go closer to identify the object would endanger the firefighter. The situation also equates to casualty identification. It is recognised that those with 'perfect' vision who achieve 6/6 or higher will perform slightly better in this scenario.

Those responsible for making this decision should bear in mind that individuals who have developed mild myopia in early adulthood (18-22) perhaps corresponding to excessive close work while studying for higher education will be discriminated against if higher unaided vision standards are set. The result would be a significantly lower proportion of graduates recruited to the Service. It should, however, be noted that most of these late onset myopes will end up with -0.75 to -1.50D of myopia giving them an unaided binocular vision of 6/12 or worse.

An unaided distance vision of 6/9 will generally achieve an acceptable standard of casualty recognition in adverse conditions and is a reasonable level to set as the minimum requirement for safety critical work.

Individuals who fail to achieve an aided binocular visual acuity of 6/12 will probably fail to achieve the standard for Group 1 driving and may have other difficulties in the working environment. It is important to determine whether they are capable of undertaking the required tasks, with or without reasonable adjustments. Specialist advice may need to be sought, particularly if there is a requirement to use specialist software; there could be compatibility issues and other issues of capability for example with control room staff where additional time to undertake tasks may not be reasonable in this role.

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Hypermetropia:

Long sightedness or hypermetropia is more common than myopia and affects about 40% of 20-year-olds. The mode for refractive error in the population is about +0.25D. Most people with low grade hypermetropia are able to focus to correct for this by accommodating without the need for corrective lenses. Those with higher hypermetropia may also be able to focus for distance but by using some of their

accommodative reserve to overcome their hypermetropia, they may run out of focussing power for prolonged close work.

The measurement of near vision is a relatively new concept for the Service and derives from the requirement to read a BA set contents gauge at a distance of 33 cm. This equates to reading N12 letters at 33cm. Although it would be possible to alter the gauge to enable those with worse near vision to read it, there are a number of other tasks firefighters have to undertake, such as adjusting the frequency on their radio sets, reading a variety of instructions and checking equipment, where a higher standard of near vision acuity is required.

Measurement of a population of UK Firefighters demonstrated that 80% achieve a near vision acuity of N5 and only 3% had a near vision acuity at 33 cm of N14 or worse. The problem is compounded with age with the onset of presbyopia (difficulty focussing on close work with age due to loss of accommodation). Although individuals with hypermetropia may have sufficient accommodation to overcome their hypermetropia and focus for reading when young, they will require reading spectacles at an earlier age than average.

Difficulty with small type rarely develops before the age of 40 in individuals without refractive error, while a study showed that 60% of a population of fire fighters aged 38 were affected 5.

The 2002 entry standard of requiring the individual to read N12 at 30 cm is the absolute minimum standard for reading the BA set gauge yet no allowance for age related deterioration is made. The standards for hypermetropia are therefore more generous than the standards for myopia as there is a significant risk that a hyperopic 25-year-old who can accommodate and read N12 letters at 30 cm may be unable to use a BA set safely 12-15 years later without correction.

A more appropriate standard for near vision acuity on entry for those under 25 would be binocular N6 at 30 cm, to allow for some deterioration. N6 also equates to the standard required to read the dial on a radio set, enabling all firefighters to adjust their own radio frequencies without assistance 6.

5 Fireground Vision Research Unit. Aids to Vision on the Fireground p144. City University, London 1996.

6 Fireground Vision Research Unit. Aids to Vision on the Fireground p143. City University, London 1996.

Astigmatism:

Astigmatism affects 33% of the population and is corrected by the use of cylindrical lenses. Simple astigmatism occurs where the image from one plane falls correctly on the retina while the image in the opposite plane does not. Compound astigmatism is where neither foci falls on the retina and the refraction is either wholly myopic or wholly hypermetropic. Eye strain may occur with small uncorrected errors and blurred vision from larger errors. Those with compound astigmatism should be carefully assessed for capability, and particularly for a history of headaches and eye strain that could affect safety.

Keratoconus:

Keratoconus is a steeply curved and thinned cornea which adopts the shape of a cone due to corneal thinning. It is a progressive condition which leads to high degrees of myopia and astigmatism and is poorly corrected. During progression there is a requirement for regular alterations of lens prescription, and there are a number of serious potential complications including corneal rupture; these may be resolved by corneal grafting, and specialised contact lenses may help. Individuals with keratoconus are at high risk from trauma as well as from poor vision and should generally be considered unfit for firefighting duties.

New section for 2012

Refractive Surgery:

The cornea is responsible for two thirds of the refractive power of the eye, so minor changes to its structure can significantly affect visual function. Various surgical techniques have been available for the past thirty years or so to correct vision and avoid or reduce the requirement to use glasses or contact lenses. There have been considerable advances in technique including the now widespread use of lasers. The main risks involve aberrant visual function caused by scarring or irregular structural defects within the cornea and, rarely, weakening of the corneal structure.

Refractive surgery does not alter the underlying structure of the eye. Individuals who are at greater risk of eye pathology such as retinal detachment because of abnormal eye shape (high myopia) will remain at risk. In addition, in the past they would not have been selected for certain employments because of poor unaided vision. It is important to determine whether there are other risk factors in these individuals when advising on their overall fitness for employment in the Service.

An individual who has undergone correction for refractive error remains at risk of underlying pathologies such as cataract, glaucoma and retinal detachment. The greater the pre-operative refractive error, the greater is the risk of these diseases.

A significant amount of information is covered below, both to allow Medical Advisers to assess the risk to individuals who have already had one of the procedures, and to allow advice to be given to individuals and management on the predicted outcome. Individuals should also expect detailed advice from the ophthalmic surgeon on prognosis; the use of overseas 'cheap offers', where preliminary advice may not be available and the outcome may not be so predictable, is not advisable.

Different approaches include corneal incisions, surface procedures and flap procedures. A number of other procedures have been developed including lens implantation and phacoemulsification.

Significant progress has been made over the past thirty years in surgical techniques. Early procedures used multiple surgical incisions to weaken the cornea and allow it to flatten. This led to significant weakening and subsequent vulnerability to trauma, and although improvements in vision were achieved, aberrations in the cornea remained. The development of laser surgery allowed procedures to become much more accurate and limited damage to the most superficial part of the cornea. Further developments in computer assessment and computer guidance can enable the surgeon to correct aberrations and potentially give the patient better vision than they could achieve with glasses.

A number of potential risks and side effects are noted for all these procedures, and are outlined below, however these risks need to be considered in context. Most patients have a good outcome, and in most cases problems such as halos around lights at night are not too troublesome.

The Military Approach:

The US Army has introduced a major programme offering refractive surgery to all active duty Army personnel 7, on the basis that the advantage of not requiring corrective glasses outweighs the disadvantages from the procedures and leads to improved combat effectiveness. The procedure of choice for the US Army is PRK, with LASIK as an alternative. The risks in combat are significantly greater than risks likely to be experienced in operational firefighting, however LASIK disqualifies personnel from serving in specialist trades such as Rangers, Special Forces and HALO parachutists. Service personnel cannot deploy for a minimum of 3 months after PRK or 1 month after LASIK.

In the UK, radial keratotomy and astigmatic keratotomy are absolute bars to service, as are any invasive intraocular surgical procedures. PRK, LASEK, LASIK and intrastromal corneal rings are suitable for entry on a case by case basis for non-specialist employment groups subject to single Service requirements. Specific concern is expressed over those working in aviation, diving and airborne roles although any decision would be on an individual basis, and surgery is sometimes offered for pilots to help correct age-related changes particularly mild myopia.

7 US Army Warfighter Refractive Eye Surgery Program (WRESP)

Radial Keratotomy and Astigmatic Keratotomy:

These are invasive procedures which involve making incisions through 95% of the corneal layers leaving a central untreated area of 3-4mm in diameter (can be even smaller). The incisions weaken the periphery, causing it to bulge, resulting in a relative flattening of the central cornea and a reduction in myopia. Astigmatism can be treated by placing transverse incisions along just one of the principal meridians or arcuate incisions close to the limbus.

Permanent radial corneal scars are visible following this procedure and in a small number may overlap the pupil when dilated under low illumination. Side effects include misting and halos, particularly in the periphery and at night. Image distortion may also be due to irregular astigmatism that has not been corrected by this procedure.

In addition, because the surgical procedure disrupts so many of the corneal layers, the cornea is significantly weakened against blunt trauma. A serious but rare complication of radial keratotomy is a 2.2% risk of corneal rupture. One study reported three cases occurring more than ten years after RK **8**. Another study considered 28 eyes that had ruptured after RK and attributed seven cases to assault, four to sport injuries, five to car crashes and 12 to 'daily living' **9**.

The PERK study ran in the United States from 1980-1985 and studied the effects of RK on 793 eyes. The study found that 53% of eyes achieved 6/6 or better unaided at 6 months and 85% achieved 6/12 or better after 10 years **10**. The procedure is more accurate and reliable for lower degrees of myopia (62-84% of < -4.5D patients achieving emmetropia +/- 1 D). Only 38% of higher myopes (-4.50 to -8.00D) achieved emmetropia. Long-term stability of the result has been questioned following the detection of a drift towards hyperopia in 43% of eyes after ten years.

A common complication is a diurnal fluctuation in refractive error and hence visual acuity **11**. Along with other forms of refractive surgery, RK can cause a reduction in the quality of vision due to an increase in forward light scatter and corneal aberrations leading to reduced contrast sensitivity **12**. This is more marked in low lighting levels, leading to complaints of glare and problems with night vision. Radial keratotomy is hardly ever performed today because of the risk of rupture, the drift towards hypermetropia and advances in excimer laser technology. Ongoing glare disability is cited as the main reason for exclusion from work as flight deck air crew **13 14**.

8 Panda A, Sharma N, Kumar A. Ruptured globe 10 years after radial keratotomy. *Journal of Refractive Surgery* 1999;15:64-5.

9 Vinger PF, Mieler WF, Oestreicher JH, Easterbrook M. Ruptured globes following radial and hexagonal keratotomy surgery. *Archives Of Ophthalmology* 1996;114:129-34.

10 Waring GO, Lynn MJ, McDonnell PJ. Results of the Prospective Evaluation of Radial Keratotomy (PERK) study at ten years after surgery. Archives of Ophthalmology 1994;112:1298-308.

11 Bores LD, Myers W, Cowden J. Radial keratotomy: an analysis of the American experience. Annals of Ophthalmology 1981;13:941-8.

12 Applegate RA et al. Corneal aberrations and visual performance after radial keratotomy. Journal of Refractive Surgery 1998;14:397-407.

13 Corbe C et al. Aircrew fitness decisions and advances in refractive surgery techniques. German Journal of Ophthalmology 1993;2:146-9.

14 Enzenauer RW et al. Radial keratotomy in the soldier-aviator. Military Medicine 1993;158:521-8.

Surface Techniques:

Early surface techniques used a fine blade or keratome to remove layers from the cornea such as Automated Lamellar Keratoplasty (ALK). While in principle no different to laser techniques the development of the excimer laser gave the surgeon much more control. Minute layers of superficial corneal tissue are removed under computer control.

(Subheadings as below)

[Photorefractive Keratectomy \(PRK\)](#)

[Photo Astigmatic Refractive Keratectomy \(PARK\)](#)

[Hypermetropic PRK](#)

[Laser Epithelial Keratomileusis \(LASEK\) and EpiLASIK](#)

Photorefractive Keratectomy (PRK):

This was the original excimer laser refractive surgical technique and the preferred technique for military personnel. PRK can be used to treat myopia, astigmatism or hypermetropia. When treating myopia, more tissue must be removed from the centre of the cornea than the periphery to produce a flatter profile. The amount of tissue removed for low myopia is in the region of approximately 50µm - less than 10% of the overall corneal thickness. The treatment of astigmatism involves greater ablation of one principal meridian than the other. Hypermetropic treatments attempt to steepen the optically significant central cornea by producing a smoothly transitioned annular ablation in the stroma at the periphery of the 5-6mm central optical zone.

Vision remains poor for 3-6 days until the epithelium has healed over the treated area **15**. Unlike radial keratotomy, PRK involves treating the centre of the cornea therefore changes in corneal clarity are of concern. A sub-epithelial opacification referred to as 'haze' develops over the first 2-3 months but this subsides by

approximately 12 months **16 17**. This may not resolve completely in every case however, and traces of corneal haze can be seen many years after PRK.

As with radial keratotomy, PRK is more successful for lower degrees of myopia (<-6.00D), where 88-99% achieve uncorrected vision of 6/12 or better and 58-78% achieving 6/6 or better by 12 months **18 19**. For higher degrees of myopia (>-6.00D), 68-74% achieve 6/12 or better but only 26% obtain 6/6 at 12 months. Enhancement procedures can be performed but predictability is not as good as for the initial procedure. Regression (a gradual partial or complete return to the myopic state) is a common complication of PRK with 10-20% requesting a repeat PRK procedure. A deliberate overcorrection by 50% reduces the chance of further regression; however individuals with a regression beyond -3.50 dioptres and who have significant anterior stromal haze show a poor response to further treatment **20**. PRK is now restricted to the treatment of myopia up to about -4.00D.

15 McDonald MB et al. Central photorefractive keratectomy for myopia - partially sighted and normally sighted eyes. *Ophthalmology* 1991;98:1327-37

16 Gartry DS, Kerr Muir MG, Marshall J. (1992) Excimer laser photorefractive keratectomy: 18 month follow-up. *Ophthalmology* 1992;99:1209-19.

17 Gartry DS, Kerr Muir MG, Marshall J. The effect of topical corticosteroids on refraction and corneal haze following excimer laser treatment of myopia: An update. A prospective, randomised, double-masked study. *Eye* 1993;7:584-90.

18 Tuunanen TH, Tervo TT. Results of photorefractive keratectomy for low, moderate and high myopia. *Journal of Refractive Surgery* 1998;14:437-46.

19 McDonald MB et al. Photorefractive keratectomy for low-to-moderate myopia and astigmatism with a small-beam, tracker-directed excimer laser. *Ophthalmology* 1999;106:1481-8.

20 Gartry DS et al. Retreatment for significant regression after excimer laser photorefractive keratectomy. A prospective, randomized, masked trial. *Ophthalmology* 1998;105(1):131-41.

Photo Astigmatic Refractive Keratectomy (PARK):

PARK was developed after PRK and is used to treat astigmatism. The results are less accurate than those for myopic PRK since the axis alignment is critical and there are variations in meridional wound healing with greater regression occurring in the meridian of greater tissue loss **21**. Only a limited number of patients with high cylinder correction achieve 6/12 **22** and some patients are worsened by the technique **23**.

21 Shieh, E., Moreira, H., D'Arcy, J., Clapham, T.N., and McDonnell, P.J. (1992) Quantitative analysis of wound healing after cylindrical and spherical excimer laser ablations. *Ophthalmology* 99, 1050-1055.

22 Shah, S., Chatterjee, A., Doyle, S.J., and Bessant, D.A. (1997) Astigmatism induced by spherical photorefractive keratectomy corrections. *Ophthalmology* 104, 1317-1320.

23 Higa et al. (1997) PRK for the treatment of astigmatism and myopia between -1.00 and -19.00D. *Journal of Cataract and Refractive Surgery* 23,

Hypermetropic PRK:

Hypermetropic PRK is more predictable for lower refractive errors (<+3.50D) **24** however, stabilisation of the refractive error can take up to 12 months **25** and the risk of losing two or more lines of best-corrected visual acuity is greater than for myopic treatments **26**.

Post operatively, forward light scatter increases and peaks at around three months before returning to normal levels comparable to spectacle wearers by 12 months **27**. There is evidence to suggest that the distribution of light scatter around the retinal image is permanently modified by PRK, with an increase in the spread of stray light leading to a reduction in retinal image contrast **28**. Studies indicate that visual performance under low illumination when the pupil is dilated (and aberrations are greatest), may be compromised for a year or more, particularly for low contrast tasks and amongst high myopes **29**.

Unlike RK, diurnal variations in refractive error post-PRK are not clinically significant **30** and neither hyperbaric nor hypobaric conditions cause corneal deformation or a refractive shift **31**. Studies have indicated that ocular integrity is not significantly compromised following PRK **32**.

24 Daya SM, Tappouni FR, Habib NE. Photorefractive keratectomy for hyperopia - six months results in 45 eyes. *Ophthalmology* 1997;104:1952-8.

25 Coronas F et al. Photorefractive keratectomy for hyperopia: long-term nonlinear and vector analysis of refractive outcome. *Ophthalmology* 1999;106:1976-82.

26 Nagy ZZ et al. Photorefractive keratectomy for hyperopia in 800 eyes with the Meditec MEL 60 laser. *Journal of Refractive Surgery* 2001;17:525-33.

27 Miller WL, Schoessler JP. Comparison of forward and backward scattered light in pre and post-surgical photorefractive keratectomy. *Investigative Ophthalmology and Visual Science* 1995;36:S709 (Abstract)

28 Chisholm CM. Assessment of visual performance: comparison of normal subjects and post-refractive surgery patients. 2002. City University. Thesis/Dissertation.

29 Montes-Mico R, Charman WN. Mesopic contrast sensitivity function after excimer laser photorefractive keratectomy. *Journal of Refractive Surgery* 2002;18:9-13.

30 Goldberg MA, Dorr DA, Pepose JS. Lack of diurnal variation in vision, refraction, or keratometry after excimer laser photorefractive keratectomy. *American Journal Of Ophthalmology* 1997;123:407-8.

31 Hjortdal JO et al. Mechanical stability of the cornea after radial keratotomy and photorefractive keratectomy. *Journal of Refractive Surgery* 1996;12:459-66.

32 Galler EL et al. Ocular integrity after quantitated trauma following photorefractive keratectomy and automated lamellar keratectomy. *Investigative Ophthalmology & Visual Science* 1995;36:580 (Abstract)

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26 Nagy ZZ et al. Photorefractive keratectomy for hyperopia in 800 eyes with the Meditec MEL 60 laser. *Journal of Refractive Surgery* 2001;17:525-33.

27 Miller WL, Schoessler JP. Comparison of forward and backward scattered light in pre and post-surgical photorefractive keratectomy. *Investigative Ophthalmology and Visual Science* 1995;36:S709 (Abstract)

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32 Galler EL et al. Ocular integrity after quantitated trauma following photorefractive keratectomy and automated lamellar keratectomy. *Investigative Ophthalmology & Visual Science* 1995;36:580 (Abstract)

Laser Epithelial Keratomileusis (LASEK) and EpiLASIK:

LASEK is used for low myopia and hypermetropia, falling part way between PRK and LASIK. It involves the production of an epithelial flap using a solution of 20% alcohol which softens the attachment of the epithelium to the underlying corneal stroma allowing the epithelium to be moved in a continuous sheet to one side. The underlying anterior stroma is ablated, as in PRK, but the epithelial flap is then replaced, acting as a bandage lens to minimise post-surgical inflammation.

It is currently being used to treat low myopia, where it produces less haze than PRK and therefore better best-corrected visual acuity whilst it avoids the potential flap complications of LASIK. There is a rapid recovery of vision following LASEK; in one study of 222 eyes ranging from -1D to -11D, 98% achieved 6/12 unaided vision within two weeks of LASEK and 63% achieved 6/6 unaided vision at one year **33**. EpiLASIK is very similar but rarely used - the epithelium is removed using a keratome with a relatively blunt, plastic blade which causes less damage than alcohol.

LASEK appears to be safe since no eyes showed a reduction in best-corrected visual acuity despite the wide range of pre-operative myopia. Another study comparing LASEK with conventional PRK for the treatment of -3D to -6.5D reported significantly less corneal haze following LASEK although there was no significant difference at 3 months post-surgery **34**. Some surgeons prefer LASEK over PRK although others regard the corneal haze generated as unacceptable and the post-

operative pain (which can last around one week) can be difficult for patients to tolerate.

There appear to be no adverse effects from photoablation on the corneal endothelium, which controls the hydration of the cornea but one study detected prolonged biochemical changes in the crystalline lens of rabbit eyes amongst LASIK but not PRK treated eyes which may be the precursor to cataractogenic changes **35**. No increase in the incidence of cataract has yet occurred.

33 Claringbold TV. Laser-assisted subepithelial keratectomy for the correction of myopia. Journal of Cataract and Refractive Surgery 2002;28:18-22.

34 Lee JB et al. Comparison of laser epithelial keratomileusis and photorefractive keratectomy for low to moderate myopia. Journal of Cataract and Refractive Surgery 2002;27:565-570.

35 Costagliola C et al. ArF 193nm excimer laser corneal surgery and photo-oxidation stress in aqueous humor and lens of rabbit: one-month follow-up. Current Eye Research 1996;15:355-61.

Flap Techniques:

The disadvantage of flap techniques is that the flap never heals 100% and can potentially be displaced by trauma and can in turn lead to significant pathology.

There are three stages in a flap procedure, cutting the flap, ablating the underlying cornea, and replacing the flap. Wavefront technology can make the ablation process extremely accurate, however if the flap is not cut accurately the outcome may remain suboptimal. New techniques have recently been developed using a laser instead of a keratome to cut the flap and this may improve the overall outcome. The limiting factor in accuracy of refractive outcome remains variability in corneal healing.

(Subheadings as below)

[Wavefront Guided Laser Refractive Surgery \(customised ablation\)](#)

[Laser Assisted In-Situ Keratomileusis \(LASIK\)](#)

[Hypermetropic LASIK](#)

[Ocular Integrity](#)

[PAI-LASIK](#)

Wavefront Guided Laser Refractive Surgery (customised ablation):

Refractive errors as defined above (myopia, hypermetropia and astigmatism) account for approximately 95% of the blur we experience when not wearing our spectacles or contact lenses. The remaining 5% of the 'blur' or defocus is made up of

a variety of additional optical defects or aberrations. A Wavefront scanner measures these aberrations and the additional information obtained can then be used to program the excimer laser with the exact treatment required (a custom ablation treatment). The aim is to re-profile the cornea to exactly the correct contour to cancel all optical defects.

There are at least three different wavefront analysers in use. Sometimes called 'aberrometers', these can either measure aberrations as light enters the eye by looking at the image formed on the retina, or as light exits after reflection from the retina.

In theory at least, if all refractive error and all aberrations are eliminated the individual could expect to see better than ever before. This has led to the term 'Super Vision' in relation to this technology and is being sought by those with particularly demanding visual requirements. There are, however, many problems that can prevent this ideal outcome. Individual healing characteristics, pupil size, accuracy of alignment of the treatment area, and accuracy of the original measurements are just some problems.

Laser Assisted In-Situ Keratomileusis (LASIK):

LASIK was developed in the early 1990s. It involves the use of a microkeratome to cut a thin flap of superficial corneal tissue followed by ablation of the underlying stroma. The flap is then repositioned and is held in place by surface tension and strong osmotic forces until the epithelium heals over the peripheral annular wound margins. The aggressive wound healing that occurs following PRK is not seen post-LASIK because of limited disruption of the corneal epithelium and so haze production is minimized, allowing higher refractive errors to be corrected. Post-operatively, a C-shaped ring is visible, although this fades with time.

Retreatment following LASIK is possible and involves lifting the initial flap and re-ablating the stromal bed. The time course of corneal healing post-surgery means that the flap is more easily lifted in the first 12 months after the initial procedure. LASIK is now the most popular refractive surgery technique in both Europe and USA, accounting for in excess of 95% of all laser refractive techniques and in excess of 90% of refractive surgery in general.

The percentage of eyes achieving 6/12 vision or better has been quoted as 86-100% at 6 months post-LASIK for corrections of -8.00D or less **36**. The refraction tends to stabilise within 1-3 months and less than 2% of eyes treated for myopia <-6.00D lose two or more lines of best corrected visual acuity. Recovery is rapid, with most patients seeing well the following day and the majority returning to work within a few days. Most experienced LASIK surgeons will therefore treat both eyes at the same time.

36 Montes M et al. Laser in situ keratomileusis for myopia of -1.50 to -6.00 diopters. Journal of Refractive Surgery 1999;15:106-110.

Hypermetropic LASIK:

Hypermetropic LASIK has proved slightly more successful than hypermetropic PRK for the correction of low hypermetropia with 80% of eyes achieving 6/12 or better **37**. An unacceptably high percentage of patients treated for hypermetropia of greater than +4.00D lose two or more lines of best corrected acuity (7.3%) **38**.

The majority of surgeons restrict LASIK treatment to refractive errors between +4.00 and -10.00D due to the reduction in accuracy and increased risk of complications **39**. The vast majority of complications manifest within the first 6-8 weeks. Surgeon experience is a key factor in the initial outcome.

37 Condon P. LASIK for hypermetropia. Session 4. 1997. BEKLS conference proceeding.

38 Goker S, Er H, Kahvecioglu C. Laser in situ keratomileusis to correct hyperopia from +4.25 to +8.00 diopters. Journal of Refractive Surgery 1998;14:26-30

39 Puk DE, Probst LE, Holland EJ. Recurrent erosion after photorefractive keratectomy. Cornea 1996;15:277

Ocular Integrity:

There have been questions raised about the integrity of the globe post-LASIK, however, a study examining the integrity of the globe following a range of different refractive surgery procedures concluded that although LASIK eyes required slightly less energy to rupture than control eyes, the difference was not statistically significant **40 41**. Because the ablation takes place within the cornea, LASIK requires sufficient corneal thickness to prevent the ablation encroaching within 250µm of the endothelium. If this does occur there is a risk of keractasia - a rare but serious condition that may not present for a year or so post-surgery (mean of 1 year +/- 0.3) **42**. The induced corneal thinning leads to protrusion of the corneal tissue, severe irregularity and a reduction in visual performance. It is almost always associated with treatment for high myopia **43**.

The risk of the flap being dislodged is very low although there have been reports of flap damage as a result of focal trauma at 6 months. A good visual outcome was achieved on flap repositioning **44**.

40 Peacock LW et al. Ocular integrity after refractive procedures. Ophthalmology 1997;104:1079-83.

41 Galler EL et al. Ocular integrity after quantitated trauma following photorefractive keratectomy and automated lamellar keratectomy. Investigative Ophthalmology & Visual Science 1995;36:580 (Abstract)

42 Argento C et al. Corneal ectasia after laser in situ keratomileusis. Journal of Cataract and Refractive Surgery 2001;27:1440-8.

43 Joo CK, Kim TG. Corneal ectasia detected after laser in situ keratomileusis for correction of less than -12 diopters of myopia. Journal of Cataract and Refractive Surgery 2000;26:292-5.

44 Geggel HS, Coday MP. Late-onset traumatic laser in situ keratomileusis (LASIK) flap dehiscence. American Journal Of Ophthalmology 2001;13:505-6.

PAI-LASIK:

An alternative technique not yet available is to cut a flap and insert a plastic inlay, leaving the corneal stroma undamaged. This would avoid the problem of removing excess cornea particularly in high refractive error and allow for further procedures.

Alternative Techniques:

Intrastromal Rings (or Intracorneal Stromal Rings):

The curvature of the cornea can be modified to correct low levels of myopia (up to -5D) by inserting semi-circular Perspex rings into the corneal stroma. This technique was never very popular and is virtually obsolete.

Laser Thermokeratoplasty (LTK):

A diode laser (DLK) or heated probe is used to cause localized scarring and therefore contraction of stromal tissue in the midperipheral cornea. A ring of such 'burns' causes steepening of the central cornea and hence a reduction in low hyperopia (<+4D). This procedure received FDA approval as a temporary procedure but is rarely used now; the effects tend to wear off after 2-3 years.

Intraocular Refractive Surgery:

Although not commonly performed in commercial UK clinics, non-corneal refractive surgery is also available. Such intraocular surgery is generally reserved for higher refractive errors that cannot be treated safely with corneal surgery, as too much corneal tissue would have to be removed. Procedures include the insertion of an additional lens into the eye (Phakic IOL) or lens extraction with lens implantation. Intraocular surgery carries a slightly higher risk of infection than corneal procedures and other possible complications include secondary glaucoma, cataract, uveitis and retinal detachment.

A key factor of importance to recruitment is that corrected high myopes will still be at a slightly increased risk of conditions such as retinal detachment and glaucoma.

Phakic Intraocular Lenses (PIOL) or Implantable Contact Lenses:

An additional lens is placed inside the eye to modify the refractive power of the eye. Lenses are available for placement in the anterior chamber, attached to the iris (iris-clip lenses) or in the posterior chamber. Although the results are relatively predictable and the corneal shape is not modified (so aberrations do not increase), some individuals (particularly younger patients with large pupils) suffer from glare and halos at night due to the small optic zone. PIOL are reserved almost exclusively for the correction of high prescriptions ($>-10D$, or $>+4D$) in patients who cannot tolerate contact lenses.

Cataract Extraction and Clear Lens Extraction:

Individuals with cataract and very high myopes and hypermetropies can achieve a good refractive outcome by simply having their crystalline lens removed and replaced with an artificial lens. Removal of the crystalline lens obviously removes the patient's ability to accommodate and therefore focus for near without spectacles although this becomes irrelevant in patients over 50 years of age. However, multifocal implants are now available, although the quality of vision tends to be slightly reduced with such implants (reduced contrast sensitivity) due to the division of light between the distance and near foci, leading to night vision problems.

Presbyopia and Refractive Surgery:

In treating presbyopia, a number of refractive surgeons advocate monovision. The dominant eye is corrected to achieve a refractive error close to emmetropia and the non-dominant eye is left with a small myopic under correction, usually in the region of about $-1.25D$ or $-1.50D$. In a study of patients treated by PRK, all patients maintained binocular fusion and some degree of stereopsis but those who are most satisfied appear to be people with lower visual expectations. The implications of monovision for tasks such as rapid response driving have not been considered ⁴⁵ and may be a problem. Some clinics are now offering scleral expansion surgery for presbyopia. This is a dangerous and flawed procedure. Any effects are temporary, and complications are common and serious.

45 Goldberg DB. Laser in situ keratomileusis monovision. *Journal of Cataract and Refractive Surgery* 2001;27:1449-55.

Night Vision and Contrast Sensitivity Following Laser Surgery:

Any reduction in the clarity of the cornea or lens will result in a higher proportion of incident light being scattered within the eye. This stray light is superimposed over the retinal image thereby reducing its contrast because of forward scatter. A reduction in

the contrast of a high contrast object such as a letter on a Snellen chart will have limited impact but reducing the image contrast of a low contrast scene such as in the 'real-world' is likely to result in the image falling below the threshold for discrimination, i.e., the object will no longer be visible.

Night vision in the normal population is poor compared to vision under good illumination for a number of reasons. Firstly, the dark-adapted retina relies on the rod receptors, which have poor resolution; secondly, as the pupil dilates, aberrations from the more peripheral parts of the cornea increase by up to 30 times; thirdly the contrast of an object against the background tends to be much lower at night. In addition, the highly myopic retina is less sensitive at low light levels and this problem might be compounded by laser refractive surgery.

Many studies in the literature in the past reported a high incidence of night vision problems such as halos, starbursts and poor quality vision following laser surgery **46**. These problems were associated with high levels of haze causing scattered light, but nowadays haze is much less severe and generally only present for the first 2-3 months post-PRK because high myopes are not treated with PRK. LASIK causes little or no haze in the majority of cases and ablation zone diameters for both PRK and LASIK have increased from around 4 or 5mm up to 6 or 6.5mm, often in combination with 8mm 'blend zones' to minimize these halo or scatter effects, making them larger or the same size as the average pupil under low illumination.

Tests of contrast sensitivity that are quick and simple to use are the Pelli-Robson chart and the 10% contrast logMAR chart, but both test under brightly lit conditions. If night vision is critical to the job, specialist ophthalmic assessment is advised, which should include assessment under low illumination.

Comparing Procedures:

The US Army assessed those in the Warfighter Refractive Eye Surgery Program (WRESP) from 2000-2003 and found similar outcomes from PRK, LASIK and LASEK **47**.

46 O'Brart DPS et al. Night vision after excimer laser photorefractive keratectomy: haze and halos. *European Journal of Ophthalmology* 1994;4:43-51.

47 Hammond MD, Madigan WP Jr, Bower KS. Refractive surgery in the United States Army, 2000-2003. *Ophthalmology*. Feb 2005;112(2):184-90.

Assessment after Refractive Surgery

Personnel being considered following refractive surgery must have obtained a good result from the procedure (better than 6/12 uncorrected) if they are to operate without any restrictions in safety critical work or where lighting conditions may be less than optimal.

The following assessments should be performed on personnel who have undergone refractive surgery and who may be involved in safety critical work [48](#).

Pre-Op Correction	Post Operative					
	Uncorrected vision	Corrected visual acuity	Contrast Sensitivity	Corneal clarity	Night Vision	Stability
<-6.00D or <+4.00D	6/12 or better	6/9 or better in each eye	< 2 lines difference at 10% contrast from high contrast.	No central scarring or opacity seen on slit lamp exam.	No glare, halos or scatter.	<0.5 D change in 2 assessments six months apart

Medical Advisers may not be in a position to fully assess recruits or serving firefighters. This requires expert assessment and advice. A report should be requested from the treating ophthalmologist to include the following details:

Confirmation that the eye has returned to normal and that there is no significant loss of corneal transparency over the pupil area.

Confirmation that there is no keratectasia (a bulging forward of the cornea as is seen in keratoconus).

Details of their pre-operative refractive error and any complications that may have occurred during or following the procedure with confirmation that the post-operative corneal thickness does not put them at increased risk from indirect trauma or from rubbing the eyes.

Confirmation that they do not have significant sensitivity to scattered light and that they retain good low-light performance is also important but difficult to measure, so Medical Advisers will usually have to rely on the individual's history.

Entry for recruits should not be considered until 12 months post surgery to allow for stabilisation.

Serving firefighters can return to duty when sufficient healing has taken place and visual performance has stabilised. This will require liaison with the treating ophthalmologist and functional assessment including assessment in poor light conditions by the individual and line management.

Return after LASIK can be swift, as symptoms generally settle within 24 hours. There would be no obvious reason to delay return to duty if symptom free with confirmation

that their visual performance is acceptable, and a return to non-operational duties after three days can be expected. A return to operational duty may be possible after a week provided the individual has demonstrated adequate functional capability.

Return after LASEK and PRK requires time for re-epithelialisation which takes 3-7 days, and functional recovery which takes 3-10 days. Patients usually have light sensitivity for 7-10 days after surgery. Glare, halos and dry eyes are common in the first 2-3 months. Vision may continue to improve over several months. Firefighters can return to non-operational duties once epithelialisation is complete (when the bandage contact lens has been removed) but are unlikely to be operationally fit for at least a month and should not return to operational duty until they have demonstrated adequate functional capability. Possible trauma to the flap needs to be acknowledged, and appropriate eye protection worn. Particular care needs to be taken in dusty environments to avoid excessively rubbing the eyes.

48 Chisholm C in British Society for Refractive
Surgery: www.bsrs2000.fsnet.co.uk/new_page_13.htm

Colour Defects:

The processing of colour information begins at the level of the retina in the cones (concentrated at the macula), with further processing at higher levels of the retina and visual cortex. Good colour vision improves visual search times by a factor of two **49** and is a useful aid to identification in a visually degraded environment **50**. Defective colour vision may be inherited (affecting 8% of men and 0.5% of women), or acquired (as a result of ageing, systemic disease or drug toxicity), therefore periodic reviews are justified. The condition is rare in people of Japanese, Chinese or African origin and complete loss of colour sense, achromatopsia (true colour blindness), is extremely rare.

Most occupations do not require perfect colour vision, however there are many with a safety critical component where colour is used to differentiate safe from unsafe (e.g., electrical cabling, warning lights) and such occupations generally exclude all but the mildest colour defectives. The Health and Safety at Work Act 1974 demands that an individual must be safe at work for his own protection and that of others. Therefore, in a safety critical occupation such as firefighting, colour vision is essential.

(Subheadings as below)

[Types of Colour Defects](#)

[Acquired Colour Defects](#)

[Effect of Colour Deficiency](#)

[Colour Defect Screening](#)

[Standards for Colour Vision](#)

49 Christ RE. Review and analysis of colour coding research for visual displays. Human Factors 1975;17:542-70.

50 Markoff JI. Target recognition performance with chromatic and achromatic displays. SRM 1972;148:72.

Types of Colour Defect:

The types of colour defect derive their names from the Greek roots of the 3 primary colours:

Deficiency	Condition	Males	Females
Red (severe)	Protanopic Dichromatism (known as protanopia)	1%	0.01%
Red (mild to severe)	Protanomalous Trichromatism	1%	0.01%
Green (severe)	Deuteranopic Dichromatism (known as deuteranopia)	1%	0.01%
Green (mild to severe)	Deuteranomalous Trichromatism	5%	0.35%
Blue	Tritanopia and Tritanomalous trichromatism	Rare – usually acquired	
Colour Blind	Monochromatism	Exceedingly rare	

Dichromats are missing one of the three colour pigments whereas Trichromats have all three pigments, but one pigment has an abnormal spectral sensitivity. Protan and Deutan defects are referred to collectively as red/green colour deficiency because they lead to relatively similar colour confusions. As displayed in the above table, Deuteranomalous Trichromatism accounts for more than half of colour deficiencies in the population. With all congenital colour defects, there is a range of severity so that some anomalous trichromats have a severe colour deficiency so that their vision approaches that of a dichromat, whereas others have only a mild deficiency that leads to only occasional colour confusions (e.g., pastels but not saturated hues).

Acquired Colour Defects:

Acquired defects occur in many retinal and optic nerve conditions or as a result of systemic disease or drug toxicity:

- Macular degeneration
- Toxic Amblyopia (excessive use of alcohol or tobacco)
- Chronic Glaucoma
- Senile cataracts (reversible)
- Diabetic retinopathy
- Multiple Sclerosis

Effect of Colour Deficiency:

A colour defective individual cannot distinguish between as many colours as a colour normal individual; some colours will be confused. The range of colours they can distinguish depends on the severity of the defect; however, colours will only be confused if they have exactly the same luminance or brightness.

Red light is used as a warning light because it retains its colour at a distance when other colours appear colourless. Green is the next colour to be determined at distance and so is used as the opposite colour in the traffic light system (although it also contains some blue light as a concession to deuteranomalous trichromats).

Protanopic individuals lack red pigment and therefore colours around the red wavelength appear less bright than surrounding colours. This has implications for protanopes and severe protanomalous individuals in the workplace; a red warning sign may be overlooked, or a red warning light missed or reactions times to red may be greatly increased.

Protanopic individuals have recognition distances for red traffic lights that are 50-70% of the normal range which has the effect of doubling the safe stopping distance of a vehicle at a red traffic light **51**. Verriest was able to show that protanopes are twice as likely to be involved in rear end traffic collisions. Difficulty interpreting traffic lights was reported by 53% of protanopes, 44% of deuteranopes, 24% of protanomalous trichromats and 17% of deuteranomalous trichromats **52**.

In other situations, such as the identification of gas cylinder contents or the correct identification of coloured hoses, non-colour clues may be used to aid identification but these clues will be degraded in less than perfect visibility or where speed of action is required.

51 Verriest G, Naubauer O, Marre M, Uviljjs A. New investigations concerning the relationships between congenital colour vision defects and road traffic security. In Verriest G ed. Colour Vision Deficiencies. Bristol: Hilger 1980:331-42.

52 Steward KM, Cole BL. What do colour vision defectives say about everyday tasks? *Optom & Vision Sci.* 1989;5:288-95.

Colour Defect Screening:

Screening for colour defects is required to exclude applicants with very poor colour discrimination (dichromats and severe anomalous trichromats) from safety critical work whilst identifying those with potentially safe, milder degrees of anomalous trichromatism.

Vocational testing has little place in the pre-employment screen due to examiner error, poor standardisation of test conditions and the use of colour naming. In addition, for safety on the fireground, the range of colours, levels of illumination and range of background contrast make true vocational testing highly complex with poor levels of repetition.

Colour charts provide a quick and repeatable method of screening for defective colour vision. Ishihara, City University Colour Vision Test and the Hardy, Rand and Rittler (HRR) test are all popular types. The Ishihara appears to be the industry standard for initial screening as it is the strictest screening test available; it will only pass those with normal colour vision or with a very mild defect, but it does not test for tritan (blue) defects. The Ishihara and HRR exploit common colour confusions, whereas the City University test exploits colour matching.

All tests should be viewed under Standard Illuminant C (overcast daylight is a reasonable compromise but not tungsten or fluorescent lighting). Should an individual fail to correctly identify 2 or more plates (pass/fail criteria vary between occupations and misreading of certain plates by normals is not uncommon), a second test is required to identify severe from medium levels of colour deficiency.

The industry standard definitive test is the Farnsworth D15 test. This will be failed by dichromats and severe anomalous trichromats (whether protan, deutan or tritan) and therefore allows those with less severe colour defects to be selected.

Standards for Colour Vision:

Monochromatic persons will fail all colour tests but are generally easily identified as they usually have significant co-existing visual disability.

Individuals who fail the Ishihara test and fail the Farnsworth D15 test by making one or more colour confusions which cross the hue circle are likely to be dichromatic or have severe anomalous trichromatism and they are unsafe for safety critical work.

If an applicant fails Ishihara but makes no errors which cross the hue circle of the Farnsworth D15 test, they have either mild deuteranomalous trichromatism or protanomalous trichromatism. At this point they can be accepted for non-operational

roles but an occupational test is required for entry as a fire fighter because protanomalous trichromats may confuse blue-green hoses with black hoses and black oxygen cylinders with maroon acetylene ones as well as remaining insensitive to red warning lights **53**. Red/Green 'safe' deuteranomaly is five times more common than protanomaly, and so occupational testing is preferable to costly external specialist investigation with an anomaloscope.

Summary of standards:

Individuals with protanopia, deuteranopia, monochromatism and tritanopia/tritanomaly are unfit for service as a firefighter. Individuals with protanomaly rarely meet the required standards while deuteranomalous individuals should be safe for firefighting.

Whilst diagnosis of the defect is an important part of the assessment, subsequent confirmation of severity is essential to determine whether they are colour safe.

53 Margrain TH, Birch J, Owen CG. Colour Vision requirements for firefighters. *Occup Med (Lond)*. 1996;46(2):114-24.

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New as of 2012

Gastro-Intestinal

Gastro-Intestinal disease may have an adverse impact on an individual's career in the Service in terms of:

- Nutritional status
- Persistent or recurrent abdominal pain
- Risk of incapacity
- Risk of soiling
- Risk of haemorrhage

Many abdominal conditions are associated with an increased tendency to sickness absence and a heightened risk that a full career term will not be completed.

The assessment of every individual requires each of these areas to be reviewed with regard to knowledge of the severity of the disorder, its likely rate of progression and the characteristics of the proposed job. There may be profound health and safety concerns in relation to firefighters but relatively few concerns in other areas of the service.

Much of the text regarding incidence rates and prognosis has been taken from Section 14 of: Warrell, David, Cox, Timothy M, Firth, John D, Benz, Edward J. The Oxford Textbook of Medicine. 4th Ed. OUP, Oxford, Feb 2004.

[Irritable Bowel Syndrome](#)

[Inflammatory Bowel Disease](#)

Irritable Bowel Syndrome

Irritable Bowel Syndrome (IBS) is a syndrome of:

- abdominal pain that is relieved by defaecation and an associated change in frequency and/or stool consistency
- together with one or more of the following symptoms:
- altered ease of defaecation
- passage of mucus
- sensation of bloating

The condition is generally diagnosed by gastroenterologists according to the 'Rome II criteria' which require 12 weeks of symptoms in a 12 month period. They are a stricter version of previous criteria and some patients previously given the diagnosis may now be reclassified [1](#) [2](#). Milk products may exacerbate the condition but lactose intolerance is no commoner amongst IBS sufferers than in the general population (5%) [3](#). On the other hand, a British study found that 22% of IBS sufferers had co-

existing coeliac disease (coeliac disease affects less than 1% of the general population) [4](#).

Diagnosis tends to be made on the history and a few simple investigations to exclude alternative pathologies. Individuals would be expected to have rectal examination, faecal occult bloods, full blood count, erythrocyte sedimentation rate and C-reactive protein. There are a number of ‘alarm features’ that indicate alternative pathologies including [5](#):

Significant weight loss	Persistent diarrhoea	Family history of inflammatory bowel disease
Onset after 50 years	Tropical travel	Family history of bowel cancer
Intestinal obstruction	Malabsorption	Abdominal mass
Faecal occult blood	Overt rectal bleeding	Arthritis

Individuals with mild symptoms, no alarm features and who don’t meet the Rome II Criteria are considered to have some other functional enteric disorder. For those who meet the Rome II criteria but have alarm features, other pathologies including Crohn’s disease, ulcerative colitis and adenocarcinoma may need to be excluded.

One of the major features of IBS is the link between anxiety and exacerbation of the syndrome. There is convincing evidence that psychiatric disease and abnormal illness behaviour are more prevalent in patients with irritable bowel syndrome. Sufferers tend to have more than twice the average rate of sickness absence and GP attendance [6](#) [7](#) [8](#). The relationship between the psychological problem and any neuromuscular abnormality remains uncertain, although it is recognized that a heightened awareness of visceral sensation is a feature of affective disorders, particularly depression. To this end, tricyclic antidepressants can play a role in the management of IBS [9](#).

IBS affects about 15-25% of the population. Because it increases sickness absence and alters the perception of illness, and consequently changes illness related behaviour, there is a significant impact on the economy [10](#). Occupations most suited to someone with moderate to severe IBS possess characteristics which will promote the individual’s autonomy whilst protecting them from conflict or other stressful situations and allow for adequate rest. Work characteristics may therefore include routine work patterns, regular hours, uninterrupted sleep, protection from conflict or confrontation and roles where short term absences of little or no notice will have minimal effect on the workplace.

The shift patterns, work characteristics of fire fighters and control staff therefore may not be suited to someone diagnosed as suffering from IBS. Decisions on employment should be based on previous history of the illness in relation to employment and the severity of symptoms.

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Inflammatory Bowel Disease

Twelve to eighteen percent of people with IBD may have one or more family members affected. The link is strongest for Crohn's Disease where specific gene mutations have been identified. Therefore a family history of inflammatory bowel disease may indicate a predisposition to developing IBD [11](#).

[Crohn's Disease](#)

[Ulcerative Colitis](#)

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Crohn's Disease

Crohn's disease is a chronic inflammatory process of the small and large bowel consisting of ulceration, submucosal oedema, fibrosis, and mesenteric lymphadenopathy. It may affect any part of the alimentary tract, is usually interspersed with lengths of normal bowel (skip lesions) and in the majority of cases is confined to the terminal ileum.

The typical patient with Crohn's disease has recurrent episodes of abdominal colic preceding diarrhoea. Bleeding is unusual outside periods of active disease, however macrocytic or a mixed anaemia is common because the absorption of bile salts and Vitamin B12 is adversely affected. As the absorption of bile salts is affected, the absorption of fats and the fat soluble vitamins (A, D E and K) is also affected leading to significant malnutrition.

Age of initial presentation is usually between 20 and 40. Cause appears to be an interplay between genetic predisposition and environmental factors such as smoking (relative risk 6). The disease may be managed using salicylate derivatives but this is only beneficial when the colon is affected. It is of marginal benefit in small bowel disease. Active disease is generally managed using systemic steroids or elemental diets. Long term steroid dependency may warrant immunosuppressive agents such as Methotrexate or Azathioprine.

Crohn's disease is unpredictable. In a small minority, the disease appears to be short lived and resolves after a handful of attacks. In most, however, the disease is progressive over their lifetime but with periods of remission. Because the granulomatous inflammation affects the entire thickness of the intestinal mucosa, ulceration and fistulae often develop. At best these affect nutrition and at worst lead to severe disability. Even in relatively mild cases, the abdominal pain of an acute attack can last from several hours to several days and confine the person to bed. During an exacerbation, a rapid build up of stool may lead to a sudden and irresistible urge to defaecate, leading to soiling.

The most common complications of Crohn's disease are stenoses, dilatation, perforation, fistulae, intestinal obstruction, perianal fistulae and abscesses [12](#). Colonic Crohn's disease is associated with colonic adenocarcinoma in a similar way to ulcerative colitis although the incidence is 8-10% after 20 years. Ileal malignancy and amyloidosis are also seen but are less common. External fistulae are less common and usually only follow abdominal surgery.

About 75% of patients will receive surgical treatment during the course of their illness. After a resection, the symptoms recur in about 30 per cent of patients in the subsequent 5 years and in 50 per cent of patients by 10 years. Half will require further surgery. In general, mortality from Crohn's disease is twice that expected in the general population.

Considerable morbidity can be expected and this may translate into regular sickness absence. About 10% are forced to change careers, 23% of sufferers cannot undertake full time work and 10% are on long-term pensions [13](#). In general, Crohn's disease has a greater effect on employment than ulcerative colitis [14](#). Additionally, Crohn's disease has a similar association with psychological disturbance as irritable bowel syndrome and many sufferers display a predisposition to anxiety which then triggers an attack [7 8 9](#). Whilst this may be a long-term reaction to chronic pain, low dose anti-depressants with anxiolytic activity have been shown to improve the quality of life and reduce the frequency of severe relapses [10](#). Ideal working conditions for someone with Crohn's disease therefore reflect those for IBS: regular hours, autonomy, low stress and roles where 'cover' for sudden absence exists.

Individuals with Crohn's disease are therefore unlikely to be considered fit for firefighting, and should be considered carefully, with expert opinion being sought, before recommending employment in the control room. Any decision on employment should be delayed eighteen months to identify the outcome of treatment, or twelve months following surgery.

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Ulcerative Colitis

Unlike Crohn's disease, ulcerative colitis is confined to the large intestine. It always involves the rectum, extending proximally in a continuous band of inflammation and ulceration. 'Skip lesions' where normal mucosa interrupts patches of inflammation are not seen. About 40% of patients have disease confined to the rectum and sigmoid colon and 20% have disease affecting the entire colon. The typical presentation is of mucus ridden blood stained diarrhoea and in severe cases the stool resembles anchovy sauce. Abdominal pain is much less of a feature than with Crohn's disease or IBS, however urgency to defaecate is a greater problem because of the loss of elasticity of the inflamed rectum and its proximity to the anus.

Because involvement of the terminal ileum is unlikely, fat absorption is generally normal and so malnutrition and extreme weight loss are unusual except in severe disease. In long standing severe disease the colon becomes shortened and featureless. Strictures are uncommon – unlike Crohn's disease. Disease classification is as follows:

Mild < 4 stools daily, +/- blood, no systemic disturbance and a normal ESR

Severe > 6 stools daily, + bleeding, systemic illness with fever, tachycardia and anaemia.

Raised ESR and C-reactive protein.

There are several concerns regarding ulcerative colitis. The onset of an attack is characterised by a disabling bloody diarrhoea which often carries little warning. As a result it interferes with mobility and leads to sickness absence. The risk of haemorrhage is greater in ulcerative colitis than in Crohn's and a severe attack may cause collapse and warrant hospitalisation, although this is unusual after the first year. Long term ulcerative colitis carries with it a risk of adenocarcinoma in 7-15% of cases at 20 years with very little risk up to the 15 year point.

Extra-intestinal effects of ulcerative colitis include:

- Erythema nodosum in 2% of patients
- Pyoderma gangrenosum in 2%
- Anterior uveitis in 8% of patients

An asymmetric large joint arthropathy in 10-15% of ulcerative colitis sufferers and sacro-ileitis in 12-15%. It has only a weak association with HLA B27 and rarely progresses to ankylosing spondylitis.

Treatment of mild disease is dependant on salicylate derivatives which reduce the incidence of relapses fourfold. Steroid enemas have more use in ulcerative colitis than Crohn's and many people with ulcerative colitis can remain well controlled on relatively low doses of topically applied steroid. Most patients with ulcerative colitis have intermittent attacks of the disease, but the duration of remission between attacks varies from a few weeks to many years and 10-15% of patients will have a chronic continuous course and rarely achieve a full remission. Few, if any, have one attack and no relapse.

Between 5 and 10% will have a severe first attack due to extensive or total disease and they are much more likely to proceed to colectomy. The severity of attacks in the first year of the disease is a good prognostic indicator and about 25% of people with severe disease require urgent colectomy at some time. Most will have an ileal pouch fashioned and this will require emptying 6-12 times a day. The incidence of pouchitis is 40%.

However, a year after diagnosis, the risk of subsequent colectomy falls to a cumulative rate of about 1% per year in all groups of the disease. Patients with disease limited to the rectum (proctitis) are a special group, in so far as most of them continue to have limited involvement, and only about 30% develop more extensive disease over 20 years. Despite having a chronic relapsing disease, 90% of ulcerative colitis sufferers are able to work with surprisingly little sickness absence. Nevertheless, quality of life can be impaired in many patients and rapid access to toilet facilities may prove to limit employability.

While individuals with mild disease may be fit to serve as firefighters, individuals with moderate to severe disease are unlikely to be able to cope. As with Crohn's disease, a period of eighteen months should be allowed before making a firm decision on employment to allow for the disease process to stabilize. Those who have had a good outcome from surgery may be considered fit after allowing twelve months to stabilize.

Dialysis

Chronic kidney disease can eventually lead to renal failure which untreated is fatal. Renal function is normally measured as the glomerular filtration rate, GFR, which is the volume of fluid filtered by the renal capillaries into the Bowman's capsule per minute, adjusted for body surface area. Normal GFR for an adult is 90ml/min per 1.73m². If nephrons are damaged the initial response is hypertrophy of remaining nephrons with hyperfiltration, so any reduction in GFR is likely to represent significant pathological changes in the kidneys.

Renal disease is staged from 1-5. Stages 3-5 are based on GFR and stages 1-2 require persistent proteinuria, albuminuria, haematuria or structural abnormalities as well as reduced GFR.

Stage 1	Kidney damage with normal or increased GFR	GFR >90ml/min/1.73m ²
Stage 2	Kidney damage with mild reduction in GFR	GFR 60-89ml/min/1.73m ²
Stage 3	Moderate reduction in GFR	GFR 30-59ml/min/1.73m ²
Stage 4	Severe reduction in GFR	GFR 15-29ml/min/1.73m ²
Stage 5	Kidney failure	GFR <15ml/min/1.73m ²

Clinical signs and symptoms do not normally appear until GFR is less than 30ml/min/1.73m² and kidney failure is usually defined as a GFR of less than 15ml/min/1.73m². The manifestations are related to the direct effects of an inability to control potassium, sodium, phosphates, sulphates and organic anions leading to hyperkalaemia and metabolic acidosis, and the indirect effects of metabolic acidosis on protein production, erythropoiesis and bone metabolism leading to loss of muscle, anaemia and bone disease.

Damage to the nephrons can be due to autoimmune disorders causing glomerulonephritis, vascular disorders causing local nephron death due to partial or total obstruction of blood flow, direct damage to nephrons from drugs, infection, toxins and immune responses, or urinary tract obstruction. While these are not directly relevant to the issues of dialysis in firefighters, the causes or treatments may be of significance. Renal failure is a common complication of diabetes and hypertension, and may well therefore be associated with other complications of these conditions, and in the case of diabetes there may be issues related to the condition itself.

As the GFR drops below 30ml/min/1.73m² a firefighter is likely to find it increasingly difficult to cope with the physical demands of operational firefighting, primarily because of fatigue.

In 2005 there were 41,776 adults on renal replacement therapy, a prevalence of 694 per million adults [15](#). A large primary care study suggested an age standardised prevalence of stage 3-5 chronic kidney disease of 8.5%, 10.6% female and 5.8% male [16](#). The prevalence will be proportionally greater with age, with substantially smaller numbers below the age of 55 although the standardised prevalence is probably reached between ages 55 and 60. It is therefore likely that significant numbers of older firefighters will have chronic kidney disease although this number could be reduced substantially if all older firefighters remained physically fit and

adopted healthy lifestyles to reduce the prevalence of diseases causing kidney disease.

The only current treatment for end stage renal disease is dialysis or renal transplant. The two options for dialysis, peritoneal and haemodialysis are both effective for long-term management of renal failure but have inevitable consequences for those in employment. It is appropriate in the context of firefighting to consider dialysis as a method of supporting the individual until renal transplantation, with adjustments to support dialysis until the individual is able to return to normal activity after transplantation. These adjustments may be required for several years.

The choice of dialysis method depends more on the individual's lifestyle. There is little good evidence to distinguish between the methods on cost or medical grounds. All have implications for employment. NICE recommended peritoneal dialysis over haemodialysis for patients with residual renal function and adults without significant associated comorbidities. Undernutrition is a frequent finding in people with established renal failure while weight gain and worsening lipid profiles is common after starting peritoneal dialysis [17](#).

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17 NICE Clinical Guideline 125 - Peritoneal dialysis. National Institute of Clinical Excellence. London July 2011.

Peritoneal Dialysis

Peritoneal dialysis has been used successfully for fifty years. The principle is very simple. A large quantity of fluid is placed in the peritoneal cavity and the concentration of various solutes reaches an equilibrium between the peritoneal fluid and the body fluids, using the peritoneal membrane as a semi-permeable membrane. The solutes move across a simple concentration gradient and water moves by osmosis. The fluid (dialysate) is made up to a specific concentration of various solutes to manage the transfer appropriately. Solute such as glucose are added to ensure none is lost from the blood to the dialysate, as are calcium and acetate or lactate. The lack of urea, creatinine and potassium ensures that these ions pass into the dialysate and can then be removed. A hypertonic dialysate will ensure that water moves across to the dialysate to maintain fluid balance.

A soft Tenckhoff indwelling catheter is placed through the anterior abdominal wall into the pelvic area. Dialysate can then be added and removed through this catheter. Dialysate can either be left within the peritoneal cavity throughout the day, with regular exchanges (continuous ambulatory peritoneal dialysis, CAPD) or the

exchange can be undertaken automatically overnight (automated peritoneal dialysis, APD).

Peritoneal dialysis is usually the first dialysis method adopted as renal function falls, and can be tailored to the degree of residual renal function. NICE found that there was no difference in health-related quality of life between CAPD and APD. There was very low quality evidence to show that adults on APD reported significantly more time for work, family and social activities than those on CAPD, with less physical and emotional discomfort with APD but more sleep problems with APD. A Cochrane review made similar findings [18](#).

Continuous Ambulatory Peritoneal Dialysis, CAPD

In CAPD the patient has 1.5-3l of fluid present in the abdominal cavity continuously apart from times of exchange which are generally undertaken three to five times a day when renal function has reached minimal levels.

Complications of CAPD

The main and most serious complication of CAPD is peritonitis. Current rates of peritonitis are around one episode every three patient-years and antibiotic treatment alone may be sufficient. If not, the treatment is removal of catheter, antibiotics and haemodialysis for four to six weeks. Care must be taken to ensure the sterility of the exchange process, so anyone having to change bags at work must have a suitable location to undertake this. Advice is usually provided by the renal team who can visit the workplace and assess suitable locations. Firefighters are unlikely to find a suitable location away from the station and this will limit the duration of any operational deployment.

Complications of CAPD within thirty days

The catheter may become obstructed early due to adhesions or the omentum, the catheter may be kinked or obstructed by fibrin or clots. The catheter can be cleared by forceful irrigation, insertion of a stiff wire under fluoroscopy, or by laparoscopy. Dialysate leakage may occur around the catheter site, or in association with a hernia. Trauma may affect the catheter entry site or damage the catheter itself.

Late Complications of CAPD

Constipation may affect the flow of dialysate around the pelvis, particularly outflow failure and treatment with laxatives generally resolves this. Dialysate can rarely leak out of the peritoneal cavity into the thoracic cavity causing an iatrogenic pleural effusion, or down a patent processus vaginalis into the scrotum. In long-term dialysis the peritoneal membrane may become damaged and fail, leading to decreased ion exchange and reduced ultrafiltration.

Hernias are a significant risk both around the catheter site and related to increased peritoneal fluid. Patients are therefore often advised against heavy lifting.

Sclerosing peritonitis may occur with thickening of the peritoneal membrane leading to adhesions and strictures with recurrent bowel obstruction. This is a potentially fatal condition and peritoneal dialysis is not usually sustainable afterwards.

Automated Peritoneal Dialysis, APD

The principle of APD is the same as CAPD, however the process is automated by a cyclor machine that pumps warmed dialysate into the peritoneal cavity, leaves it a set period then pumps it out and replaces it again, repeating this process several times over a period usually of nine hours. This is most conveniently undertaken overnight. The machines are portable, enabling overnight dialysis away from home.

18 Rabindranath KS et al. Continuous ambulatory peritoneal dialysis versus automated peritoneal dialysis for end-stage renal disease. Cochrane Database Syst Rev. 2007;(2):CD006515.

Haemodialysis

Haemodialysis is usually considered as the definitive treatment for renal failure until a transplant is available. It is more reliable than peritoneal dialysis, and has fewer complications. The practical impact on the patient may be greater particularly if it is only available in a hospital environment. NICE found that home dialysis had a number of advantages including long-term costs and convenience, but this depended on the patient coping with the machinery [19](#).

The principle is the same as peritoneal dialysis, although an artificial semipermeable membrane is provided outside the body and blood is pumped over this while dialysate flows countercurrent to the blood. A blood flow of around 200ml per minute is required, and this is best provided from an arteriovenous fistula. Usually created in the non-dominant forearm, this is either created directly or using artificial materials to link artery and vein. The resulting pressure in the vein 'arterialises' the vein leading to dilation and thickening of the vein wall enabling a large-bore cannula to be readily placed for high blood flow. Patients usually require three sessions a week of around four hours each.

The main complication is fistula failure or graft malfunction with thrombosis. Percutaneous angioplasty, thrombolysis and thrombectomy have replaced surgical procedures over the past few decades. Fistulas last on average three years without complications, less than 15% remain patent for the duration of haemodialysis with an expected duration of around seven years. The risk of thrombosis is increased substantially with venous stasis, so pressure around the fistula from tight clothing or proximal pressure from a blood pressure cuff should be avoided.

If a fistula cannot be created or is malfunctioning, tunnelled, cuffed catheters may be used short-term. There are significant problems of infection and thrombosis with catheters.

Haemodialysis can be delivered in a hospital environment or at home if the patient is able to manage the equipment and it is available. Home dialysis is generally much more convenient for the patient, and more compatible with employment.

19 Technology Appraisal Guidance No. 48. Guidance on home compared with hospital haemodialysis for patients with end-stage renal failure. National Institute for Clinical Excellence. London Sep 2002.

Is operational firefighting compatible with dialysis?

No studies were found that specifically reported on firefighters working operationally while undergoing dialysis. This suggests that those requiring dialysis are not physically capable of maintaining the workload of operational firefighting safely and effectively.

Fitness for Work [20](#) states that haemodialysis and peritoneal dialysis are contraindicated in firefighting. The main reasons are the heavy manual handling, high energy demands over extended hours and work in a hot environment. Firefighters progressing to end stage renal disease may cope for a period of time as they start on dialysis, however once they require full dialysis treatment they would be expected to redeploy to a non-operational role while awaiting renal transplant.

Individuals are more likely to remain in employment while progressing to dialysis if they have erythropoietin treatment for anaemia [21](#).

A Swedish study of 33 patients aged 30-81 found maximal grip strength was 70%, ability to heel-lift was 49% and walking speed was 85% of the reference and overall physical activity was 56% expected in patients on peritoneal dialysis [22](#).

A Dutch study of 659 patients on dialysis for a year found that at the start of the study 35% were employed compared to 61% of the general population. Within one year the proportion of employed patients decreased from 31% to 25% of haemodialysis patients and from 48% to 40% of peritoneal dialysis patients. In patients who were working at the start of dialysis, independent risk factors for loss of work within one year were impaired physical and psychosocial functioning [23](#). An Irish study of 114 patients of whom 49 were on haemodialysis and 35 were on peritoneal dialysis found that a pre-morbid physical occupation predicted unemployment and age, female sex and musculoskeletal disease were independent predictors of poor physical function [24](#). Several other studies have made similar findings.

The availability of late shift haemodialysis, availability of dialysis training, provision of frequent haemodialysis and vocational rehabilitation was associated with higher employment rates [25](#).

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New Section for 2012

Stomas

A firefighter may have an ileostomy, colostomy or urostomy. Intestinal stomas are usually created in the colon or distal ileum, and in firefighters most are for inflammatory bowel disease, trauma or malignancy. Urostomies are usually needed following malignancy or trauma.

There are three distinct issues with stoma formation:

The practical issues of managing a stoma

The psychological impact of having a stoma

The underlying pathology

There is very little statistical evidence in relation to stoma patients at work. This section is intended to provide information and guidance in the absence of evidence.

Where a stoma is created because of malignancy there may be residual disease with a poor prognosis and treatment with chemotherapy or radiotherapy, and this is likely to have a substantial impact on the ability to cope with operational firefighting.

Stomas created for trauma may be temporary, and a full recovery can be anticipated. It may be more practicable to redeploy a firefighter with a temporary stoma while he recovers from the primary condition.

Apart from co-morbidities, there is no absolute reason why an individual cannot work effectively as an operational firefighter with a stoma.

Useful literature can be found on the following websites:

www.colostomyassociation.org.uk/

www.iasupport.org

www.uagbi.org

Stoma Site

Ideally a stoma should be away from the umbilicus, bony prominences, puckered scars and skin creases, although trauma or previous surgery may affect the location. It is normally placed below the waist band, within the rectus muscle to ensure support for the stoma. The appliance should ideally be capable of remaining in situ with a good seal for several days.

Stoma Type

There are different surgical techniques required for stoma creation for example depending whether a stoma is temporary or permanent, but in practice the main issues are the site of the stoma and the management of the stoma.

Pouches

Pouches or covers are worn with all stomas, and have to be worn at all times because of lack of output control. Output is not continuous; colostomies generally fill once or twice a day and the pouch may only need emptying or changing once a day. The pouch normally fills shortly after a meal, so activity can be predicted. The process of pouch changing is not a sterile procedure. It is more practical to empty the pouch when the stoma is quiescent rather than active.

There are various types and designs of pouch, and the patient will choose the most appropriate for them. Most allow for an appliance adhering to the skin which is left in place for a few days to a week. Some bags are drainable, while others have a bag which separates from a base plate allowing for easy changing.

Irrigation

Some colostomates with a low colonic stoma are able to stimulate emptying by flushing the stoma with around a litre of warm water, so pouches are not needed and a colostomy plug or small pouch can be used instead. This enables the individual to be more active and avoids problems associated with pouch filling and pouch vulnerability.

Many can only achieve good control by irrigating at the same time daily or every other day; this could be difficult to manage with shiftwork. The procedure generally takes 45-60 minutes and would normally be undertaken at home, not in the workplace.

Ballooning

Pouches have a filter to enable wind to escape, but this does not always function and the pouch may balloon out. The only sensible way to manage a ballooning pouch is to change it. Many factors predispose to wind, and there is plenty of advice available on how to minimise the risk.

Parastomal Hernia

A parastomal hernia may develop where abdominal muscles are weak. They are common, the Colostomy Association state that up to 70% of those with a colostomy may eventually develop a hernia, but not all are symptomatic. There is no evidence that regular exercise and heavy manual handling are more likely to cause parastomal herniae in individuals who are fit and muscular, but individuals who have lost abdominal musculature, particularly those who are overweight or obese, may need to regain fitness before attempting heavy physical activity. Wearing a support belt may substantially reduce the risk of developing a parastomal hernia when undertaking heavy manual handling.

Continent Ileostomy

Some individuals have a 'continent ileostomy' where an internal pouch similar to a J-pouch is formed from the ileum and a valve is implanted in the skin to control flow out. This is unusual in UK. The pouch is then emptied through a catheter. Around one in three patients may have at least one episode of 'pouchitis' where the pouch endothelium becomes inflamed and requires antibiotic treatment.

Urostomy

A urostomy is in practice no different to any other stoma. Bowel is used as the conduit for urine, so the stoma will look identical to an ileostomy, and bag systems are used to collect urine, either two-piece with a detachable bag, or a one-piece bag. Bags have a valve to allow emptying as they become full. The stoma site should be protected when undertaking heavy lifting or manual handling, using a suitable belt or girdle.

Returning to Full Activity

Firefighters should be expected to return to full activity. The stoma site will need time to heal, generally four to six weeks before returning to light activity and eight to twelve weeks before resuming heavy manual activity. The firefighter will have to learn to manage the stoma, but six to eight weeks should be sufficient time although it is important to allow individuals time to come to terms with their stoma. Some may be very open about their stoma, and very relaxed about managing it, while others may find the process very difficult to cope with.

Appropriate support for the stoma site may be required before undertaking heavy physical activity. If a support is not used there are risks such as prolapse and hernia, and protection may be needed to avoid direct trauma to the stoma site. There is no clear evidence that a support has to be worn, and it may be uncomfortable to wear under all the other firefighting equipment.

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Hearing

Most occupational physicians who are concerned about hearing are mostly concerned about noise induced hearing loss. Many of the standards related to hearing are primarily aimed at identifying those who might be vulnerable to hearing damage from noise.

Noise is an issue for firefighters, but hearing capability is also an issue. A firefighter who cannot hear a radio or shouted commands in an emergency represents a substantial risk to themselves and to colleagues. It is therefore important to ensure that all firefighters have sufficient hearing to be safe and effective. 'Sufficient hearing' is not, however, just a measure of pure tone hearing thresholds, it is a measure of the ability of the firefighter to interpret sounds. Ideally a standard of hearing would be identified below which a firefighter would be considered unsafe, and therefore unfit, for operational firefighting and this could be used as the standard for all recruitment and retention.

Setting a standard for this capability has proved to be particularly difficult. Pure tone audiometry is simple and reliable because it can be standardised across all Fire Services, but audiometry alone has poor sensitivity and specificity when compared with hearing capability. It is, however, the most reliable objective measurement of hearing currently available. A new test has been developed by London Fire Brigade in order to address the difficulties with pure tone audiometry as the only standard, and this will be considered in this section.

[Reduction in Hearing Ability during Employment](#)

[Hearing Requirements in the Service](#)

[Selection of Appropriate Standards for Hearing](#)

[Summary of Hearing Standards](#)

[Investigating Hearing Loss](#)

[Tinnitus](#)

Reduction in Hearing Ability during Employment:

Hearing capability decreases with age. Individuals may therefore meet employment standards when young but fall below them after a number of years in employment. This decrease is unpredictable between individuals, and the noise exposure of firefighters is both variable and unpredictable. Although Management will do their best to ensure firefighters are protected from noise, the emergency nature of the task will at times expose individuals to events such as explosions that could not have been foreseen and cannot be protected against.

It is not therefore possible to apply a fair or reasonable standard that allows for a degree of age-related hearing loss.

Hearing Requirements in the Service:

Active firefighters must not only communicate over the radio, but they must respond to shouted warnings, audible alarms and cries for help – all above the environmental noise at the incident. In addition, they may be exposed to noise in the form of explosions, cutting or vibrating equipment and sirens reaching 109 dB(A) for periods of a minute or so 1.

Control room staff must also be able to communicate clearly and effectively in difficult circumstances.

While it may be possible to provide aids to hearing that are compatible with communications equipment, the safety and effectiveness of control room staff must not allow disability issues to lower standards. Any reasonable adjustment must enable control room staff to be fully functional.

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Selection of Appropriate Standards using Pure Tone Audiometry:

The point at which an individual's hearing may interfere with their function in a safety critical area can be taken as the point at which loss of perception of the speech frequencies becomes symptomatic and interferes with normal life. This is known as the Low Fence Value and is an average of the hearing thresholds over the speech frequencies 1, 2 and 3 kHz. A 30 dB HL LFV is widely accepted as the onset of disability 2. In the medico-legal context, such a three-frequency average hearing loss in each ear would be expected to produce 18% speech-hearing disability 3.

Standards that sum the low frequencies (LF: 500 Hz, 1 kHz, 2 kHz) and the high frequencies (HF: 3 kHz, 4 kHz, 6 kHz) are used in the military PULHHEEMS standards. The military standards are generous enough to enable recruitment despite quite marked hearing loss or alternatively they allow for quite marked deterioration of hearing before any change in medical grade is made. This may be appropriate for the military where roles vary widely but is less appropriate for the Fire Service where it is important to both maximise recruitment opportunity and minimise noise damage to hearing.

The approach recommended in the past has been to split the military "H2" grade (45-83 dB HL [LF] and 45-123 dB HL [HF]) so that a middle grade exists which corresponds with asymptomatic non disabling hearing loss. Recruitment and placement in safety critical areas is possible at this level without significantly affecting safety on the fireground.

In addition, greater emphasis was placed on auditory function at 1, 2 and 3 kHz as this reflects the bulk of frequencies found in normal speech and therefore radio

communications. They can also be accurately measured using bone conduction should specialist referral become necessary.

It is said that individuals who have been employed as aircrew regularly using communications equipment learn to adapt and maintain their capability in the presence of significant hearing loss. Therefore, while new Service applicants may fail to meet the capability standard because of a degree of hearing loss, serving firefighters and control room staff may maintain their capability in the presence of a greater degree of hearing loss. It may therefore appropriate to deny recruitment at a standard where serving personnel are permitted to continue in employment.

Three separate measures should be recorded from the basic data:

The sum of LF thresholds (0.5, 1 and 2 kHz)

The sum of HF thresholds (3, 4 and 6 kHz)

The sum of the Speech Frequency thresholds (1, 2, 3 kHz).

	500 Hz	1 kHz	2 kHz	SUM	3 kHz	4 kHz	6 kHz	SUM	8 KHz
Left									
Left Speech									

Right									
Right Speech									

Using this table, each individual can be assigned a hearing risk score – both at the time of recruitment and on subsequent reviews.

The following summative measures are used to assign an overall score for each ear. The worse ear is used to grade the individual in their placement within the Service:

	LF Sum	HF Sum	Speech Sum
H1	≤ 45 dB HL	≤ 45 dB HL	≤ 35 dB HL
H2	≤ 60 dB HL	≤ 80 dB HL	≤ 60 dB HL (no value > 25 dB HL)
H3	≤ 80 dB HL	≤ 120 dB HL	≤ 90 dB HL (no value > 40 dB HL)
H4	< 120 dB HL	≤ 150 dB HL	≤ 120 dB HL
H5	> 120 dB HL	> 150 dB HL	> 120 dB HL

Using the H1 criteria for recruitment purposes will allow 70% of the male population aged 18-30 years to be considered for safety critical roles. Relaxing these standards slightly to the H2 level would mean a larger population base can be considered for full-time or retained firefighter training without affecting fireground safety.

2 Robinson DW, Wilkins PA, Thyer NJ, Lawes JF. Auditory impairment and the onset of disability and handicap in noise induced hearing loss. ISVR Technical Report no. 126 Southampton, University of Southampton, 1984.

3 King PF, Coles RRA, Lutman ME, Robinson DW. Assessment of hearing disability: Guidelines for medicolegal practice. London: Whurr Publishers. See Table A2.

Summary of Standards using Pure Tone Audiometry:

Applicants for firefighting or control room work who meet the H2 standard should be considered fit for role. Applicants who score lower than H2 may meet alternative capability standards and it is a matter for individual Fire and Rescue Services to decide whether to apply alternative capability standards. Applicants who fail to meet H3 are more likely to have their active firefighting career curtailed early as a result of progressive hearing loss. Applicants scoring lower than H3 with significant signs of noise-related hearing loss need to have a risk assessment in relation to future noise exposure (see below) as well as a capability assessment.

Serving personnel who drop below H3 should have a capability assessment before any decisions are made on redeployment or retirement.

Control room staff who drop below H3 should be reviewed by a specialist, and possible adjustments to headsets considered to maintain capability. Where it is not possible to improve hearing sufficiently with reasonable adjustments, redeployment or retirement will be necessary.

Whilst referral through the individual's GP maintains normal medical protocols, it is unusual for such referrals to take precedence over other NHS activities. Brigade funds may have to be released in order to fund specialist referral in a timely fashion, especially if restricted duties or a medical suspension is involved.

The London Fire Brigade Functional Hearing Test (FHT):

Using the pure tone tests alone, as above, has raised difficulties. A number of firefighters who score in the H3 category and lower have been found to be capable of functioning effectively as firefighters. Some fail the audiometry test by a substantial margin but appear fully capable in their role. This applies to some, but not

all, firefighters who score below H2. A functional hearing test (FHT) has been developed by QinetiQ ⁴ for London Fire Brigade (LFB).

The test involves listening to a number of word lists through a headset in different environments. The number of words correctly identified correlates with the ability of the test subject to function safely and effectively in that environment. The two standardised environments selected were:

Pump and engine noise at the command post

Combined fire roar, water spray and alarm noise with speech through a BA mask

Word lists were constructed from standard word lists used in experimental settings and specialised firefighting words and phrases which were agreed with LFB. The result is a combination of familiar operational words and unfamiliar random rhyming words, intended to represent the situation where unexpected commands are transmitted. The combination is considered to be representative of the wide range of communications expected on the fireground.

The voices were recorded from four test subjects: male and female speakers with a neutral accent, a male London accent and a male London Afro-Caribbean accent. The nature of speech in an operational environment means that in practice the difference in accents was only evident for a small number of words.

The FHT was standardised against sufficient firefighters across the spectrum of hearing to be able to compare results in the FHT against audiometry results. Some firefighters with good audiometric results achieved poor scores on FHT, while some firefighters with very low audiometric scores achieved high FHT scores.

The development of the test demonstrated that audiometric tests are poor predictors of speech communication performance. The development went on to produce an automated computer-based test to ensure optimum objectivity in testing. The test can be run on a normal PC with high quality headphones. There is a short initial test to familiarise the subject, followed by a longer series of tests to provide a full score. The test takes approximately one hour in total to perform, substantially longer than a routine audiogram.

Using the Functional Hearing Test:

While the FHT appears to be a more appropriate functional test of capability, it remains a surrogate test as there are inevitably other factors that will influence capability and performance particularly including visual and other clues. London Fire Brigade are not therefore using the FHT as the sole test until and unless it can be proved completely reliable.

London Fire Brigade currently use the FHT as an additional test for individuals who have scored below H2 on standard audiometric testing. Subject scores are assessed against standardised scores for FHT against audiometry. Those whose FHT score

equates to the top 95% of subjects scoring H2 and above are considered to have functional hearing. It is accepted that 5% of those who score H2 and above will fail the FHT but still be considered fit for firefighting. This also means that some individuals may fail audiometry but score better on FHT than others who pass audiometry.

There is, however, no linear relationship between scores on audiometry and scores on FHT so the comparison cannot be direct. If a 100% standard is set, some individuals would pass with very poor audiometry scores, and it is currently felt that a suitable margin of error is needed to ensure safety is maintained.

The test as currently used does represent an opportunity to retain firefighters who remain functionally capable in spite of poor performance in audiometry. It would be best to regard it as a test still in development. The test can be purchased direct from LFB.

4 DERA/AS/SID/CR010143/1.0 unpublished research paper, currently commercial in confidence.

Investigating Hearing Loss:

Consideration of Noise-Induced Hearing Loss (NIHL) centres on a threshold 'notch' at 4 kHz with a positive history of excessive noise exposure. However, this is not a prescriptive definition. If the criteria [5](#) below are met, the hearing loss should merit specialist referral.

Criteria For Noise – Induced Hearing Loss

It is always sensorineural, affecting the hair cells in the inner ear.

It is almost always bilateral and is usually symmetrical.

The earliest damage to the inner ear occurs at 4 kHz and is seen as a characteristic 'notch' on the audiogram. Over time, this may deepen and 'widen' as 3 kHz and 6 kHz become affected.

High-frequency losses may reach 75 dB and are always greater than low frequency losses (500 Hz, 1 kHz and 2 kHz) which may reach 40 dB. It rarely produces a profound hearing loss.

Once the exposure to noise is discontinued, there is no significant further progression of the hearing loss.

Previous NIHL does not make the ear more sensitive to future noise exposure. Given stable exposure conditions, high-frequency losses usually reach their maximum level in about 10 to 15 years. Further loss is minimal and slow.

Diagnosis is based on consistently raised auditory thresholds of the characteristic pattern, in association with a positive history for noise exposure.

Tympanometric impedance testing should be performed by competent occupational health staff, in response to an unexpected low-frequency hearing loss. If the history suggests an upper respiratory tract infection and the tympanometry supports this, re-testing should be conducted once the symptoms have resolved.

5 Kirchner DB et al. [ACOEM Task Force on Occupational Hearing Loss. Occupational noise-induced hearing loss](#). JOEM 2012; 54(1): 106-8.

Tinnitus:

Tinnitus is a 'sound' which is audible to the individual but has no external origin; this may be termed subjective tinnitus. Tinnitus is, in the majority of cases, a transient non-intrusive perception. 8% of the population experience tinnitus causing moderate to severe annoyance but only 0.5% experience tinnitus which is of such severity as to effect their ability to lead a normal life.

Tinnitus may be associated with all pathologies giving rise to hearing loss, as well as a number of neurological and general medical conditions. Unfortunately, there are no diagnostic tests which indicate severity of the tinnitus, or even its existence. The vast majority of people who experience tinnitus do not complain about it. However, any persistent tinnitus associated with noise exposure may require a firefighter to be protected from further exposure, to minimise the possibility of the sensation becoming worse. A number of reports have confirmed that the intrusiveness is correlated with psychological factors. Severe intrusive tinnitus warrants detailed ontological investigation. Before any decisions are made on redeployment or retirement, an opinion should be sought from a psychologist with particular expertise in this field.

References:

- 1 Tubbs RL. Occupational Noise Exposure and Hearing Loss in Fire Fighters assigned to airport Fire Stations. Am Ind Hyg Assoc J. 1991; 52(9): 372-8.
- 2 Robinson DW, Wilkins PA, Thyer NJ, Lawes JF. Auditory impairment and the onset of disability and handicap in noise induced hearing loss. ISVR Technical Report no. 126 Southampton, University of Southampton, 1984.
- 3 King PF, Coles RRA, Lutman ME, Robinson DW. Assessment of hearing disability: Guidelines for medicolegal practice. London: Whurr Publishers. See Table A2.
- 4 DERA/AS/SID/CR010143/1.0 unpublished research paper, currently commercial in confidence.
- 5 Kirchner DB et al. [ACOEM Task Force on Occupational Hearing Loss. Occupational noise-induced hearing loss](#). JOEM 2012; 54(1): 106-8.

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Mental Health

Mental ill health in one form or another is extremely common in the UK adult population. In many cases its effects are transient and effectively treated by drug or psychological therapies. In other cases, features are longer lasting or recurring and are more likely to present a permanent barrier to safe service as an operational firefighter. Features which are likely to be most problematical and of greatest concern to medical advisers are altered behaviours which may be unsafe and unpredictable, and altered concentration, cognition and reaction time which may give rise to increased errors and risk to safety. These latter features may result from the condition itself and from its treatment.

Disease classification is particularly important in psychiatry, as a tool for diagnosis, and an aid to treatment and research. The WHO has sponsored an international disease classification process, the International Classification of Diseases, now in its tenth version (ICD10) [1](#). In parallel the United States developed its own Diagnostic and Statistical Manual of Mental Disorders, now in its fourth version (DSMIV) [2](#). Initially developed for different reasons, these classifications are now much more similar in their latest versions. Although in UK the ICD10 classifications are generally used, they are not ideal in some areas where the DSMIV classification is preferred.

In this chapter, where possible, each condition or group of conditions has been given systematic consideration with ICD10 definitions and categorisations (where relevant), features causing problems for firefighting, prevalence rates (where available), treatment and prognosis. DSMIV is used occasionally where this is more relevant.

This guide is not intended as a substitute for a good general psychiatric reference and the Oxford Textbook of Psychiatry by Michael Gelder et al [3](#) is recommended as a readable text. This text also includes a full explanation of the differences in classifications and reasons behind them.

Assessment of Fitness

Psychiatric disorders can lead to sudden onset risks to safety of both the individual and others. This is unusual and in most cases the problem is one of capability while the individual is symptomatic. While the risk to health and safety should lead to a careful consideration of fitness for initial employment, the longer-term capability issue should be carefully balanced against the requirements of the Disability Discrimination Act 1995.

Where the issue is a question of 'reasonable adjustment' the decision on employment must be a managerial one, particularly when long periods of sickness absence would have to be tolerated and/or issues of behaviour or capability would have to be considered. It is much easier to make decisions when the individual is already in employment, is known to management, and at least some of their past psychiatric history is familiar. It is much more difficult to assess recruits, and in

general a decision to employ an individual with a significant psychiatric history should only be made with the benefit of a detailed psychiatric report from a specialist, and where appropriate a detailed psychological assessment.

The assessment of early retirement of serving firefighters depends on a judgement of permanent incapacity. Redeployment may become an alternative, however it is important to distinguish between the different physical demands of different roles as opposed to the mental pressures that may remain while employed by with the Fire Service.

1 World Health Organization. The ICD-10 classification of mental and behavioural disorders-clinical descriptions and diagnostic guidelines. World Health Organization, Geneva 1992.

2 American Psychiatric Association. Diagnostic and statistical manual of mental disorders (4th edn). American Psychiatric Association, Washington, DC. 1994.

3 Gelder M, Gath D, Mayou R, Cowen P. Oxford Textbook of Psychiatry 3rd Edition, Oxford: Oxford University Press, 1996.

New section for 2012

Personality Disorders:

Personality disorders are controversial, with many suggesting they are a social concept rather than a disease. Individuals exist on a personality spectrum, and any definition of what is good, bad, reasonable or unreasonable is determined by social and cultural norms, situations and expectations. Any attempt to measure and classify 'personality' will be fraught with subjectivity, bias and the inherent negativity associated with the words 'personality disorder'.

Personality disorders are probably best described as enduring behaviour patterns that consistently and substantially deviate from social expectations. They may or may not be considered problematic by the individual, but they should be extreme or significant deviations from the cultural norm for the individual, be present from early adolescence and be evident in multiple domains.

Any epidemiological study of personality can only be relative to that society and culture, although there is considerable concordance in studies within various Western societies. Arguably society even in the UK is subdivided so what is deviant in one group may be the norm in another. It is also important to differentiate between personality traits, which make us individual, and personality disorder. Personality disorders are traits which are sufficiently extreme and persistent to cause significant distress and difficulties with social functioning and performance. Many personality traits may be seen as desirable and positive in specific circumstances and roles; some degree of obsessiveness is good in someone whose role is to check for faults or follow safety protocols while someone with emotional coldness may cope better when exposed to certain types of trauma.

There is increasing acceptance that personality disorders exist on a spectrum, making categorical diagnosis difficult. One study attempting to measure severity of personality disorders assessed 8391 individuals in UK against the DSM-IV and ICD-10 criteria and found only 23% had 'no personality pathology'. They found that an increase in severity was associated with younger age, childhood institutional care, expulsion from school, contacts with the criminal justice system, economic inactivity, more psychiatric co-morbidity and greater medical service contact. Significant handicap was noted among people with even low levels of personality pathology 4. The results of this and other similar studies have led to calls for new classifications of personality to include measures of severity in any personality disorders diagnosed.

Despite the difficulties associated with classifying personality disorders, they remain an important clinical entity. Individuals with personality disorder are more likely to be unemployed, have increased rates of long-term sickness absence, higher rates of offending and increased mortality.

DSM-IV usefully divides the ten defined personality disorders into 'clusters' (see below), cluster A are the 'odd or eccentric' types, cluster B are the 'dramatic, emotional or erratic' types and cluster C are the 'anxious-fearful' type. The prognosis and treatment for these clusters differs significantly.

Epidemiological studies show between 4 and 12% of the population have formally diagnosed personality disorder. A study of 626 persons aged 16-74 against DSM-IV criteria in the UK found a weighted prevalence of 4.4% 5. A study of 2053 individuals in Oslo, Norway against DSM-III-R criteria found a prevalence of 13.4%, with paranoid (2.4%), histrionic (2.0%), avoidant (5.0%) and obsessive-compulsive (2.0%) being the most common diagnoses 6. A study of 21,162 people across 13 countries found a prevalence of 6.1%, with higher levels amongst males, previously married, unemployed and the young and poorly educated 7. Rates of specific disorders can also vary greatly amongst different groups. For example, it is estimated that amongst the UK general population only 0.3% (0.6% men, 0.1% women) of adults have antisocial personality disorder, although amongst male prisoners the estimate rate is close to 60% 8. The DSM-IV subtypes also have different prevalence across the sexes, with schizoid evenly split, antisocial personality disorder three times more common in men, obsessive-compulsive personality disorder twice as common in men and borderline personality disorder three times more common in women.

Firefighters who succeed through the recruitment system are unlikely to have severe personality disorder, but a substantial number may have specific personality traits, and these could develop to the point where they have a severe impact on employability. Every Fire and Rescue Service will have a number of individuals expressing significant symptoms of one or more personality disorders to the point where they interfere with their occupational activities and may well lead to termination of contract. Psychiatric co-morbidity is common, and the personality disorder may either compound, or be misdiagnosed as, depression, anxiety and

PTSD. Specific personality traits may also become more prominent in an individual dealing with stressful situations or suffering from a depressive disorder.

Psychiatrists and particularly GPs are reluctant to acknowledge the diagnosis of personality disorder. This is partly because of the perceived negativity of the term and also represents the difficulty of making a diagnosis without detailed knowledge of the patient. Patients on the other hand usually accept the diagnosis as it allows them to understand their situation better and to appreciate and respond to treatments appropriate to the condition. The difficulty persuading the medical profession to recognise the problem as a diagnosis rather than a value judgement has been recognised, and it is hoped that the availability of treatments with an evidence base may help expose the problem without misunderstanding and with the offer of treatment **9**.

NICE have recently published guidance for treating those with borderline personality disorder **10** and antisocial personality disorder **11**.

4 Yang M, Coid J, Tyrer P. Personality pathology recorded by severity: national survey. *Br J Psychiatry*. 2010;197(3):193-9.

5 Coid J et al. Prevalence and correlates of personality disorder in Great Britain. *Br J Psychiatry*. 2006;188:423-41.

6 Torgerson S, Kringlen E and Cramer V. The prevalence of personality disorders in a community sample. *Arch Gen Psychiatry*. 2001;58:590-6.

7 Huang Y et al. DSM-IV personality disorders in the WHO World Mental Health Surveys. *Br J Psychiatry*. 2009;195:46-53.

8 McManus S et al. Adult psychiatric morbidity in England, 2007: results of a household survey. NHS Information Centre for Health and Social Care. Leeds. 2009.

9 Tyrer P. Personality disorder and public health. *Clin Med*. 2008;8(4):423-7

10 National Collaborating Centre for Mental Health. Borderline personality disorder: The NICE guideline on treatment and management. National Clinical Practice Guideline Number 78. The British Psychological Society and The Royal College of Psychiatrists. London. 2009.

11 National Collaborating Centre for Mental Health. Antisocial personality disorder: The NICE guideline on treatment and management. National Clinical Practice Guideline Number 77. The British Psychological Society and The Royal College of Psychiatrists. London. 2010.

DSM-IV General Diagnostic Criteria for a Personality Disorder **12:**

DSM-IV defines a personality disorder as an enduring pattern of inner experience and behaviour that deviates markedly from the expectations of the individual's culture. There ten subdivisions in three clusters, and these are listed in detail in the

publication. Unfortunately they cannot be included here for copyright reasons, however there are many websites that list them in full including the one which [this link](#) takes you to.

DSM-IV-TR personality disorders:

- Cluster A: (odd, eccentric) Paranoid, Schizoid, Schizotypal
- Cluster B: (dramatic, emotional) Antisocial, Borderline, Histrionic, Narcissistic
- Cluster C: (anxious, fearful) Avoidant, Dependent, Obsessive-Compulsive

Other personality disorders: depressive, passive-aggressive, self-defeating

Some of these are covered by the links below (click on the DSM-IV tab):

[301.0 Paranoid Personality Disorder](#)

[301.20 Schizoid Personality Disorder](#)

[Antisocial Personality Disorder](#)

[Borderline Personality Disorder](#)

[Obsessive-compulsive Personality Disorder](#)

12 American Psychiatric Association. Diagnostic and statistical manual of mental disorders (Revised 4th ed.). 2000. Washington, DC.

ICD-10 Diagnostic Criteria for a Personality Disorder 13:

ICD-10 categorises adult personality disorders as a variety of clinically significant conditions and behaviour patterns which tend to be persistent and are the expression of an individual's characteristic lifestyle and mode of relating to self and others. Some emerge early in the course of individual development, as a result of both constitutional factors and social experience, while others are acquired later in life.

Codes F60-62 are specific personality disorders, mixed and other personality disorders, and enduring personality changes. These are deeply ingrained and enduring behaviour patterns, manifesting themselves as inflexible responses to a broad range of personal and social situations. They represent either extreme or significant deviations from the way the average individual in a given culture perceives, thinks, feels, and particularly relates to others. Such behaviour patterns tend to be stable and to encompass multiple domains of behaviour and psychological functioning. They are frequently, but not always, associated with various degrees of subjective distress and problems in social functioning and performance.

Specific personality disorders are listed as:

- F60.0 Paranoid
- F60.1 Schizoid
- F60.2 Dissocial
- F60.3 Emotionally Unstable
 - .30 Impulsive type
 - .31 Borderline type
- F60.4 Histrionic
- F60.5 Anankastic
- F60.6 Anxious [avoidant]
- F60.7 Dependent
- F60.8 Other Specific
- F60.9 Personality Disorder, Unspecified
- Some of these are outlined further below:
- F60.0 Paranoid Personality Disorder

Personality disorder characterized by:

- excessive sensitiveness to setbacks and rebuffs.
- tendency to bear grudges persistently, e.g., refusal to forgive insults and injuries or slights.
- suspiciousness and a pervasive tendency to distort experience by misconstruing the neutral or friendly actions of others as hostile or contemptuous.
- a combative and tenacious sense of personal rights out of keeping with the actual situation.
- recurrent suspicions, without justification, regarding sexual fidelity of spouse or sexual partner.
- tendency to experience excessive self-importance, manifest in a persistent self-referential attitude.
- preoccupation with unsubstantiated "conspiratorial" explanations of events both immediate to the patient and in the world at large.

F60.1 Schizoid Personality Disorder:

Personality disorder meeting the following description:

- few, if any, activities, provide pleasure.
- emotional coldness, detachment or flattened affectivity.
- limited capacity to express either warm, tender feelings or anger towards others.
- apparent indifference to either praise or criticism
- little interest in having sexual experiences with another person (taking into account age);

- almost invariable preference for solitary activities.
- excessive preoccupation with fantasy and introspection.
- lack of close friends or confiding relationships (or having only one) and of desire for such relationships.
- marked insensitivity to prevailing social norms and conventions.

F60.2 Dissocial Personality Disorder:

Personality disorder, usually coming to attention because of a gross disparity between behaviour and the prevailing social norms, and characterized by:

- callous unconcern for the feelings of others
- gross and persistent attitude of irresponsibility and disregard for social norms, rules and obligations
- incapacity to maintain enduring relationships, though having no difficulty in establishing them.
- very low tolerance to frustration and a low threshold for discharge of aggression, including violence.
- incapacity to experience guilt or to profit from experience, particularly punishment.
- marked proneness to blame others, or to offer plausible rationalizations, for the behaviour that has brought the patient into conflict with society.

There may also be persistent irritability as an associated feature. Conduct disorder during childhood and adolescence, though not invariably present, may further support the diagnosis.

Includes: amoral, antisocial, asocial, psychopathic, and sociopathic personality (disorder)
Excludes: conduct disorders (F91.-) emotionally unstable personality disorder (F60.3)

F60.3 Emotionally Unstable Personality Disorder:

A personality disorder in which there is a marked tendency to act impulsively without consideration of the consequences, together with affective instability. The ability to plan ahead may be minimal, and outbursts of intense anger may often lead to violence or "behavioural explosions"; these are easily precipitated when impulsive acts are criticized or thwarted by others. Two variants of this personality disorder are specified, and both share this general theme of impulsiveness and lack of self-control.

F60.30 Impulsive Type:

The predominant characteristics are emotional instability and lack of impulse control. Outbursts of violence or threatening behaviour are common, particularly in response to criticism by others.

Includes: explosive and aggressive personality (disorder)

Excludes: dissocial personality disorder (F60.2)

F60.31 Borderline Type:

Several of the characteristics of emotional instability are present; in addition, the patient's own self-image, aims, and internal preferences (including sexual) are often unclear or disturbed. There are usually chronic feelings of emptiness. A liability to become involved in intense and unstable relationships may cause repeated emotional crises and may be associated with excessive efforts to avoid abandonment and a series of suicidal threats or acts of self-harm (although these may occur without obvious precipitants).

F60.5 Anankastic Personality Disorder:

Personality disorder characterized by:

- feelings of excessive doubt and caution
- preoccupation with details, rules, lists, order, organization or schedule
- perfectionism that interferes with task completion
- excessive conscientiousness, scrupulousness, and undue preoccupation with productivity to the exclusion of pleasure and interpersonal relationships
- excessive pedantry and adherence to social conventions
- rigidity and stubbornness
- unreasonable insistence by the patient that others submit to exactly his or her way of doing things, or unreasonable reluctance to allow others to do things
- intrusion of insistent and unwelcome thoughts or impulses

Includes: compulsive and obsessional personality (disorder), obsessive-compulsive personality disorder

Excludes: obsessive-compulsive disorder (F42.-)

13 World Health Organisation. ICD 10 - International Classification of Diseases and health related problems: tenth revision. 2004. Geneva.

Diagnosing Personality Disorders in Firefighters:

Medical Advisers should have a low threshold of suspicion when considering personality disorder in firefighters, particularly when considering referrals for behavioural or management issues that are recurrent or exceptional. Someone

complaining of stress due to unreasonable behaviour of others, who has done so in the past when in different roles and situations may have aspects of paranoid personality disorder. Someone who has a history of unstable relationships outside work, alcohol abuse and self-harm may have borderline personality disorder. On the other hand, if several firefighters complain about one manager who is particularly callous and difficult to please, aggressive and blames others, the manager in question may have aspects of dissocial personality disorder.

It is important to identify these traits in order to focus treatment in the most appropriate way. An open discussion about behaviour should be considered, in a non-confrontational way, to explore the firefighter's understanding about their own behaviour, their relationships with others and how others might perceive their behaviour. Where a co-morbidity is suspected, the same discussion may help identify a more appropriate diagnosis and may explain why current treatments have been unsuccessful.

While it can be useful to explore personality and behaviour, any firm diagnosis should be left to a clinician with appropriate expertise. It may well be appropriate to write to the treating clinician and suggest the possibility of a personality disorder with reasons. Specialist diagnostic testing is usually based on detailed clinical examination, ideally with the aid of collateral history, but may involve use of diagnostic tools and psychological testing.

Because of frequent co-morbidity with other psychiatric disorders and the subjective nature of many of the diagnostic criteria, there is often some disagreement around the diagnosis of personality disorder. It can also be unhelpful to take an 'all or nothing' view of diagnosis, when individuals exist on a spectrum of symptoms and severity. Many will have mild symptoms of a specific personality trait while few will have severe symptoms constituting the disorder, but many may benefit from some treatment.

Employability in Personality Disorder:

Some features of personality disorder have a direct negative impact on employability.

A study of 60 young people with borderline personality found high levels of impulsivity associated with poor vocational outcome at 12 months **14**.

A review of 151,618 employees in Finland found the relative risk of early retirement for patients with personality disorders was 2.3 to 3.5-fold **15** compared to those with anxiety, and 1.1 to 1.7-fold compared to depression.

In many cases where employees develop chronic symptoms related to work, personality disorder, or more mild levels of dysfunctional personality traits may be strongly associated with both their symptoms and their future employability. The associated features probably explain why so many patients seen in occupational

medicine clinics are 'difficult', showing dissatisfaction and sometimes aggression, impulsive behaviour, persistent difficulties with a range of management and colleagues, and a failure of recovery that does not conform to any underlying pathology.

Personality disorders appear to be more common amongst those seeking compensation for work-related injuries, and who fail to rehabilitate and fail to return to work as well as those having greater interpersonal difficulties, more perceived job stress, impairment in role functioning and disability. However some of these associations have not been found consistently and the role of some personality traits in predicting occupational dysfunction remains uncertain **16**. This suggests there may be other factors affecting the relationship between personality disorder and work, and one study showed that neuroticism, a feature of most personality disorders, features strongly in impairment of work functioning independent of psychiatric diagnosis, along with a more external locus of control and lower self-esteem **17**.

Examples of studies showing a link are outlined below.

A review of 26 workers compensation claimants with 'stress' found that of those who stated stress was precipitated by interpersonal issues, 79% met the criteria for a personality disorder **18**.

A review of employees absent with chronic back pain found a significant association between duration of absence and the presence of a personality disorder **19**. Personality disorder has been associated with earlier age of chronic employment disability **20**. Borderline personality disorder was found to be a predictor for poor return to work in work-related upper extremity chronic pain **21**. In 36 injured workers with compensation claims, a third had personality disorders and these had a poorer outcome from vocational rehabilitation and poorer health **22**.

Higher levels of sickness absence in Australians were associated with borderline personality disorder **23**. People with borderline personality disorder found employment circumstances particularly stressful and difficult to cope with **24**.

Antisocial behaviour was more likely to predict unemployment **25**.

Much of the research looks at associations rather than at ways to improve employability. In many cases simply concluding that a diagnosis of personality disorder is likely or identifying important personality traits can be helpful. This may enable Medical Advisers to direct efforts at addressing psychosocial issues. While there is evidence that aspects of personality disorders are inherent, some aspects are acquired, and are therefore amenable to change.

In many cases individuals 'behave badly' not only because of a predisposition, but because they can. If it is made clear to them that they cannot, or sanctions may be applied, their behaviour often rapidly modifies. While this may not apply to those with severe personality disorders, those on the mild part of the spectrum (and some studies suggest this could apply to the majority of the population) will respond when

told clearly what they can expect as a result of their behaviour. Persuading the individual that change might be beneficial is an important start point, and in many cases a combination of 'carrot and stick' can be successful.

In cases where the main problem is high sickness absence the disciplinary process alone can have a major impact, while suggesting that higher sickness should be tolerated as an adjustment under the Equality Act may be counterproductive. Achieving the right balance here is not easy, and management need to have a clear understanding of what approach may help given the specific personality traits involved and how best to tackle the issue.

14 Sio IT et al. The relationship between impulsivity and vocational outcome in outpatient youth with borderline personality features. *Early Interv Psychiatry*. 2011;5(3):249-53.

15 Korkeila J et al. Early retirement from work among employees with a diagnosis of personality disorder compared to anxious and depressive disorders. *Eur Psychiatry*. 2011;26(1):18-22.

16 Sansone RA, Sansone LA. Personality dysfunction and employment dysfunction. *Psychiatry (Egmont)*. 2010;7(3):12-16.

17 Michon HW et al. Mental disorders and personality traits as determinants of impaired work functioning. *Psychol Med*. 2008;38(11):1627-37.

18 Eliashof BA, Streltzer J. The role of 'stress' in worker's compensation stress claims. *J Occup Med*. 1992;34(3):297-303.

19 Gatchel RJ, Polatin PB, Kinney RK. Predicting outcome of chronic back pain using clinical predictors of psychopathology: a prospective analysis. *Health Psychol*. 1995;15(5):415-20.

20 Ekselius L, Eriksson M, von Knorring L, Linder J. Personality disorders and major depression in patients with somatoform pain disorders and medical illnesses in relation to age at onset of work disability. *Eur J Psychiatry*. 1996;10:35-43

21 Burton K, Polatin PB, Gatchel RJ. Psychosocial factors and the rehabilitation of patients with chronic work-related upper extremity disorders. *J Occup Rehabil*. 1997;7:139-153.

22 Wall CL, Ogloff JR, Morrissey SA. The psychology of injured workers: health and cost of vocational rehabilitation. *J Occup Rehabil*. 2006;16(4):513-28.

23 Jackson HJ, Burgess PM. Personality disorders in the community: results from the Australian National Survey of Mental Health and Well-being Part III. Relationships between specific type of personality disorder, Axis 1 mental disorders and physical conditions with disability and health consultations. *Soc Psychiatry Psychiatr Epidemiol*. 2004;39(10):765-6.

24 Jovev M, Jackson HJ. The relationship of borderline personality disorder, life events and functioning in an Australian psychiatric sample.

25 Pajer K et al. Women with antisocial behaviour: long-term health disability and help-seeking for emotional problems. *Crim Behav Ment Health*. 2006;16(1):29-42.

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Treatment:

There is good evidence for both heritability and altered organic brain function in several types of personality disorder reflecting an enduring problem that cannot be 'cured'. Treatment is therefore aimed at improving insight and adjusting behaviour towards social acceptability and better functioning. While treatment may be difficult and responses variable, some good success has been demonstrated with specific psychotherapies.

There is no good evidence to support pharmacological treatment in the long term, although it may be appropriate in acute situations. For this reason, it can be important to consider the possibility of personality disorders where pharmacological treatment has been tried for an apparent mood disorder for many years with no obvious success.

Psychotherapies are generally specific not just to personality disorder, but to the specific features and level of psychological understanding of each individual. Appropriate selection is essential.

More details on treatment are included in the relevant NICE guidelines **26** **27**.

Psychodynamic Therapy:

Psychodynamic therapy is used for problems with paranoia and self-image. It uses the concepts of transference and countertransference to analyse patient perceptions, the sources of these from the past, and helps patients adjust their perception and response to future events. This is generally a long-term process with regular sessions (usually at least once a week) over a period of years reflecting the deep-rooted nature of the problem. Psychotherapy may be undertaken on an individual or group basis. Therapeutic communities also exist, where patients live, work and undertake therapy together over a long period.

Cognitive Behavioural Therapy (CBT):

CBT assumes that problems arise from errors of cognition and belief leading to inappropriate and maladaptive behaviours. Active therapy is provided usually over 6-20 weekly sessions (with homework and behaviour experiments set in between

sessions) and is focussed on reformulating perceptions, challenging core beliefs, developing coping mechanisms and adapting behaviour. Several courses of therapy are usually needed for personality disorders.

Interpersonal Therapy (IPT):

IPT is occasionally used specifically for interpersonal problems, again usually over 6-20 weekly sessions. It is based on the idea that many psychological problems are related to interpersonal crises and that a better understanding of this and the learning of specific techniques to deal with interpersonal issues can help reduce symptoms levels and improve social functioning.

Cognitive Analytic Therapy (CAT):

CAT is often viewed as a treatment which sits in between psychotherapy and CBT. It is more time limited and problem-focused than psychotherapy but draws on psychoanalytic principles to help understand how problematic behaviours became established and are maintained. It also focuses on the importance of interpersonal relationships and often examines the role of reciprocal relationships, where certain patterns of relationships are established and repeated by individuals over their life course.

Dialectical Behaviour Therapy (DBT):

DBT is specifically used for borderline personality disorder. It is a broad ranging treatment with features of cognitive and behavioural therapy, skills training and support. These interventions usually focus on mood lability, impulse control and self-harm, although there is evidence that improvements may extend to functional measures, such as employment.

Medication:

Self-harm is a significant risk in some types of personality disorders, particularly borderline personality disorder, making overdose risk a key consideration in selection of medication. There is no good evidence for benefit from medication in the long term, but antidepressants have a place in controlling co-morbid depressive episodes. There may be some value in use of mood stabilisers such as sodium valproate or lithium where impulsive and aggressive behaviour predominates, although evidence for this is limited. Schizotypal disorder may respond to antipsychotic medication, although usually at relatively low doses.

In some cases, individuals with a personality disorder, particularly borderline personality disorder, may present in an acute crisis with high levels of distress and thoughts of self-harm. Very short-term use of sedatives in combination with increased support and possibly a brief admission may be needed in more severe cases.

26 National Collaborating Centre for Mental Health. Borderline personality disorder: The NICE guideline on treatment and management. National Clinical Practice Guideline Number 78. The British Psychological Society and The Royal College of Psychiatrists. London. 2009

27 National Collaborating Centre for Mental Health. Antisocial personality disorder: The NICE guideline on treatment and management. National Clinical Practice Guideline Number 77. The British Psychological Society and The Royal College of Psychiatrists. London. 2010.

Outcome:

The outcome depends largely on the previous history, the role of current stressors, the presence of co-morbid mental illness and the specific personality traits involved. Where it is evident that an individual has had consistent and substantial difficulties, the prognosis is likely to be poor. A firefighter who develops substantial problems within a year or two of recruitment and who has a history of moving jobs frequently prior to this because of performance difficulties is unlikely to succeed long-term as a firefighter. On the other hand, a firefighter who has been in employment for five to ten years, with occasional difficulties, may well respond sufficiently from treatment to successfully remain in employment. Some improvement can be expected with age in those with paranoid, schizoid and borderline personality disorders. Those with anxious or fearful disorders tend not to improve with age.

The nature of personality disorders and the treatments used has made establishing a clear evidence base for effective interventions difficult. However, there is growing evidence that the treatment strategies outlined above can lead to symptomatic and functional improvements. One study found that over a six year follow up period with a range of treatment options, two thirds of patients with borderline personality disorder met criteria for remission **28**.

When a clear diagnosis can be made and confirmed by an appropriate psychiatric specialist at the time of recruitment, it is likely that recruits for firefighting or the control room would not be considered fit.

There is substantial overlap with other psychiatric conditions, and some individuals who develop personality change do so as a result of organic brain disease or injury. A differential diagnosis of these can include frontal lobe injury or pathology, early dementia, severe mental disorder (such as schizophrenia or bi-polar affective

disorder) or exceptional severe stressful experiences leading to enduring personality change. Consideration should also be given to the possibility of drug or alcohol induced personality changes.

28 Zanarini MC et al. The longitudinal course of borderline psychopathology: 6-year prospective follow-up of the phenomenology of borderline personality disorder. *American Journal of Psychiatry*. 2003;160:274-83.

Neuroses

- [Anxiety Disorders](#)
- [Simple Phobia](#)
- [Social Phobia](#)
- [Agoraphobia](#)
- [Panic Disorder](#)
- [Obsessive Compulsive Disorder](#)
- [Conversion and Dissociative Disorder](#)

Anxiety Disorders

These are abnormal states in which the most striking features are mental and physical symptoms of anxiety. These include symptoms such as fearful anticipation, irritability and poor concentration in addition to physical symptoms of the gastrointestinal, respiratory, cardiovascular, genitourinary and neuromuscular systems (which may be distracting and disabling) and sleep disturbance. When present in any degree of severity, these features are clearly incompatible with safe firefighting and are often incompatible with safety in the control room. Although anxiety commonly occurs in association with depression, these disorders have been addressed separately.

Generalised Anxiety Disorders

ICD 10 requires that symptoms should have been present for 'most days for at least several weeks at a time, and usually several months'. One-year prevalence rates in studies in the USA vary from 2.5% to 6.4% [29](#). Many anxious patients do not meet the diagnostic criteria and it is important to ensure that an individual has been properly diagnosed, preferably by a psychiatric specialist, before decisions on employment are made.

Treatment with cognitive behavioural therapy can be helpful in many cases. Drug treatment with anxiolytics such as benzodiazepines may be helpful in the short term stabilisation of anxiety symptoms. They should however seldom be prescribed for longer than three weeks because of the risk of dependence. It is now recognised that antidepressants (SSRIs & SNRIs) are effective in the management of anxiety disorders. They may need to be prescribed in higher doses than usual for

depression. The treatment needs to be long term as the anxiety disorder usually relapses on stopping the medication.

Most anxiety disorders improve within six months but of those lasting longer, about 80% persist for more than three years [30](#). In one major study, even with 80% receiving treatment, remission was only 15 per cent at one year and 27 per cent by three years. Where patients had co-morbid psychiatric disorders, the proportions achieving remission from anxiety disorders were only 8% and 17% at one and three years respectively [31](#) [32](#).

Poorer prognosis is associated with severe symptoms and with syncopal episodes, agitation, derealisation, hysterical features and suicidal ideas. Somatisation is also a poor prognostic sign. A single episode of anxiety disorder, particularly related to some stressful event, which resolves within six months, should not be a contraindication to employment as an operational firefighter. Recurrent or longer lasting episodes however are more likely to give cause for concern.

There is evidence that anxiety disorder predisposes to development of PTSD (see next page).

29 Weissman M, Merikangas K. The epidemiology of anxiety and panic disorders. *Journal of Clinical Psychiatry* 1986;47(Suppl): 11-17.

30 Kedward H, Cooper B. Neurotic disorders in urban practice: A 3-year follow-up. *Journal of the Royal College of General Practitioners* 1966; 12(2):148-63.

31 Massion A et al. Quality of life and psychiatric morbidity in panic disorder and generalized anxiety disorder. *American Journal of Psychiatry*, 1993; 150(4):600-7.

32 Yonkers KA et al. Phenomenology and course of generalised anxiety disorder. *British Journal of Psychiatry*, 1996;68:308-13.

Simple Phobia

In this disorder a person is inappropriately anxious in the presence of one or more particular objects or situations. Most simple phobias of adult life are a continuation of childhood phobias. A minority begin in adult life as a result of a particularly stressful experience. In one study, lifetime prevalence in adults has been estimated as 4% in men and 13% in women [33](#).

The relevance of simple phobias to firefighting depends on the nature of the phobia. A phobia of something commonly encountered during firefighting (for example claustrophobia) will clearly cause the occurrence of anxiety symptoms with consequent unacceptable risks to safety. A fear of flying or of snakes for example may be less of a problem to the operational firefighter. Though no systematic study of prognosis has been available, clinical experience indicates that simple phobias originating in childhood last for many years but those occurring as a result of stressful events in adulthood have a better prognosis [3](#).

3 Gelder M, Gath D, Mayou R, Cowen P. Oxford Textbook of Psychiatry 3rd Edition, Oxford: Oxford University Press, 1996.

33 Kessler R, McGonagle K, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: Results from the national co-morbidity survey. Archives of General Psychiatry 1994;51:8A9.

Social Phobia

In this disorder, inappropriate anxiety is experienced in situations in which the person is observed and could be criticised. The condition usually begins between the ages of 17 and 30. As socially phobic people tend to avoid situations where they might be criticised, they will avoid making conversation or will sit in a place where they are least conspicuous.

If the condition arises prior to application for employment as a firefighter, then it is likely that such an individual would not be successful in application because of these disabling features. If it arises after employment as a firefighter, then it could give rise to the features of anxiety mentioned above which may increase risks to safety. Treatment by cognitive behaviour therapy is effective in many cases [34](#). Drug treatment is probably inappropriate except for short-term control of symptoms. In the untreated patient, the condition may last for many years.

34 Butler G, Cullington A, Munby M, et al. Exposure and anxiety management in the treatment of social phobia. Journal of Consulting and Clinical Psychology 1984;52:642-50.

Agoraphobia

Agoraphobic patients are anxious when they are away from home, in crowds, or in situations that they cannot leave easily. Symptoms are similar to those of other anxiety disorders but panic attacks and anxious cognitions about fainting and loss of control are more frequent among agoraphobic patients. The features are likely to be a significant risk and cause of disability to serving firefighters. One study estimated the one-year prevalence of agoraphobia to be 1.7% in men and 3.8% in women [33](#).

Treatment with behaviour therapy will often give some improvement in symptoms but persistence of anxiety responses is common. Agoraphobia lasting for one year or more changes little in the next five years [35](#).

33 Kessler R, McGonagle K, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: Results from the national co-morbidity survey. Archives of General Psychiatry 1994;51:8A9.

35 Marks I. Fears and Phobias. Heinemann. London 1969.

Panic Disorder

The essential feature of this condition is the occurrence of panic attacks; these are sudden attacks of anxiety in which physical symptoms predominate and are accompanied by fear of a serious consequence such as a heart attack. Symptoms resulting from hyperventilation are common. Such features would clearly present serious risks to safety in the context of operational firefighting and the control room.

Treatment with cognitive behaviour therapy has been found to be successful to some extent in many cases [36](#). Drug treatment with benzodiazepines control panic attacks when given in high doses but cannot be used in the longer term. The antidepressant drugs such as imipramine (a tricyclic antidepressant) as well as other antidepressants (including SSRIs) also control panic attacks but side effects from some drugs may be incompatible with operational firefighting (see below). Studies of patients with panic disorder (with or without agoraphobia) have indicated that the course is characterised by fluctuating anxiety and depression [37](#).

36 Clark D, Salkovskis P, Hackmann A, et al. A comparison of cognitive therapy, applied relaxation and imipramine in the treatment of panic disorder. *British Journal of Psychiatry* 1994; 164(16):759-69.

37 Noyes R, et al. Outcome of panic disorder. Relationship between diagnostic subtypes and comorbidity. *Archives of General Psychiatry*. 1990;47:809-18.

Obsessive Compulsive Disorder

This condition is characterised by obsessional thinking and compulsive behaviour with various degrees of anxiety, depression and personal isolation. This would be seriously incapacitating and of high risk in the context of operational firefighting. The condition is less common than anxiety neuroses. Estimates of one-year prevalence rates vary from 1.1% to 1.8% with lifetime prevalence varying from 1.9% to 2.5%. About two-thirds of cases improve by the end of one year. If symptoms last for more than one year, the condition will normally run a remitting and relapsing course sometimes for many years. Prognosis is worse when the symptoms have been severe or where there are continuing stressful events in the persons life [3](#).

Treatment with counselling, anxiolytic drugs, clomipramine, SSRI's, behaviour therapy, psychotherapy and psychosurgery have varying degrees of success. However, none of these has been proved to affect long term prognosis. Because of the uncertain prognosis, recruits for firefighting or the control room with a history of obsessive compulsive disorder are unlikely to be considered fit and serving firefighters and control room staff must be very carefully assessed according to their clinical state and medical history.

3 Gelder M, Gath D, Mayou R, Cowen P. Oxford Textbook of Psychiatry 3rd Edition, Oxford: Oxford University Press, 1996.

Conversion and Dissociative Disorders

These terms refer to disorders that until recently were known as hysteria. The main features of these disorders are physical symptoms, and certain mental symptoms, which occur without the expected physical pathology but with psychological causes. The symptoms usually confer some advantage on the patient, which is commonly referred to as a secondary gain. Dissociative disorders take a number of forms including amnesia, pseudodementia, fugue (amnesia with wandering), stupor, identity disorder and trance. The related conversion disorders include dissociated motor disorder, convulsions and sensory disorder.

The differential diagnosis from organic disease may be difficult and conditions such as Multiple Sclerosis have presented and been misdiagnosed as hysteria in the past. In the context of firefighting, the most likely presentation of such a condition is where compensation or injury-award is the secondary gain leading to psychological reinforcement of physical or mental symptoms. In these cases, a distinction must be drawn between dissociative disorders and malingering or fraud.

This diagnosis should not be made without specialist confirmation regarding the absence of organic disease and psychiatric confirmation of the congruity of the diagnosis. In cases where the diagnosis is certain, these disorders are likely to be incompatible with future safe firefighting and must be very carefully considered.

Disorders of Mood

There are a number of different classifications of depressive disorders. These conditions have in common various features that are to a greater or lesser extent disabling. In addition to low mood, these may include lack of interest and enjoyment, reduced energy, psychomotor retardation, anxiety, irritability, loss of concentration, poor memory, and sleep disturbance with consequent fatigue.

In severe depressive disorder, these features occur with greater intensity and may be accompanied by psychotic symptoms including delusions and hallucinations [3](#). The nature and severity of symptoms will determine how disabling the condition will be in the context of operational firefighting or working in the control room. Firefighters may not report mild degrees of depression, but if cognition, concentration or memory is affected, risks to safety on the fireground may become significant.

Certain treatments may also affect cognition, concentration and reaction time and consequently increase risks to safety. These effects are discussed in a later section of this chapter. For the purposes of considering prevalence and prognosis in the context of fitness for firefighting, depressive disorders may best be classified as bipolar (manic depressive psychosis) and unipolar.

3 Gelder M, Gath D, Mayou R, Cowen P. Oxford Textbook of Psychiatry 3rd Edition, Oxford: Oxford University Press, 1996.

Bipolar Affective Disorder

Episodes of manic disorders can last for considerable periods, sometimes up to two or three years. 20% to 30% of patients have three or four episodes of mania or hypomania per year. Psychotic features with manic episodes are not uncommon. Manic disorders often recur and subsequent depressive disorders are frequent. Relapse is less common in those on lithium therapy [3](#) or other mood stabilisers such as carbamazepine. Some individuals may develop a progressive pattern with more frequent, more intense episodes.

Where recurrence is more often than four times per year the term 'rapid cycling' may be used, and the terms 'ultra-rapid' and 'ultra-ultra-rapid' may be used where the episode of hypomania can run its course within 24 hours. It should be possible to identify these individuals from the history of disease progression, and where there is a very rapid fluctuation there may be a risk to the individual and others on the fireground or in the control room before treatment has commenced [38](#).

Because of the risk of the recurrence of symptoms on withdrawal of treatment and consequent risks to safety, it is likely that a firefighter or controller with a history of bipolar affective disorder will be considered permanently unfit for operational firefighting or control room work. There may be exceptions to this rule but every case must be considered very carefully before allowing the individual to return to operational duties.

3 Gelder M, Gath D, Mayou R, Cowen P. Oxford Textbook of Psychiatry 3rd Edition, Oxford: Oxford University Press, 1996.

38 Post R M. Rapid cycling and depression in Perspectives. in Psychiatry vol 3 Long-term treatment of depression. S Montgomery & F Rouillon (eds). John Wiley & Sons. Chichester. 1992.

Unipolar Depressive Disorders

Depressive disorders are common. Prevalence is mainly given as a point prevalence or period prevalence rate. The point prevalence rate of major depressive disorder is around 4%. The six-month and one year prevalence is between 3-6% and the lifetime prevalence is probably of the order of 18% although some studies indicate a much lower prevalence [39](#). Brief depressive episodes that do not meet the criteria for major depression are also common (one-year prevalence of 4-6% in the age group 20-30 years), they last less than two weeks (generally one to three days) and are highly recurrent, with 10-12 episodes per year [40](#).

The severity and duration of depressive episodes varies widely. Most people with depression recover within a period of two years from the onset of clinical illness. Antidepressant medication and cognitive behavioural psychotherapy have been shown to be effective treatments for depression. Simple counselling alone has not been shown to be effective. Around 25% of people with unipolar disorders will have a recurrence within one year. 75% will have a recurrence in the following ten years [41](#).

It is essential to distinguish between those with low mood who may continue at work and may or may not require any drug treatment and those with depression as defined by DSM IV. In the former case they may state that they have a diagnosis of depression, however this diagnosis may be unhelpful in assessing their fitness for work now or in the future. Key aspects of the history include hospitalisation, sectioning under the Mental Health Act, treatment and review by a psychiatrist and/or the community mental health team. These latter aspects of history indicate a more severe disorder, with the advantage of the possibility of requesting a report from a specialist.

Where an individual has a diagnosis of depression, possibly including medication, but have remained at work their assessment should be based on their capability while at work rather than their medical diagnosis. Recurrent episodes and recent episodes should be very carefully assessed and these individuals are unlikely to be considered fit as firefighters or control room staff.

The past history of the illness is essential in assessing future capability. Where the condition is related to home or work circumstances that were relatively abnormal or extreme and which have now changed there will be a lower risk of recurrence than for those where there was little obvious external cause and little change in personal circumstances since. Recurrence is generally very difficult to predict, however it is associated with bipolarity, early age of onset, number of previous episodes, and no obvious external cause. There is evidence that presence of a sick spouse may increase the relapse rate [41](#).

A history of mild depression over a year or two ago may be acceptable in an applicant. Mild depression that is not related to work is unlikely to be a cause for retirement or redeployment of serving firefighters. Recurrent or severe episodes and those which are causally related to work may be disabling in the long-term and therefore require very careful consideration. Prognosis of outcome is particularly difficult as there are few variables that appear to be related to outcome. A poor outcome is associated with social isolation, uncertain situations and physical poor health. The presence of a confiding relationship appears to improve outcome and some studies suggest that good social support and older age are predictive of better recovery at 6-30 months. One major study suggests women over 30, women with unstable marital history and both sexes with a poor education are significantly associated with persistence of depression. History of previous depression, severity and greater co-morbidity are also associated with persistence of depression, and all these factors have more impact than sociological factors [41](#).

When suffering from depression, people commonly selectively recall negative experiences and suffer from troubling dreams. This is important in a population such as firefighters who are likely during their career to encounter a number of events which would be sufficiently horrific to be a potential cause for PTSD. If a firefighter develops a depressive disorder, one would commonly expect them to have bad dreams and perhaps ruminate over past traumatic events. This may be incorrectly diagnosed as PTSD, especially if there are other incentives or encouragement from spouse or colleagues for the firefighter to label it so.

Overall, the premorbid personality features are of best prognostic value. Low intelligence, hysterical and obsessional personality traits, social deviation and high neuroticism scores are poor predictors while high extraversion scores predict a more favourable outcome [41](#).

It is usual for maintenance treatment to continue for around six months after remission of symptoms in order to help avoid relapse at this early stage. There are no reasons why individuals should not return to normal duties during this period provided their medication does not affect their performance. Where recurrence does occur the process is rarely immediate and acute (unlike bipolar disorder where some individuals may cycle through mania within 24 hours). It is therefore very unlikely that the individual who has a risk of relapse represents a risk to colleagues on the fireground. The risk is for long-term sickness absence and the associated disruption to human resources management.

39 Angst J. How recurrent and predictable is depressive illness? In Perspectives in Psychiatry vol 3 Long-term treatment of depression. S Montgomery & F Rouillon eds. John Wiley & Sons. Chichester. 1992

40 Angst J et al. New aspects on epidemiology of depression. In: Angst J, Woggon B (eds) Lofepamine in the treatment of depressive disorders: review of the past 10 years and future prospects, pp 1-14. International symposium organised by the Psychiatric University Hospital Zurich, Lugano, 1987. Braunschweig: Vieweg-Verlag. 1988.

41 Piceinelli N, Wilkinson G. Outcome of depression in psychiatric settings. British Journal of Psychiatry 1994;64:297-304.

New since 2012

Reactions to Stressful Experiences:

[Acute Stress Disorder](#)

[Adjustment Disorders](#)

[Post Traumatic Stress Reactions \(PTSR\)](#)

[Post Traumatic Stress Disorder \(PTSD\)](#)

Subheadings as below:

Acute Stress Disorder:

Acute stress disorder is a prolonged response to a stressful event, lasting from a few days to four weeks. The core symptoms are anxiety and depression **42**. A history of such an episode in an applicant for the Fire and Rescue Service should not be a bar to entry. However, the occurrence of an acute stress disorder is a significant risk factor for the development of post-traumatic stress disorder, so such cases should be carefully considered. By definition (ICD10), acute stress disorder will resolve and is therefore not grounds for retirement for serving firefighters.

42 Gelder M, Gath D, Mayou R, Cowen P. Oxford Textbook of Psychiatry 3rd Edition, Oxford: Oxford University Press, 1996

Adjustment Disorders:

These are psychological reactions resulting from the adaptation to new circumstances including for example bereavement, divorce, major job change, birth of a handicapped child etc. The features include those of anxiety and depression. Although the stressful event is the necessary cause of this disorder, individual vulnerability is thought to be an important factor **43**. The term adjustment disorder can be used to classify individuals who suffer from a post-traumatic stress response of insufficient severity to satisfy the full criteria for PTSD.

A range of talking therapies, including problem solving counselling have been found to be helpful and drug treatment for depressive symptoms may be necessary. There is no systematic evidence relating to prognosis but most cases last for several months and some may last for years. In the latter case, such episodes would eventually be reclassified as an anxiety or depressive disorder. This reclassification reflects the artificial construct of psychiatric diagnostic systems rather than the patient and their problems. These changes in classifications can be useful in guiding escalating treatment and may reflect symptoms becoming more chronic and less linked to the initial trigger. However, this is not always the case and the movement to a more general disorder may remove the emphasis on external stressors and the need for the individual to resolve such issues to facilitate recovery. The term 'chronic embitterment' **44** has been suggested to reflect the situation in many cases of adjustment disorder.

Where the problem is a work colleague, management or another aspect of work, the situation may well be reached where the firefighter cannot adjust and recover without leaving the service. Once they have left, a full recovery would be likely, and it would be inappropriate to consider the condition 'permanent' in relation to ill health retirement. It is often more helpful to everyone to consider this as a management problem that has been medicalised.

Symptoms may well interfere with operational firefighting in the same way as those of anxiety and depression (see above). Because of the vulnerability that may underlie a past history of this disorder, recruits will need to be considered very carefully as recurrence of this or related disorders might require redeployment or early retirement on health grounds.

Sudden onset, with associated risks to safety, is less likely so judgements about serving firefighters must be made according to the history and course of the condition.

43 Gelder M, Gath D, Mayou R, Cowen P. Oxford Textbook of Psychiatry 3rd Edition, Oxford: Oxford University Press, 1996

44 Sensky T. Chronic embitterment and organisational justice. *Psychother Psychosom.* 2010;79(2):65-72.

Post Traumatic Stress Reactions (PTSR):

Most individuals will react to traumatic events, and do so in a wide variety of ways, developing a range of symptoms. Post-traumatic stress disorder (PTSD) is only one of these and is tightly defined. In most cases individuals will demonstrate symptoms of PTSR but not of PTSD. PTSD is over-diagnosed, particularly by practitioners who are unaware of the specific definitions (see below). This is unhelpful in managing individuals who then have unreasonable and incorrect expectations in terms of treatment and employment that need to be addressed along with their symptoms.

It may be more helpful to discuss the concept of PTSR with individuals and leave a diagnosis of PTSD for a specialist to make.

Post Traumatic Stress Disorder (PTSD):

Post traumatic stress disorder is a relatively new term (coined in the early 1980s) which describes a condition that has been known throughout history, but which in the past has sadly been misdiagnosed and individual responses have been misinterpreted **45**. The natural history of the condition in relation to current social expectations remains the subject of debate, and it is likely that the response to trauma and development of PTSD is in part conditioned by our social surroundings **46**. Recent research suggests that there is a distinct neuro-biochemical basis to the condition which represents an incomplete emotional processing of the event **47**. Evidence suggests the interaction between the amygdala, hippocampus, cingulate cortex and prefrontal cortex is altered in PTSD. Activation of the amygdalae leads to production of autonomic neurotransmitters and endocrine activity producing the key arousal symptoms of PTSD while hypoactivation in areas such as the cingulate cortex, hippocampus and prefrontal cortex may represent

dysfunctional regulation or processing of these emotions. Further evidence of the organic aspects of PTSD come from MRI studies showing a reduction in size of the hippocampus, **48 49** and numerous studies showing alterations in the hypothalamic pituitary adrenal pathway in those suffering from PTSD **50**.

There are a number of theories for the psychological component of PTSD, including 'fear conditioning', the concept of a 'trauma memory' being different and more overwhelming than normal memories, and trauma memories being laid down in 'current memory' rather than 'past memory', leading to the arousal symptoms not normally felt when remembering past events.

Despite the above, our understanding of PTSD is far from complete and at present it remains a symptomatic diagnosis and therefore individuals have to meet strict diagnostic criteria as laid down in DSM IV or ICD 10 (see next page). Everyone exposed to a traumatic event can have some features of PTSD, however, in most individuals they will be mild and transient and full recovery should be expected. Even when the condition is severe it usually responds well to treatment.

The National Institute for Clinical Excellence has recently considered PTSD diagnosis and treatment **51**, and all FMAs are advised to read the full guideline produced by the Royal College of Psychiatrists and the British Psychological Society (rather than the shorter clinical guideline) in conjunction with the notes on the upcoming pages.

45 Raphael B and Middleton W. After the horror. British Medical Journal 1988;296:1142-3.

46 Summerfield D. The invention of post-traumatic stress disorder and the social usefulness of a psychiatric category. British Medical Journal 2001;322:95-98.

47 Mezey G, Robbins I. Usefulness and validity of post-traumatic stress disorder as a psychiatric category. British Medical Journal 2001;323:561-3.

48 Medina J. Stress, PTSD and the Hippocampus. Presented at: 16th Annual US Psychiatric and Mental Health Congress. Orlando, FL: November 6-9, 2003.

49 Smith ME. Bilateral hippocampal volume reduction in adults with post-traumatic stress disorder: a meta-analysis of structural MRI studies. Hippocampus. 2005;15(6):798-807.

50 Etkin A, Wagner TD. Functional neuroimaging of anxiety: a meta-analysis of emotional processing in PTSD, social anxiety disorder, and specific phobia. Am J Psychiatry 2007;164:1476-1488.

51 Royal College of Psychiatrists and British Psychological society. National Clinical Practice Guideline 26. Post traumatic stress disorder (PTSD): the management of PTSD in adults and children in primary and secondary care. 2005. National Institute for Clinical Excellence. London.

Subheadings as below.

DSM IV Criteria for PTSD 52:

The current Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) specifies the diagnostic criteria for PTSD. These cannot be included here for copyright reasons, but can be found on many websites, for example:

<http://www.ptsd.va.gov/professional/pages/dsm-iv-tr-ptsd.asp>

Medical Advisers should be familiar with these diagnostic criteria.

52 American Psychiatric Association. Diagnostic and statistical manual of mental disorders (Revised 4th ed.). 2000. Washington, DC.

ICD 10 Criteria for PTSD:

The ICD 10 code for PTSD is F43.1. In a small number of cases the condition may follow a chronic course over many years, with eventual transition to an enduring personality change F62.0 **53**. The criteria for PTSD are less strict than DSM IV.

- A.** The patient must have been exposed to a stressful event or situation of exceptionally threatening or catastrophic nature, which would be likely to cause pervasive distress in almost anyone.
- B.** There must be persistent remembering or 'reliving' of the stressor in intrusive 'flashbacks', vivid memories, or recurring dreams, or in experiencing distress when exposed to circumstances resembling or associated with the stressor.
- C.** The patient must exhibit an actual or preferred avoidance of circumstances resembling or associated with the stressor, which was not present before exposure to the stressor.
- D.** Either of the following must be present:
 - inability to recall, either partially or completely, some important aspects of the period of exposure to the stressor.
 - persistent symptoms of increased psychological sensitivity and arousal (not present before exposure to the stressor), shown by any two of the following:
 - (a)** difficulty in falling or staying asleep
 - (b)** irritability or outbursts of anger
 - (c)** difficulty in concentrating
 - (d)** hypervigilance
 - (e)** exaggerated startle response.

E. Criteria B, C and D must all be met within 6 months of the stressful event or the end of a period of stress (for some purposes, onset delayed more than 6 months may be included, but this should be clearly specified).

53 World Health Organisation. ICD 10 - International Classification of Diseases and health related problems: tenth revision. 2004. Geneva.

Diagnosing PTSD:

It is particularly important to understand the concept of 'diagnosis' in psychiatry. There is inevitable subjectivity in all psychiatric diagnoses because they are based on what the patient says and the clinician's interpretation of this. Furthermore, every patient is different and may present differently at various times. The division of psychiatric diagnoses into a wide variety of specifically defined conditions is a relatively recent phenomenon and is inevitably an artificial construct which has been substantially adjusted over the years as various iterations of the WHO International Classification of Diseases and the American Psychiatric Association Diagnostic and Statistical Manual have been produced. A test which produces 100% sensitivity, and 100% specificity is rare in science and rarer in medicine. This suggests that a practitioner who diagnoses PTSD in every patient who 'ticks all the boxes' is merely ticking boxes rather than deciding what is actually wrong and what treatment is appropriate. The fact that there is a wide spectrum of opinion in this does not mean some are right and some are wrong, merely that they are taking different approaches. Some will regard PTSD as a common occurrence to be expected in many people exposed to trauma while others regard it as a relatively rare condition. It is helpful to know where a psychiatrist lies within this spectrum in order to judge whether others might agree, and what the likely outcome will be. Those who make the diagnosis often will see most patients recovering fully, some with 'watchful waiting' rather than treatment, while those who rarely make the diagnosis will expect to treat all and will see a smaller percentage recover. Ideally, a balance is needed between these two extremes. A diagnostic threshold set too high risks missing those who are suffering and may benefit from treatment, while a threshold set too low results in unnecessary medicalisation and labelling with potentially adverse outcomes.

There are particular consequences to a diagnosis of PTSD in firefighters, with issues of qualifying injury and ill health retirement potentially interfering with the process of recovery. Care should therefore be taken to ensure the diagnosis of PTSD is correct early on in the process, particularly when there is a difference of opinion among specialists.

Once an individual has started on the ill-health retirement journey, issues of secondary gain will inevitably play a part and can represent a major obstacle to recovery, as can the process of litigation **54 55**. While there have inevitably been suggestions of compensation-seeking in PTSD claims, and there will be some who do so, there is no good evidence that it is commonplace. There is, however, a clear

link between those who seek compensation and those who develop PTSD **56**. It has been suggested that one factor may be anger or embitterment. While this may in part be intrinsic to the individual, management factors during and after the event may have a significant and avoidable part to play.

In some cases, the diagnosis of PTSD is incorrect, or PTSD may not be the main factor in their continuing ill-health. Where there have been relationship difficulties between the firefighter and colleagues or management a situation of chronic embitterment **57** or more general depression may have arisen, and feelings of anger, anxiety and depression may become entrenched by the ill-health retirement application process, the need to prove they are 'permanently unfit' and the need to continue to appear too ill to work. A specific diagnosis of 'Posttraumatic Embitterment Disorder' has been suggested, but it yet to be accepted as a formal diagnosis **58**. This may simply be an inevitable result of the current approach to ill-health retirement that is similar to other uniformed services, but it is not beneficial for the individual who may become very unwell because of the process rather than because of any preceding issue or event **59**. Where the diagnosis is wrong, treatment for PTSD is unlikely to be beneficial, and once symptoms and beliefs are entrenched the firefighter may no longer engage or respond to a more appropriate treatment for a more appropriate diagnosis. The complexity of diagnosis in cases of PTSD is further complicated by the high rates of co-morbid illness, particularly depression and substance misuse.

Diagnosis can be aided by using validated, structural clinical interviews using tools such as the Structured Clinical Interview for DSM-IV (SCID), the Clinician-Administered PTSD Scale (CAPS) and the PTSD Symptom Scale - Interview version (PSS-I). All are based on DSM IV and should add additional validity to a purely clinical diagnosis. Medical Advisers are not expected to use these tools themselves, but it would be appropriate to ask if such tools have been used to reach the diagnosis.

Posttraumatic stress disorder requires, by definition, a precipitating traumatic event. This has been defined by DSM III-R as 'outside the range of usual human experience' and that it 'would be markedly distressing to almost anyone'. Some felt this is too narrow a definition; is a road traffic crash part of the usual human experience now, or outside it? ICD10 defines the event as 'a stressful event or situation...of an exceptionally threatening or catastrophic nature, which is likely to cause pervasive distress in almost anyone'. DSM-IV requires that the person 'experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others' and importantly that the 'person's response involved intense fear, helplessness, or horror'. Many firefighters will experience an event that meets this definition but that does not automatically mean PTSD is an appropriate diagnosis. The individual must also have experienced intense fear, helplessness or horror at the time. While not all individuals may demonstrate this, it is reasonable to expect some early distress or functional impairment to be witnessed by others in most cases.

The classic symptoms of PTSD are the triad of intrusive re-experiencing, avoidance of associated activity or location, and hyperarousal. Continuing impairment may be best identified by peers who may note cognitive impairment and disturbed interpersonal relationships. Increased arousal, irritability and loss of interest or withdrawal are also key features **60**. The onset of symptoms is usually in the first month after a traumatic event, but in around 15% symptoms will appear later than this **61**.

54 Blanchard EB et al. Who develops PTSD from motor vehicle accidents? Behaviour Research and Therapy. 1996;34:1–10.

55 Ehlers, A., Mayou, R. A. & Bryant, B. (1998) Psychological predictors of chronic posttraumatic stress disorder after motor vehicle accidents. Journal of Abnormal Psychology, 107, 508–519.

56 Bryant, R. A. & Harvey, A. G. (1995) Avoidant coping style and post-traumatic stress following motor vehicle accidents. Behaviour Research and Therapy, 33, 631–635.

57 Sensky T. Chronic embitterment and organisational justice. Psychother Psychosom. 2010;79(2):65-72.

58 Linden M. Posttraumatic embitterment disorder. Psychother Psychosom. 2003;72(4):195-202.

59 Summerfield D. Metropolitan Police blues: protracted sickness absence, ill health retirement and the occupational psychiatrist. BMJ. 2011;342:d2127.

60 Raphael B et al. Rescuers' psychological responses to disasters. British Medical Journal 1991;303:1346-7.

61 Royal College of Psychiatrists and British Psychological society. National Clinical Practice Guideline 26. Post traumatic stress disorder (PTSD): the management of PTSD in adults and children in primary and secondary care. 2005. National Institute for Clinical Excellence. London.

How common is PTSD?

The differing opinions and differing uses of diagnostic criteria have lead to wide variations in the quoted epidemiology of PTS. Current estimates of the overall prevalence of PTSD are largely derived from overseas studies. In USA lifetime prevalence against DSM III criteria was 10.4% in women and 5% in men, reflecting a general finding that women are more likely to develop PTSD in response to a traumatic event **62**. Annual prevalence rates vary between 1.3% in Australia and 2.6% in USA. Other studies have suggested an overall point prevalence of 1% **63** while subgroups may have a much higher level, and a lifetime prevalence of 5-6% in men and 10-12% for women **64 65**. A UK household survey in 2007 found

that 33.3% of people reported having experienced a traumatic event since the age of 16, slightly higher in men than women. 3.0% of adults screened positive for current PTSD, and when 'conditional probability' was used to indicate the likelihood of current PTSD if someone has experienced trauma since aged 16, the rate expected for women was 10.4% and for men 7.5%. 28% of those who screened positive for PTSD were receiving treatment for a mental or emotional problem compared with 7% of those who screened negative **66**.

One study found that 30% of survivors of war trauma had PTSD **67**, while a study of UK military peacekeepers found a prevalence of 3.6 to 5.5%, lower than reported by other nations **68**. Levels of 30% have been described in firefighters exposed to a major bush fire **69**. A follow-up of patients with severe accidental injury admitted to intensive care showed PTSD symptoms in 6% two weeks after the accident, a diagnosis of PTSD in 2% after one year, and 4% after three years, and long-term PTSD was predicted by symptoms at 6 months and delayed onset of symptoms **70**.

A study looking at prevalence of PTSD in US firefighters found wide variations in previous studies from 6.5% to 37% depending on the measures used, cut-off scores, samples and events. Using the Posttraumatic Stress Disorder Checklist on 131 firefighters, a prevalence rate of 8% was found. When they included measures of fear, helplessness or horror and functional impairment a lower prevalence of 5% was found **71**. This is a key issue when assessing PTSD; was there an initial response at the time, and do the current symptoms actually cause functional impairment? They also found that previous psychological treatment, age of recruitment, 'miscellaneous calls' and a response of horror following the firefighter's single worst event all predicted PTSD symptoms. They recommended using a tool measuring symptoms against the full DSM-IV criteria.

Incidence, as opposed to prevalence, studies have found around 8% of men and 20% of women exposed to a traumatic event will develop PTSD, but this depends on the exact diagnostic protocol used, the nature of the trauma and the characteristics of the individuals involved. A few studies have suggested much higher figures, but while these may make good headlines for sensational reporting, they are unhelpful when managing firefighters exposed regularly to traumatic events.

62 Kessler RC et al. (1995) Post traumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry*. 1995;52:1048–1060.

63 Jackson G. The rise of post-traumatic stress disorders. *British Medical Journal* 1991;303:533-4.

64 Resnick HS et al. Prevalence of civilian trauma and post-traumatic stress disorder in a representative national sample of women. *Journal of Consulting and Clinical Psychology* 1993;61:984–91.

65 Breslau N et al. Sex differences in post-traumatic stress disorder. *Archives of General Psychiatry* 1997;54:1044–8.

- 66** McManus S et al. Adult psychiatric morbidity in England, 2007: results of a household survey. NHS Information Centre for Health and Social Care. Leeds. 2009.
- 67** Johnson H, Thompson A. The development and maintenance of post-traumatic stress disorder (PTSD) in civilian adult survivors of war trauma and torture: a review. *Clin Psychol Rev.* 2008;28(1):36-47.
- 68** Greenberg N et al. Getting a peace of the action: measures of post traumatic stress in UK military peacekeepers. *J R Soc Med.* 2008;101:78-84.
- 69** McFarlane AC. Life events and psychiatric disorder: the role of a natural disaster. *British Journal of Psychiatry.* 1987;151:362-7.
- 70** Hepp U et al. Post-traumatic stress disorder in serious accidental injury: 3-year follow-up study. *Br J Psychiatry.* 2008;192(5):376-83.
- 71** Del Ben K et al. Prevalence of posttraumatic stress disorder symptoms in firefighters. *Work Stress.* 2006;20(1):37-48.

What can be expected in UK firefighters attending traumatic events?

Most firefighters will not develop PTSD after a single event. Firefighters expect to see trauma, and in most situations they themselves are not at risk. They are trained to cope and are less likely to develop immediate symptoms of horror or helplessness. Prevalence figures suggest that of those experiencing severe trauma, around 5% would develop early symptoms of PTSD, **72** decreasing significantly over time. In a group of firefighters who regularly attend traumatic events, a general prevalence of 5% with PTSD could be expected, but in those who rarely attend such events, a lower prevalence would be expected.

Fire and Rescue Services should analyse the experiences of their staff to determine the risk. In general, traumatic events which involve witnessing accidents or natural disasters tend to be less likely to be associated with PTSD than direct physical attacks, being held hostage or threatened with a weapon. Attendance at house fires would be a low risk, but attendance at house fires with fatalities would be high risk. Attendance at road traffic crashes would only be high risk if there were major trauma. Attendance at a major event where firefighters were severely injured or killed would represent a very high risk. Nevertheless, studies suggest that of firefighters significantly injured in a situation where others lost their lives would only be expected to show a prevalence of around 5% PTSD against the full DSM IV criteria. A much higher prevalence of symptoms would be expected, but not of the actual diagnosis.

There is a clear dose-response relationship between the severity of the event and risk of developing PTSD. Fire Services should be aware of this and be prepared to expect PTSD after particularly traumatic events such as the Marlie Farm fireworks fire in 2006 where two firefighters were killed and others injured in an explosion.

72 Del Ben K et al. Prevalence of posttraumatic stress disorder symptoms in firefighters. *Work Stress*. 2006;20(1):37-48.

Screening for PTSD:

PTSD is best treated early, however, as noted above, PTSR symptoms are relatively common after a traumatic incident and at present there is no good evidence that the benefits of screening outweigh the risks. The NICE guidelines currently advice against widespread screening amongst individuals with relatively low risks of PTSD. However, they recommend consideration of more targeted screening of high risk individuals using a brief screening instrument one month after exposure to a potentially traumatic event **73**.

Self-reported symptoms can be assessed using tools such as the Impact of Event Scale (IES), the Post-traumatic Diagnostic Scale (PDS), the Davidson Trauma Scale, the Trauma Screening Questionnaire (TSQ) or the PTSD Checklist. A recent study using the PTSD Checklist was found to have 0.85 sensitivity and 0.82 specificity compared to the results from a trained interviewer **74**. This suggests that self-report screening may have a place in identifying firefighters at high risk for PTSD. NICE did not recommend any specific screening tool in 2005, **75** although they felt the shorter and simpler tools, such as and the TSQ, a shorter version of the DTS (the SPAN questions) or the IES questionnaire were most likely to be of use in a non-specialist setting.

However, despite this, the issue of screening has remained controversial. Some have suggested that many individuals with symptoms of PTSD do not get help and that screening may help identify these individuals early. However, encouraging self-diagnosis and screening is not without risks. Screening will inevitably cause some false positives (those who screen positive but do not have the disorder) resulting in potentially unnecessary anxiety and a greater sense of vulnerability. Screening programs can also be very expensive and can divert resources away from those seeking help. To date there is no good evidence that screening after traumatic experiences can prevent or reduce the levels of post-trauma mental illness, although studies testing the role of screening after military deployment are currently ongoing and will hopefully provide a more definitive answer in the near future **76**.

73 Royal College of Psychiatrists and British Psychological society. National Clinical Practice Guideline 26. Post traumatic stress disorder (PTSD): the management of PTSD in adults and children in primary and secondary care. 2005. National Institute for Clinical Excellence. London.

74 Chiu S et al. Performance characteristics of the PTSD Checklist in retired firefighters exposed to the World Trade Center disaster. *Ann Clin Psychiatry*. 2011;23(2):95-104.

75 Royal College of Psychiatrists and British Psychological society. National Clinical Practice Guideline 26. Post traumatic stress disorder (PTSD): the management of PTSD in adults and children in primary and secondary care. 2005. National Institute for Clinical Excellence. London.

76 Kings Centre for Military Health Research. A fifteen-year report. What has been achieved by fifteen years of research into the health of the UK Armed Forces. KCMHR Sep 2010.

Predicting PTSD in Individuals:

It is very difficult to predict those at higher risk of developing PTSD although some individual factors have consistently been shown to be associated with an increased risk. Although males are more likely to be exposed to traumatic events, once exposed to trauma, females have an increased risk of PTSD. Personality factors such as neuroticism and past psychiatric disorder may be contributory factors **77**. There is a high incidence of co-morbidity between PTSD and other psychiatric disorders, although it can often be difficult to know which disorder came first. While depression and substance abuse appear to follow from PTSD in most cases, where there is associated anxiety this preceded PTSD in around half the cases **78**.

While increased use of alcohol can be seen secondary to PTSD symptoms, other studies have suggested that alcohol abuse may increase the likelihood of traumatization because of its association with violence and accidents **79**.

A study of victims of an Armenian earthquake found a clear genetic link with 41% of PTSD symptoms heritable ($p < 0.001$), and a 0.75 correlation between PTSD and anxiety symptoms ($p < 0.001$), and a 0.71 correlation between PTSD and depressive symptoms ($p < 0.001$) **80**. This suggests that a family history of PTSD, depression or anxiety, and a prior history of depression and anxiety is a predictive factor for an individual developing PTSD in future. Twin studies have suggested that around one third of the variance of PTSD may be attributed to genetic factors, with some evidence that specific genes such as the serotonin promoter gene, may interact with certain environmental situations to increase an individual's vulnerability **81 82**.

Evidence suggests that adults who were exposed to trauma as children are more at risk **83**. Another study showed that fear of emotion was a significant predictor of PTSD, possibly by preventing social support from buffering distress **84**.

A prospective follow-up study of 43 Swiss firefighters found that a high level of hostility and a low level of self-efficacy accounted for 42% of the variance in posttraumatic stress symptoms after 2 years. Subjects with both risk factors at baseline showed a significant increase in measures of PTSD symptoms, depression,

anxiety, general psychological morbidity, global symptom severity and alexithymia (a personality trait involving difficulty understanding, processing or describing emotions). They also measured neuroendocrine activity by examination of awakening and diurnal salivary cortisol and 24-hour catecholamine excretion but these were not predictive of developing psychopathological symptoms **85**.

After an event that meets the DSM IV definition of 'traumatic' there may be some factors that could predict individuals at risk. Emotional numbing at the time of the traumatic event has been shown to predispose to PTSD **86** and individuals who feel guilt may also be more at risk. Guilt may be because the individual feels they either made a mistake on the fireground, or that they could have done more. Studies of UK military personnel have also identified factors such as weak unit cohesion and poorer perceived leadership as being important in predicting PTSD after combat experiences **87**.

Overall, the most important factors predicting PTSD appear to be prior trauma and psychological morbidity, the trauma severity, peri-traumatic dissociation, post-trauma lack of social support, and more subsequent life stress **88 89**.

A recruit with a significant history of clinically diagnosed and treated anxiety and depression within the last few years is likely to be at too high a risk of future problems including PTSD. A significant history would be one episode lasting longer than 12 weeks, or two or more episodes within the last three years, or more than two episodes requiring clinical intervention. A previous diagnosis of PTSD represents too high a risk of recurrence for a recruit, but care should be taken to ensure the original diagnosis was correct.

77 McFarlane AC. The aetiology of post-traumatic morbidity: predisposing, precipitating and perpetuating factors. *British Journal of Psychiatry*. 1989;154:221-8.

78 Kessler RC et al. post-traumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry* 1995;52:1048–60.

79 McFarlane AC. Epidemiological evidence about the relationship between PTSD and alcohol abuse: the nature of the association. *Addictive Behaviors* 1998;23:813–25.

80 Goenjian AK et al. Heritabilities of symptoms of posttraumatic stress disorder, anxiety, and depression in earthquake exposed Armenian families. *Psychiatr Genet*. 2008;18(6):261-6.

81 True WR, Rice J, Eisen SA, Heath AC, Goldberg J, Lyons MJ, et al. A twin study of genetic and environmental contributions to liability for posttraumatic stress symptoms. *Arch Gen Psychiatry*. 1993;50:257–264

82 Koenen KC, Amstadter AB, Nugent NR. Gene-environment interaction in posttraumatic stress disorder: An update. *J Trauma Stress*. 2009 October; 22(5): 416–426.

- 83** Krahé B, Scheinberger-Olwig R, Waizenhöfer E, Kolpin S. Childhood sexual abuse and revictimization in adolescence. *Child Abuse Negl.* Apr 1999;23(4):383-94.
- 84** Farnsworth JK, Sewell KW. Fear of emotion as a moderator between PTSD and firefighter social interactions. *J Trauma Stress.* 2011;24(4):444-50.
- 85** Heinrichs M et al. Predicting posttraumatic stress symptoms from pretraumatic risk factors: a 2-year prospective follow-up study in firefighters. *Am J Psychiatry.* 2005;162(12):2276-86.
- 86** Roemer L et al. Emotional response at the time of a potentially traumatizing event and PTSD symptomatology: a preliminary retrospective analysis of the DSM-IV criterion A-2. *Journal of Behavioural Therapy and Experimental Psychiatry* 1998;29:123–30.
- 87** Mulligan K et al. Mental health of UK military personnel while on deployment in Iraq. *Br J Psychiatry.* 2010;197(5):405-10.
- 88** Brewin, C. R., Andrews, B. & Valentine, J. D. (2000) Meta-analysis of risk factors for post-traumatic stress disorder in trauma-exposed adults. *Journal of Consulting and Clinical Psychology*, 68, 748–766..
- 89** Ozer, E. J., Best, S. R., Lipsey, T. L., et al (2003) Predictors of post-traumatic stress disorder and symptoms in adults: a meta-analysis. *Psychological Bulletin*, 129, 52–73.

Resilience:

Do beliefs influence development of PTSD? An assessment of firefighters in training and followed up after six months found that post-traumatic stress was predicted by pre-trauma catastrophic thinking. This supports the view that a tendency to catastrophise about negative events is a risk factor for developing post-traumatic stress symptoms **90**. Such findings have led some to wonder whether it is possible to increase individuals' resilience prior to any traumatic event occurring.

Some individuals show increased resilience, and a recent study of firefighters found 'mindfulness' was associated with fewer PTSD symptoms, depressive symptoms, physical symptoms and alcohol problems **91**. Mindfulness is a psychological concept taken from Buddhist meditation and represents the ability to focus the mind completely on the present in a non-judgemental way, accepting what is happening 'as it is'. Other religions and cultures have similar approaches in accepting events as 'the will of God', and this could in part explain the significant cultural differences in incidence and prevalence of PTSD.

A new assessment tool, the Firefighter Coping Self-Efficacy (FFCSE) Scale has been developed in the US. This has been analysed in relation to measures of psychological well-being, social support, work-related stress and psychological distress **92**. More work may show how important it is to manage stressors at work

and ensure good social support, how to identify those at risk, and help develop tools to improve resilience among firefighters.

Resilience may change during service. A study in Canada found that new recruits entered service with considerable experience of exposure to critical events, but a linear relationship was found between years of experience and levels of traumatic stress and depression. The study also found that experienced firefighters had lower levels of social support and lower self-efficacy than new recruits, suggesting that these protective factors may diminish over time **93**.

Organisations are increasingly adopting risk management approaches, training and organisational measures to try to reduce the risk of PTSD. While these are in part aimed at dealing with the aftermath (see below), there is evidence that adopting these procedures reduces the risk. A system widely adopted throughout the UK military, Trauma Risk Management (TRiM) aims to train soldiers to help support their peers after a traumatic event and to help facilitate appropriate treatment when needed. Programs such as TRiM are not aimed at preventing or treating PTSD, but hope to alter the culture of a workgroup and reduce the barriers which might delay those with symptoms seeking help **94**.

Resilience may vary between occupational groups, possibly because of differences in selection processes, training or unit cohesion. One study found significant differences between Royal Marines, Paratroopers and Infantry, where the differences were not explained by the level of unit cohesion, suggesting a higher level of preparedness may lessen the psychological impact of deployment **95**.

A study comparing prevalence of PTSD between Police and Firefighters following the World Trade Center disaster found overall prevalence of PTSD at 6.2% for police, 12.2% for firefighters and 21.2% for unaffiliated volunteers. A variety of possible reasons for the discrepancy were suggested, including differences in training and preparedness (unlikely between police and firefighters), differences in selection (police recruit selection may favour more resilient individuals) and reporting (police underreporting to avoid sanctions for carrying weapons in future) **96**. No difference was reported after Hurricane Katrina, with PTSD prevalence 19% in police and 22% in firefighters. The difference here was significant increased risk to the police from civil disobedience, hostility and violence **97**.

90 Bryant RA, Guthrie RM. Maladaptive appraisals as a risk factor for posttraumatic stress: a study of trainee firefighters. *Psychol Sci.* 2005;16(10):749-52.

91 Smith BW et al. Mindfulness is associated with fewer PTSD symptoms, depressive symptoms, physical symptoms and alcohol problems in urban firefighters. *J Consult Clin Psychol.* 2011;79(5):613-7.

92 Lambert JE et al. The Firefighter Coping Self-Efficacy Scale: measure development and validation. *Anxiety Stress Coping.* 2011; epub:1-13.

93 Regehr C et al. social support, self-efficacy and trauma in new recruits and experienced firefighters. *Stress Health.* 2003;19(4):189-93.

94 Greenberg N et al. A cluster randomised controlled trial to determine the efficacy of TRIM (Trauma Risk Management) in a military population. *J Traumatic Stress* 2010; 23: 430-6.

95 Sundin J et al. Mental health among commando, airborne and other UK infantry personnel. *Occup Med (Lond)*. 2010;60(7):552-9.

96 Perrin MA et al. Differences in PTSD prevalence and associated risk factors among world trade center disaster rescue and recovery workers. *Am J Psychiatry*. 2007;164:1385-94.

97 Bernard BP, Driscoll RJ. Health hazard evaluation of police officers and firefighters after Hurricane Katrina—New Orleans, La, Oct 17–18 and Nov 30–Dec 5, 2005. *MMWR* 2006; 55:456–458

Differential Diagnosis:

PTSD is just one of the possible psychological consequences of exposure to a traumatic event. Firefighters may present with significant symptoms of a variety of mental health disorders, such as adjustment disorder, personality disorder, depression, phobias, psychosis or substance abuse (particularly alcohol abuse). These may be secondary to PTSD, they may co-exist with symptoms of PTSD or they may lead to PTSD symptoms being exaggerated.

Co-morbid psychiatric problems are common, and in two studies in USA **98** and Australia **99** 85-88% of men and 78-80% of women with PTSD had a co-morbid psychiatric diagnosis using the DSM-III criteria. Deciding which is the primary condition requires an assessment of the functional relationship between the two, and the timing of symptoms. Where PTSD symptoms arise after other significant mental health symptoms had been reported this suggests it is not the primary condition. Where other symptoms arise after trauma and after PTSD symptoms, this suggests these are a part of the presentation of PTSD. In the first of the two studies noted above, PTSD was primary to affective disorders or substance misuse in most cases, and primary to anxiety disorders in around half of cases.

It is particularly important to determine whether PTSD is the principal diagnosis, or whether an alternative diagnosis is more appropriate as treatment and expectations will be different. The history given may vary considerably between practitioners, which is why diagnoses may differ considerably. It is important to ensure that a treating mental health practitioner has a full and appropriate history. Copies of reports from the treating mental health practitioner should be requested, and if there are obvious gaps such as prior mental health problems, or details of previous traumatic exposure, these should be made clear. The role of the Medical Adviser in these circumstances is primarily to support the firefighter, and employment details must not be withheld if they could help with diagnosis and treatment.

Particular concern has been expressed in the past in relation to personality disorders. These are more enduring and entrenched, although traumatic events can be important in understanding how an individual with strong personality traits is currently presenting. It has been suggested that some PTSD treatments may be harmful in personality disorder. Treatment for other co-morbidities such as depression may help, and NICE suggests that patients with personality disorder and PTSD could benefit from trauma-focussed psychological interventions, but may need these for an extended duration **100**.

98 Kessler RC et al. (1995) Post traumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry*. 1995;52:1048–1060.

99 Creamer M, Burgess P, McFarlane AC. Post-traumatic stress disorder: findings from the Australian National Survey of Mental Health and Well-being. *Psychological Medicine*, 2001;31:1237–1247.

100 Royal College of Psychiatrists and British Psychological society. National Clinical Practice Guideline 26. Post traumatic stress disorder (PTSD): the management of PTSD in adults and children in primary and secondary care. 2005. National Institute for Clinical Excellence. London.

Critical Incident Support:

Around thirty years ago, medical practitioners became aware that the problem of PTSD was significant and that 'something needed to be done' both to treat individuals suffering acute symptoms and to try to prevent the problems developing into PTSD.

A significant step in prevention was the development of 'Critical Incident Stress Debriefing' (CISD), a concept first suggested by Mitchell **101** following his work with New York firefighters, and subsequently studied by Dyregrov **102**. However this process has since been rigorously assessed **103** and two key issues identified; some individuals benefit from the specific CISD process while others can be harmed by the process. Overall, CISD has been shown to not be helpful and to possibly increase the risk of PTSD **104**. The reasons for this are not clear, although it has been speculated the CISD may interfere with usual coping mechanisms.

Current NICE guidelines recommend that the systematic provision of brief, single-session interventions (often referred to as debriefing) that focus on the traumatic incident, should not be routine practice when delivering services **105**. There is now also evidence that multiple session debriefing may also result in worse outcomes **106**.

What should be done post-incident?

This does not mean that nothing should be done. It is only debriefing that should not be used routinely. There are other less specific support mechanisms that are of benefit and should be provided **107 108**.

Where individuals have significant symptoms early on, they will benefit from treatment whether or not they meet the DSM IV criteria. NICE note that where symptoms are mild and have been present for less than four weeks, watchful waiting is appropriate, with follow-up to ensure recovery.

Practical support delivered in an empathetic manner is recommended to promote recovery. General support from colleagues and managers is one of the most important aspects of good post-incident management. The other important aspect is identification of those who have specific problems and require referral to specialist medical and psychological practitioners. This can be achieved through a risk assessment process and education of those effected. Events that meet the DSM IV criterion for 'traumatic' can be identified and represent the hazard. Those exposed to the hazard may be at risk of developing post-traumatic stress reactions.

The task of risk assessment should be carried out by management following appropriate training. Any advice then required, or follow-up of individuals considered to be vulnerable or showing signs or symptoms of PTSD, would involve occupational health and clinical specialists as appropriate.

A number of organisations have introduced structured systems for trauma risk assessment and management, the TRiM system being a good example **109**. The focus is on support from colleagues and line management rather than external intervention. In a well-prepared organisation, this support will be intrinsic to the organisation, providing holistic support throughout employment, rather than just intervention after traumatic events.

Treatment after four weeks:

Treatment is usually through a combination of medication and psychotherapy. Psychotherapeutic techniques can be very emotionally challenging for the patient, and medication may help the patient cope with the early stages of treatment.

The NICE guidelines **110** recommend trauma-focussed CBT for those with severe post-traumatic stress symptoms within the first month after the traumatic event, on an individual outpatient basis. All people diagnosed with PTSD at a later point should be offered a course of trauma-focussed CBT or eye movement desensitisation and reprocessing (EMDR), normally on an individual outpatient basis. Drug treatments should not be used as a routine first-line treatment in preference to trauma-focused psychological therapy, but paroxetine or mirtazapine can be used by GPs, and amitriptyline or phenelzine by mental health specialists, for those who express a preference not to engage in trauma focussed psychological treatment.

Cognitive behaviour techniques and desensitisation therapies have been shown to be effective **111**, as has EMDR **112**. Access to these can be very variable through the NHS with long delays possible. Many organisations establish a system for private referrals in these circumstances in order to access timely support and care.

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Outcome of PTSD:

Most individuals recover over a period of six months to a year with little intervention, and will continue at work. A few will be unable to work, and many of these will recover with treatment. Some firefighters may recover if removed from the job but may find their symptoms relapse on returning to work. As there is little evidence on the question as to whether a previous episode of PTSD makes individuals significantly more vulnerable if re-exposed to similar circumstances, one episode of PTSD related to firefighting should not automatically bar an individual from further service as a firefighter.

Any decision to retire a firefighter with this diagnosis should be considered very carefully following appropriate advice from a psychiatric specialist and only after sensible treatment options have been tried and failed.

Individuals who have developed further PTSD symptoms after return to active firefighting should be considered to be at high risk of further ill-health and should avoid further exposure if possible. Any return to firefighting should follow discussions with the individual and the treating clinician.

Persistent symptoms of severe PTSD can lead to enduring personality change ICD-10 F62.0. This is characterised by social withdrawal, hostility and mistrust with feelings of emptiness or hopelessness and is not normally compatible with employment.

Schizophrenia

Schizophrenia is a rare condition. The incidence and prevalence of the disorder depend on the criteria for diagnosis and the populations surveyed but the prevalence in the UK is estimated to be almost 1%. The annual inception rate in various studies has been found to be around 0.1 per 1000 [113](#). Some of the features of schizophrenia including thought disorders, delusions and hallucinations could have serious and dangerous effects in the context of operational firefighting or the control room.

A small proportion of patients with schizophrenia in this country (less than 20%) have a complete and permanent remission following a single episode [114](#). In others, the condition will be only partially controlled or regularly relapsing.

Good prognostic signs include sudden onset, short episode, no previous psychiatric history, prominent affective symptoms, paranoid type of illness, older age at onset, married, good previous personality, good work record, good social relationships and good compliance.

It is conceivable that an applicant for the Fire and Rescue Service who has a history of a single episode of schizophrenia and who has been in complete remission for more than two years could be deemed at low risk of recurrence and be considered fit for employment as a firefighter or controller. It seems much more likely that people with a past history of schizophrenia would either not apply for employment as a firefighter or would be found unsuitable.

If a single episode occurs in a serving firefighter, it may be inappropriate to retire the employee until very careful consideration has been given to their prognosis. However, it is unlikely, though possible, that such an individual would be deemed fit to return to operational firefighting or control room duties.

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Deliberate Self Harm

People harm themselves for a variety of reasons including an intention to end their life and a wish to express their desperation but without an intention to die. In either case there is often a history of long-term relationship or social problems including unemployment and financial difficulties. In addition there is often an underlying psychiatric disorder such as depressive disorder, personality disorder or dependence on alcohol or other substances. There is usually a history of excessive life stresses in the preceding six months [3](#).

Prognosis for these people is dependent on any underlying condition and its response to treatment in addition to the ongoing life circumstances of the person concerned. An applicant for the Fire Service with a past history of deliberate self-harm is at greater risk of subsequent psychiatric illness and potential ill health retirement. Where the problem happened many years previously in response to a particular set of circumstances which are unlikely to recur and the applicant is considered free from any psychiatric disorder, he or she might be accepted after very careful consideration. Recruits and serving firefighters and controllers must be carefully assessed for the likelihood of sudden onset, uncontrolled risks to safety.

3 Gelder M, Gath D, Mayou R, Cowen P. Oxford Textbook of Psychiatry 3rd Edition, Oxford: Oxford University Press, 1996.

Cognitive Disorders and Organic Mental Ill Health

Any significant current cognitive impairment secondary to organic disease or injury is likely to severely affect performance during the process of application and assessment for operational roles with the Fire Service. Application following full or partial recovery from such a disorder must be judged on its merits including the level of functional ability and the prognosis of the causative condition. In serving individuals, the prognosis will relate to the underlying condition and judgements about ill health retirement cannot be made until this is fully understood.

Eating Disorders

Eating disorders are most prevalent in young women but can occur in men. Such disorders include anorexia nervosa, in which there is significant weight loss together with distorted views of body image and fatness. The other major category is bulimia nervosa, in which subjects binge and vomit and this too is associated with a distorted view of body image. There is also a milder problem of excessive preoccupation with weight and dieting which is very common and is difficult to distinguish from normal behaviour.

Anorexia is associated with behaviours such as laxative abuse, and the illicit use of diuretics, thyroid hormone, appetite suppressants and excessive exercising. This, together with loss of body weight may have serious implications for operational fire fighting. Anorexia nervosa has a poor prognosis and often runs a chronic course. The diagnosis of continuing anorexia nervosa would normally lead to advice not to employ candidates as firefighters and the consideration of redeployment or medical retirement in those already serving.

Bulimia nervosa is not associated with such a poor prognosis, and in general there is less likelihood of physical incapacity. However it can be associated with other mental disorders such as depression, personality difficulties and substance abuse, such that the discovery of such a diagnosis should lead to the careful examination for other problems.

Alcohol and Drug Abuse

Intoxication with alcohol or other substances while on duty is a matter for discipline, which is quite likely to result in dismissal. The medical issues relate to the medical conditions consequent on longer-term misuse. These will be addressed separately for alcohol and other substances.

Alcohol

Epidemiological evidence from the USA suggests a 1 year prevalence of alcohol dependence between 7% and 10% [8](#). While there is no equivalent research from the UK, alcohol dependence is common in the UK working population and support must be available for firefighters who seek help with this condition.

In addition to the social effects of excessive drinking, medical effects fall into two general categories, physical (including hepatic and neurological conditions) and psychiatric (including psychosis, personality and mood disorders and suicide behaviour). The phenomenon of dependency is defined in ICD10 by (three out of) six criteria.

Prognosis for psychiatric or physical effects depends on the effect concerned, its severity, and the long-term success or otherwise of withdrawal. In a prospective study in the USA, only 25% of subjects remained abstinent after 6 months and only 10% after 18 months although 70% had reduced their alcohol intake [115](#).

An actuarial assessment of fitness for applicants to whole time service is concerned with the risk of subsequent medical problems and consequent premature retirement. This is likely to be considered unacceptably high in those with a previous history of alcohol dependency and associated physical or psychiatric disorders even in those who have apparently made a full recovery.

In serving firefighters and controllers, the assessment is one of the likelihood of sudden onset, uncontrolled risks to safety. Careful consideration will need to be given before judging the recovering alcoholic as fit for operational duties.

Other Substances

In practice, neither serving staff nor recruits are likely to admit to illicit use of drugs such as amphetamines, opiates, cocaine, ecstasy, cannabis or hallucinogens. Proven use of such substances which becomes known to management is likely to result in discipline and possibly dismissal.

The use of performance or muscle enhancing drugs such as anabolic steroids by body builders etc. presents a similar quandary for the medical adviser, particularly where there are known harmful physical effects. It is not appropriate to discuss ethical issues about the disclosure of such information in this guidance and other references do cover these issues in more depth [116](#). There should be a Service policy on drug abuse.

With regards to assessment of fitness for firefighting and the control room, the medical issues are very similar to those discussed above under alcohol. Physical or psychiatric disorders apparently resulting from use of and dependency on illicit substances must be assessed separately for their prognosis. Medical Advisers should base advice on employment on medical issues, relying on the Service policy on drug abuse to deal with any future disciplinary issues.

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New for 2012

Psychoactive Medications:

There is a great deal of published evidence in relation to drug side effects, although as this is constantly being updated and is vast in its quantity, it would be of limited value to list it all here. The British National Formulary **115** is an obvious and very useful reference, and there are many useful internet sites. More detailed information can also be found in the Maudsley Prescribing Guidelines **116**. Fitness to Drive **117** is also of relevance to firefighting. While some of the more common side effects are listed below, numerous others are recognised and may arise in individual firefighters in a way which can be difficult to predict.

Many different therapeutic agents affect mental function. The effects can be on cognition, coordination, mood or behaviour. In some, the drug is being used for a physical condition, in others it is being used for a mental health condition. Treating clinicians will always be trying to achieve a balance between therapeutic advantage and side effects, and the ability to remain in work is usually high on the list of priorities. In most cases the response to the drug varies considerably between patients, and the treating clinician will choose the drug that combines treatment efficacy with tolerability.

Where the effect on work has become unacceptable, in most cases it should be possible to identify an alternative drug that has less or different side effects. Before making a long-term decision on fitness it is important to ensure that the treating clinician is aware of the problem and has done all that can reasonably be expected to try alternative medications and alternative doses.

In the context of assessing long-term fitness for firefighting, the issues that need consideration with psychoactive medications are as follows:

Does the drug (or interaction between drugs) cause unwanted effects which might be associated with an unacceptable risk to safety in operational firefighting?

Is the nature or degree of unwanted side effects likely to change over time?

Does the condition being treated have residual uncontrolled features that might be associated with an unacceptable risk to safety in operational firefighting?

Will treatment be required in the longer-term? (How long?)

Will withdrawal of treatment carry a risk of relapse of the disorder being treated? This is a particular issue with poor compliance, particularly when poor compliance is a feature of the underlying condition.

When selecting recruits, the risk assessment needs to include both the risk from the underlying condition and from medication. Risk in the context of firefighting can be substantial and management may well be justified in taking a firm stance in relation to enduring mental health problems with potentially high risk of sudden changes in behaviour or cognition, a high risk of prolonged and repeated sickness absence, or a high risk of side effects from treatment. In most mental health conditions, the best predictor of future behaviour is past experience, and care should be taken to get a full history of past employment, past problems and any difficulties with medication.

It is often more important to consider the underlying condition rather than the medication. For example the DVLA 'At a Glance Guide' **118** recommends a person with a history of an acute psychotic disorder should have a period of three years when they are well and stable before driving Group 2 vehicles, and a similar approach would be expected in firefighters. A person with a history of severe anxiety or depression should have a stable period of at least six months before driving Group 2 vehicles. The focus is on the stability of the condition while on medication.

Many drugs potentiate the effects of alcohol, and this should be an additional consideration.

Women may be stable on treatment for many years, but the treatment may be contra-indicated in pregnancy, and this can lead to difficulties with recurrence of illness if a female firefighter has decided to start a family. This is likely to need careful supervision during any medication changes and during pregnancy. Time should be allowed for her to settle back onto effective treatment after pregnancy before resuming normal duties.

115 British National Formulary. British Medical Association and Royal Pharmaceutical Society of Great Britain. London. Published six monthly.

116 Taylor D, Paton C, Kapur S. The Maudsley Prescribing Guidelines in Psychiatry. 11th Edn. Wiley and Sons Ltd. London. 2012 (due publication in Mar 2012).

117 Carter T. Fitness to drive: a guide for health professionals. Royal Society of Medicine and HMSO: London. 2006

118 Drivers Medical Group DVLA. At a glance guide to the current medical standards of fitness to drive. DVLA Swansea Sep 2011, updated at least every six months.

Psychoactive drugs usually incompatible with safe firefighting:

Drugs that can produce drowsiness, ataxia, impaired vision, impaired co-ordination, impaired judgement / cognition or impaired reaction times are likely to be incompatible with safe firefighting and can be dangerous in the control room. Many drugs cause these effects without the patient being aware of them. Medical advisers should be aware of the potential risk and should have a low threshold for concern,

but identifying those employees who are significantly affected by their medication can be difficult.

Antipsychotic Medications:

Typical Antipsychotic Medications:

Developed mainly to treat schizophrenia and related disorders, or disorders with similar features such as depression with psychosis, the most commonly used of these are Chlorpromazine, Haloperidol, Perphenazine, Sulpiride, Flupentixol, Pipotiazine and Fluphenazine. A number of these can be given either as an oral dose or depot injection (usually given once every two to four weeks). Typical side effects include:

- Drowsiness and poor concentration
- Dizziness
- Motor or extrapyramidal effects including rigidity, muscle spasms, tremors and restlessness.
- Tardive dyskinesia
- Blurred vision
- Palpitations
- Along with skin rashes, menstrual problems and other minor effects

In many cases the major side effects settle within a few days or weeks. These drugs are most likely to be used in the more enduring and severe mental health conditions which are likely to be incompatible with a career as a firefighter. Medical Advisers are unlikely to come across recruits or firefighters on these medications, and if they do it is important to ensure they fully understand the diagnosis and prognosis before advising the individual is fit.

Atypical Antipsychotic Medications:

Developed more recently, this group includes Clozapine, Risperidone, Olanzapine, Quetiapine, Ziprasidone, Aripiprazole, Amisulpride and Paliperidone.

These agents were initially developed to treat psychotic illnesses with less motor or extrapyramidal side effects compared to the typical antipsychotics. Because of this altered side effect profile and some reported improvements in treatment efficacy, atypical antipsychotics tend to often, but not always, be the first line treatment for those with a psychotic illness.

Recent evidence has shown that many atypical antipsychotics have other actions beyond treating psychosis. Some have been shown to have significant anxiolytic, antimanic and antidepressant properties. As a result, atypical antipsychotics have begun to be used for conditions other than schizophrenia, such as for refractory depression, and as a primary mood treatment and mood stabilisation for bipolar disorder. It is not unusual for a firefighter to develop these conditions and to respond

well to treatment. Any decision on fitness will depend on the individual circumstances of the case. As noted above, atypical antipsychotics tend to not have the more severe motor and extrapyramidal effects of the typical antipsychotics but may be more prone to cause sedation and metabolic side effects in some. Side effects of these include:

- Drowsiness and poor concentration
- Dizziness
- Blurred vision
- Palpitations
- Metabolic changes including significant weight gain.
- Along with skin rashes, menstrual problems and other minor effects

Mood Stabilisers:

Mood stabilisers are mostly used in bipolar disorder but may also be used for individuals with recurrent depression or depression which does not respond to usual treatment. Commonly used mood stabilisers include lithium, sodium valproate, carbamazepine, lamotrigine, oxcarbazepine. Some have epileptogenic potential, and this should be considered. DVLA should always be informed when Group 2 drivers are on these medications and the Group 2 licence may be withdrawn temporarily or permanently.

Lithium is very effective in many patients but also potentially very toxic, meaning regular monitoring of blood levels is needed. Acute dehydration increases the risk of toxicity. A period of several months should be allowed before recommending a return to normal firefighting duties. A number of studies have suggested Sodium Valproate has similar levels of effectiveness to Lithium. Side effects of each individual mood stabiliser will vary, but include:

- Mild gastrointestinal upset and nausea
- Tremor
- Loss of coordination
- Polydipsia and polyuria
- Blackouts and seizures
- Slurred speech
- Disturbance of thyroid function
- Cardiac rhythm disturbances
- Altered vision

Of particular concern, a number of mood stabilisers are established human teratogens, meaning a change in treatment is often needed if pregnancies are being planned.

Antidepressant Medications:

There is currently concern that there may be some over prescribing of antidepressants in primary care, with evidence of substantial effectiveness of medication compared to other interventions in mild depression limited, particularly when the symptoms are a reaction to adverse life events. Where adverse reactions are preventing a firefighter from working safely, the issue of medication should be raised with them and their treating clinician to ensure that the medication is appropriate and necessary. When an episode of depression has responded to antidepressant medication, it is advised that antidepressant should, where possible, be continued for at least six to nine months in order to reduce the risk of an early relapse **119**.

Antidepressants, like most psychoactive medications, affect levels of neurotransmitters. Target neurotransmitters include serotonin, noradrenaline and dopamine. Older antidepressants include tricyclics, tetracyclic and monoamine oxidase inhibitors (MAOIs). Newer antidepressants include selective serotonin reuptake inhibitors (SSRIs) and serotonin and noradrenaline reuptake inhibitors (SNRIs). Both old and newer antidepressants have similar levels of efficacy, so the choice of which agent to use is usually made based on the most acceptable side effect profile. Despite overall levels of efficacy being similar, individual responses to different agents may vary, so swapping antidepressants is usually the first step when a depressive episode does not respond adequately to treatment.

There are particular risks associated with sudden withdrawal of antidepressants, particularly if the individual has been taking them regularly for more than a few weeks. These effects include insomnia, irritability, nausea, flu-like symptoms, dizziness, paraesthesia, problems with concentration, increased dreams, anxiety and panic attacks and motor restlessness. These symptoms are usually mild and self-limiting, but they can be wrongly mistaken for a relapse and, at times, can be severe enough to limit work functioning for a short period. While it is important to be aware of this possibility, it is equally important for patients to understand that antidepressants are not addictive and that these symptoms can usually be minimised by avoiding sudden withdrawal of antidepressant medication.

Many people take antidepressant medication for prolonged periods with no significant ill-effect. There is no clear reason to stop a firefighter from working normally once they are stable on treatment.

SSRIs:

- Commonly used SSRIs include Fluoxetine, Citalopram, Sertraline, Paroxetine, Fluvoxamine and Escitalopram. Common side effects include:
- Headache
- Nausea
- Abdominal pain

- Diarrhoea
- Sleeplessness or drowsiness (insomnia more common, so usually advice to take in the mornings)
- Agitation
- Sweating
- Sexual dysfunction
- SNRIs

Commonly used SNRIs include Venlafaxine and Duloxetine. Common side effects include:

- Headache
- Nausea
- Sleeplessness or drowsiness
- Agitation
- Dizziness
- Increased blood pressure
- Dry mouth and constipation
- Sexual dysfunction
- Tricyclic Antidepressants

Tricyclics can be divided into those with additional sedative properties and those which are less sedative. Commonly used tricyclics with sedative properties include amitriptyline, clomipramine, dothiepin, doxepin, maprotiline, and trimipramine. Mianserin and trazodone are tetracyclics with similar actions but fewer anticholinergic effects than tricyclics. Less sedative tricyclics include amoxapine, imipramine, lofepramine, nortriptyline and viloxazine. Protriptyline is relatively unique amongst tricyclic antidepressants in that it has a stimulant action. Most tricyclic antidepressants have the potential for cardiovascular side effects and many are very cardiotoxic in overdose. As a result, they should be used with great caution in any individual with significant risk of overdose. Due to this concern and the side effects associated with the antimuscarinic action of tricyclics, they tend to no longer be first line therapy for depression.

Common side effects (besides sedative properties as above) include:

- Blurred vision
- Postural hypotension
- Tachycardia and arrhythmias
- Dry mouth
- Constipation
- Bladder problems

MAOIs:

MAOIs are rarely used now, and the most often used are phenelzine and isocarboxazid. They are generally chosen for patients resistant to other treatments with phobias, hypochondriacal or hysterical features. Of particular concern are the interactions with other foods and medicines particularly those containing tyramine. Foods include cheese, wine, broad and soya beans, meat or yeast extracts and pickles. Medicines include decongestants and cold medicines. Interactions with tyramine include severe hypertension and stroke.

Common side effects are:

- Postural hypotension
- Dizziness
- Headache
- Insomnia or drowsiness
- Weakness and fatigue
- Other Antidepressants

Mirtazepine is an antidepressant which acts of a variety of receptors. It is more likely to cause sedation than most of the other newer antidepressants, but it is effective and is less likely to cause other common antidepressant side effects such as nausea and sexual dysfunction.

119 Anderson IM et al. Evidence-based guidelines for treating depressive disorders with antidepressants: a revision of the 2000 British Association of Psychopharmacology guidelines. *J Psychopharmacol* 2008; 22: 343-396

Anxiolytic Medication:

Anxiety is often linked to depression, although even in the absence of co-morbid depression many of the antidepressants may be used successfully to treat anxiety symptoms. While alternative treatments including specific anxiolytics are available, SSRI antidepressants are now considered first line treatment (along with psychological treatments) for panic disorder, generalised anxiety disorder and obsessive-compulsive disorder. Because some individuals will notice an initial worsening of anxiety symptoms on commencing an antidepressant, starting doses are usually lower than those used to treat depression, with doses gradually titrated up to effective levels.

Benzodiazepines:

Benzodiazepines provide rapid symptomatic relief from anxiety. Commonly used benzodiazepines include clonazepam, lorazepam and alprazolam. All have potential problems with tolerance and addiction, meaning the lowest effective dose should be

used and except in very usual situations, benzodiazepines should not be prescribed for longer than four weeks. Temazepam is too short-acting to be of use as an anxiolytic but is often prescribed to help with sleep and may be considered for those needing to sleep on long-haul flights. The major side effects of benzodiazepines are drowsiness, disinhibition, impaired driving performance, ataxia and dizziness.

Beta Blockers:

Beta blockers, such as propranolol, are sometimes prescribed to those who suffer panic attacks, however, it should be noted that they do not have any psychiatric effect and will only reduce the physical symptoms of acute anxiety. As such, they do not really have much of a role in the treatment of anxiety, beyond short term symptoms relief in acute situations such as performance anxiety. Common side effects include:

- Fatigue
- Dizziness related to postural hypotension
- Cold hands

Use of beta blockers is not in itself a contraindication to operational duties though side effects can include undue fatigue on exertion and step test results will be affected.

Buspirone:

Buspirone acts on specific serotonin receptors and may be helpful in treating some anxiety disorder. Common side effects include drowsiness, nausea, dizziness, nervousness and excitement.

Stimulants:

Adult attention deficit hyperactivity disorder (ADHD) may be a controversial diagnosis, but it is not unusual to find individuals prescribed with stimulants for this. The most common is methylphenidate. This does not commonly have any adverse side effects although it can cause insomnia, mood and appetite changes and more rarely hallucinations, paranoia and mania.

Herbal Remedies:

Herbal remedies are commonly tried and cannot all be listed here. St John's Wort is often used for depression. While there is some evidence to suggest St John's Wort may have some antidepressant effect, there is currently no good understanding of the mechanisms for this and what side effects may occur. Despite this, it is important to

note that it is not a “harmless herbal remedy” and there is good evidence of harmful interactions between St John's Wort and other medications.

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Musculoskeletal

Musculoskeletal problems make up one of the largest groups of disabilities. Unlike many other medical conditions, they are also common in younger people often resulting from sporting activities, road traffic accidents and congenital abnormalities.

Firefighting is a physically demanding job and some of the typical tasks required of firefighters produced a high load on the musculoskeletal system. Ill-health retirement statistics 1 for all fire brigade employees for 1999/2000 show:

	Back	Upper Limb/Neck	Lower Limb	Total
Injury/illness due to service	73	25	39	230
Injury/illness not due to service	78	47	55	545

Medical Advisers will regularly be faced with these problems and as a result will have to make difficult decisions on fitness for appointment or to continue in service.

There are a number of considerations for assessment:

Is the individual currently fit to undertake their role?

Is the individual at risk of sudden incapacity that might affect safety?

Is the individual at increased risk of developing long-term damage and/or disability as a result of his/her employment?

Is the individual at risk of developing long-term problems that will affect fitness and may require early payment of pension?

This chapter does not intend to be comprehensive, but provides guidance on fitness for those suffering from the more commonly presenting musculoskeletal problems.

Musculoskeletal problems:

- [Shoulder Conditions](#)
- [Elbow, Wrist and Hand Conditions](#)
- [Hips](#)
- [Knee](#)
- [Ankle](#)
- [Intra-Articular Fractures](#)
- [Post Traumatic Osteoarthritis](#)
- [Specific Sites of Injury](#)
- [Metal Implants](#)
- [Cervical Spine](#)

- [Lumbar Spine](#)
- [Inflammatory Arthritis](#)

Shoulder Conditions

Dislocation

Anterior dislocation of the shoulder is an extremely common injury, usually caused by a fall or a wrenching external rotation force. Posterior dislocation is much less common.

After dislocation, there is a risk in the long-term of a painful shoulder with limited movement or recurrent dislocation. Fitness for work following dislocation depends to a great extent on the method of treatment. Even a single dislocation treated with strict immobilisation for at least three weeks can recur in up to 30% of cases in young men.

There are grounds for optimism if there has been no recurrence during the preceding two years and there is a negative apprehension test. (Backward pressure with arm in ball throwing position.)

In recurrent dislocation treated with surgery there is a potential risk of further dislocation (5-10%), although the figure may be greater in physically demanding jobs. There is also the risk of a painful shoulder or limited mobility as a result of pre-operative damage to the joint surfaces.

If a dislocation has recurred prior to application, a careful history and examination should be made to determine future risk, with specialist advice sought if the recurrence has been within two years or apprehension test is positive. If a surgical repair has been undertaken, a specialist opinion should be sought to determine increased risk to the prospective firefighter.

Serving firefighters who have had a surgical repair should be reassessed after twelve weeks to determine whether they should be redeployed or are fit to continue.

Frozen Shoulder

Frozen shoulder due to adhesive capsulitis or periartthritis is more commonly found in patients aged 45-60 years and is usually associated with a history of some kind of trauma. The symptoms (pain, stiffness and limitation of movement) are likely to continue for up to a year or even longer. Steroid injections and/or manipulation under anaesthetic may hasten recovery. Once the problem has resolved it is unlikely to recur at the same site.

The firefighter may be unfit for operational duties for a period which may exceed a year, and depending on age and experience it may be better to consider temporary or permanent redeployment. Individuals should not return to operational firefighting duties until they have a full pain-free range of movement.

Rotator Cuff Degeneration and Impingement Syndrome

In these cases there is a high risk of continuing problems or recurrence, especially in those involved in physically demanding jobs. Mild cases may respond to steroid injections, but severe cases may be offered an operation with only 60-80% success rate depending on the damage.

Acromio Clavicular Joint Subluxation and Dislocation

Injuries to the acromio clavicular joint often follow a fall on the shoulder and therefore are commonly seen in rugby players and wrestlers. They usually result in no disability or loss of function, but may take several months to settle. The straps of breathing apparatus may prove a problem, in which case surgery is a possibility. A functional assessment should be carried out. Individuals with significant problems are likely to have difficulty with the standard service drills.

Elbow, Wrist and Hand Conditions

Epicondylitis – Tennis Elbow/Golfer's Elbow

This is one of the commonest forms of elbow disorder and is only occasionally due to tennis or golf. Most cases follow minor and often unrecognised trauma. Individuals who have been symptom free for over two years are at low risk of recurrence.

Individuals with a history of pain and tenderness within the last two years are more likely to develop a recurrence, particularly during recruit training, and they should be advised to defer training until they have been pain free for two years.

Conservative treatment is usually offered initially, but surgery may be an alternative in resistant cases although not always successful. If surgery is successful, the outcome is usually maintained long-term.

The Wrist and Hand

Firefighting requires considerable forearm and wrist strength and any defect is likely to lead to long-term problems. Any history of trauma, deformity or medical problems with the wrist should be fully investigated.

Fractured Scaphoid

This usually results from a fall on the dorsiflexed hand and if ununited often gives rise to osteoarthritis in the long-term. Those with radiological evidence of a well united fracture with no complications are at low risk of further problems.

Firefighters with a screw in situ or non-union should be assessed by a specialist before advising on employment.

Carpal Tunnel Syndrome

The condition is more commonly found in women and in many cases the cause remains a mystery. If treated surgically, symptoms are unlikely to recur. Recruits

should not be accepted until they have been clear of symptoms for at least six months.

Hips:

New for 2012

Pain, limp and deformity in the hip most often results from congenital dislocation, childhood hip disorders, Perthes disease, slipped epiphysis, and osteoarthritis.

Where individuals develop and have treatment for hip problems at an early age (less than eight years) the prognosis is usually excellent. Individuals should be assessed to ensure they have a spherical femoral head within an undeformed acetabulum. The majority (70-90%) of patients are pain free at 20-40 year follow up. Any persistent hip pain in a recruit is likely to be incompatible with firefighting.

Where there has been significant trauma to the hip, it is important to seek a specialist opinion to determine the current state of the hip joint. Any signs of deterioration will imply a significant risk of further damage through work as an operational firefighter. The presence of metalwork is covered elsewhere.

[Osteoarthritis of the Hip](#)

[Hip Replacement](#)

[Choice of Surface for Hip Arthroplasty Bearings](#)

[Hip Resurfacing](#)

[Total Hip Arthroplasty](#)

[Duration of Implant](#)

[Rehabilitation following Hip Replacement](#)

[Smoking](#)

[Measuring Outcome after Arthroplasty](#)

Choice of Surface for Hip Arthroplasty Bearings:

Most hip prostheses used in the past had different materials for the acetabular and femoral components. The acetabular component is commonly polyethylene, and this wears substantially more than the metal femoral head, although if the head wears through the polyethylene the metal acetabular shell may in turn cause wear on the femoral head. Entrapped particles may also cause abrasive wear. The polyethylene component may also deform or 'creep' early on during 'bedding in' or 'running in', a process that appears complete by 12-18 months. The problem with polyethylene was partly due to sterilisation processes and advances in preparation and sterilisation have led to significant improvements.

Wear rates from the traditional metal on polyethylene (MOP-THA) total hip replacements have led to recent developments in hard-on-hard surfaces, either ceramic on ceramic (COC-THA), ceramic on metal (COM-THA) or metal on metal (MOM-THA) in order to improve wear rates.

There are significant concerns from MOM-THA with elevated levels of metal ions found, with local tissue reactions and teratogenicity. The alloys of concern are cast moulded alloys of cobalt and chromium and both metals are released as ions. Local pseudo tumours and distant toxicity, particularly renal toxicity, have been reported and a delayed type IV hypersensitivity may be to blame. The risk is unpredictable and appears to be in the order of 0.3%, and is more of a problem in women under the age of 40 **4**.

One meta-analysis found eight prospective randomised trials with no significant differences between MOM-THA and MOP-THA. Cobalt and chromium concentrations were elevated after MOM-THA but there was no significant differences in complication rates in short to mid-term follow up **5**. Longer follow-up may be needed to show the expected advantage in wear rates.

Ceramic on ceramic total hip replacements have shown excellent clinical results, but a significant side effect is 'squeaking' which appears to be a problem with metal-on-metal bearings too. One study found 14 (10.4%) of 131 patients complaining of squeaking although only one patient had complained prior to the study and squeaking was only reproducible in four cases **6**. Survival of COC-THA have been recorded as 90.8% to 97.4% at ten years in young and active patients **7**. A recent review found excellent results from COC-THA with exceptionally low wear rates and virtually no local adverse effects. The main concerns were insertional chipping, in-vivo fracture and squeaking. There was little data on COM-THA. It was felt likely that the use of hard-on-hard bearings will continue to increase, especially in young and active patients **8**.

Significant problems have been noted with the extra-large diameter metal-on-metal DePuy ASR XL prosthesis, with a total of 28.6% showing implant dysfunction including pain, loosening, squeaking and grinding. 17.1% required revision **9**.

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9 Bernthal NM, Celestre PC, Stavrakis AI, Ludington JC, Oakes DA. Disappointing short-term results with the DePuy ASR XL metal-on-metal total hip arthroplasty. *J Arthroplasty*. 2011 Oct 12 epub ahead of print.

Hip Resurfacing:

Total hip replacement involves significant destruction of the proximal femur, with risks associated with high stresses around the shaft of the femoral component and resultant weakening. Resurfacing allows bone-sparing around the proximal femur, with the possibility of a subsequent total hip arthroplasty if and when failure of the resurfaced hip requires it.

Early results from hip resurfacing were variable, partly because of aseptic loosening from poor fixation, and partly because of femoral neck fracture. In order to conserve bone in the proximal femur, large diameter femoral components are required, with associated large acetabular components. These can lead to significantly more polyethylene wear with MOP joints, and MOM have been preferred, but with associated problems with metal ion levels. In theory better results could be expected from the use of ceramics but this creates difficulties because of the thickness of ceramic material needed.

More recent developments have improved the technical performance of the components, allowing the biomechanical advantages of resurfacing to be realised. The result should allow the patient to return to a more active lifestyle. Current devices use a cemented metal femoral component and a cementless metal acetabular component. Recent studies do show good outcomes including return to high-impact sports; however these so far only cover short to medium term and the evidence-level is low. The main reason for low evidence levels is the lack of randomization **10**. Another review showed higher activity levels but higher complication rates **11**.

There is currently concern about the longer-term outcome of MOM hip resurfacing. The presence of soft tissue reactions related to metal debris (pseudo tumours) continues to be reported. This has a higher incidence in women, especially with smaller size components, but has still been observed in larger male patients **12**.

Hemi resurfacing is an option, preserving the acetabulum, but there is no useful evidence in the literature and the procedure is unlikely to be encountered in a firefighter.

NICE set a benchmark for choosing a total hip replacement at a survival rate of 90% at follow-up of ten years. A recent review of metal-on-metal hip resurfacing arthroplasty found a total of 3.5% revised, but many studies were short term. None met the NICE standard, but several studies showed satisfactory survival compared with the NICE three-year benchmark **13**.

There are many reports of individuals returning to high levels of physical activity after hip resurfacing, and the evidence suggests that activities discouraged following total hip arthroplasty are tolerated well by patients after hip resurfacing. Modern resurfacing performs well in young, active individuals despite high activity levels **14**. The main findings are that a return to high levels of activity is possible. It would be reasonable to expect a firefighter to be able to return to active firefighting after hip resurfacing, but any final decision should depend on the results of rehabilitation and advice from the surgeon. Provided a good recovery has been achieved, the risk to the joint from working as a firefighter is not substantially increased.

10 Van Gerwen M, Shaerf DA, Veen RM. Hip resurfacing arthroplasty: a systematic review of functional outcome. *Acta Orthopaedica*. 2010;81(4):680-683.

11 Jiang Y, Zhang K, Die J, Zhao H, Wang K. A systematic review of modern metal-on-metal total hip resurfacing vs standard total hip arthroplasty in active young patients. *J Arthroplasty*. 2011;26(3):419-26.

12 Kwon YM et al, *J Arthroplasty*. 2011 Jun;26(4):511-8

13 Van der Weegen W, Hoekstra JH, Sijbesma T, Bos E, Shemitsch EH, Poolman RW. Survival of metal-on-metal hip resurfacing arthroplasty: as systematic review of the literature. *J Bone Joint Surg Br*. 2011;93(3):298-306.

14 Golant A, Christoforou DC, Slover JD, Zuckerman JD. Athletic participation after hip and knee arthroplasty. *Bulletin of the NYU Hospital for Joint Diseases* 2010;68(2):76-83.

Total Hip Arthroplasty:

Some studies have showed increased failure rates among those doing high levels of activity, particularly high impact sports, while others show that physical activity promotes bone strengthening and argue that the positive benefits of activity outweigh the effects of wear. A general consensus has identified three groups of activity, those that are recommended, those allowed with experience and those not recommended. It is argued that an experienced athlete has sufficient proprioceptive control to minimise stresses on joints, while the newcomer may have higher risk of sudden stresses. A good example is skiing, where the inexperienced skier will have an unstable position with frequent falls while the experienced skier will adopt a stable position with good control. A full list of sporting activities was developed following the 1999 American Hip Society Survey. This is available in free-text online publications **15**. The list includes cross-country skiing and horseback riding for those

with experience, but does not recommend rock climbing, football, jogging, and racquet sports.

Most firefighting activities are compatible with a total hip arthroplasty, and even those involving strenuous activity should not compromise the joint significantly. A firefighter with a total hip replacement is not therefore likely to be harmed by firefighting. The key issue is whether he is capable of firefighting, and particularly whether he can maintain fitness. The evidence shows that many have successfully done so.

15 Golant A,Christoforou DC, Slover JD, Zuckerman JD. Athletic participation after hip and knee arthroplasty. Bulletin of the NYU Hospital for Joint Diseases 2010;68(2):76-83.

Duration of Implant:

Significantly lower survival rates have been recorded for cemented implants compared to cementless implants after an average 20-year follow-up **16**. This is not, however, supported by wider literature reviews which suggest the most reliable results are achieved with cemented implants in patients under 50 years old **17**.

Choice of fixation for the acetabular component does appear to be more important in younger, more athletic individuals, with a greater risk of failure of cemented acetabular component compared with the press-fit components **18**.

16 Korten K, Bourne R, Charron K, Au K, Rorabeck C. Comparison of Total Hip Arthroplasty Performed with and without Cement: A Randomized Trial: A Concise Follow-up, at Twenty Years, of Previous Reports. J Bone Joint Surg Am. July 2011;93(14).

17 De Kam DC, Busch VJ, Veth RP, Shreurs BW. Total hip arthroplasties in young patients under 50 years: limited evidence for current trends. A descriptive literature review. Hip Int. 2011;21(5):518-25.

18 Golant A,ChristoforouDC, Slover JD, Zuckerman JD. Athletic participation after hip and knee arthroplasty. Bulletin of theNYUHospital for Joint Diseases 2010;68(2):76-83.

Rehabilitation following Hip Replacement:

There is a risk of posterior dislocation following hip replacement surgery. This is greater where the posterior approach is used as this involves detaching the posterior hip rotator muscles. Using the anterior approach preserves the muscles which stabilise the hip and allows more freedom in postoperative rehabilitation with a faster recovery **19**. Capsular repair during posterior approach substantially reduces the risk of dislocation. Anterolateral and lateral approaches can require detachment of the hip abductors via a trochanteric osteotomy, leading to temporary or permanent abductor weakness, and abduction exercises should be avoided initially after

surgery. Revision hip surgery can involve significantly more invasive procedures to access the joint **20**.

In the first six weeks following surgery, patients are generally advised to avoid flexing beyond 90 degrees (use elevated toilet seats and chairs) and rotating more than 45 degrees internally or externally. Adduction should be avoided, and at night a pillow should be placed between the thighs. In a study comparing patients advised on these restrictions and patients who were unrestricted, the average time to return to work was 6.5 weeks in the unrestricted group and 9.5 weeks in the restricted group. All 98 patients in the unrestricted group had returned to their normal occupation within six months while only 81 out of 85 had done so from the restricted group **21**. There is little in the literature on returning to work after THA, and the time to return varies substantially from a little over a week to several months, although most returned swiftly. Operative technique may be relevant, but as in many studies of returning to work after surgery, advice from doctors seems to hinder rather than help their speed of return **22**.

Cemented prosthesis can weight-bear immediately after surgery, while cementless prostheses need a period of partial weight-bearing, usually six weeks, to allow bone ingrowth.

Patients who undertook maximal strength training with leg press and abduction five times a week for four weeks improved strength, rate of force development and improved work efficiency **23**. Early multidisciplinary rehabilitation can improve outcomes but there is little long-term evidence available **24**.

19 Berger RA, Jacobs JJ, Meneghini RM, et al. Rapid rehabilitation and recovery with minimally invasive total hip arthroplasty. *Clin Orthop Relat Res*. Dec 2004;(429):239-47.

20 Golant A, Christoforou DC, Slover JD, Zuckerman JD. Athletic participation after hip and knee arthroplasty. *Bulletin of the NYU Hospital for Joint Diseases* 2010;68(2):76-83.

21 Peak EL, Parvizi J, Ciminiello M, Purtill JJ, Sharkey PF, Hozack WJ et al. The role of patient restrictions in reducing the prevalence of early dislocation following total hip arthroplasty. A randomized prospective study. *J Bone Joint Surg Am*. 2005;87:247-53.

22 Kuijer PPFM, de Beer MJPM, Houdijk JHP, Frings-Dresen MHW. Beneficial and limiting factors affecting return to work after total knee and hip arthroplasty: a systematic review. *J Occup Rehabil*. 2009;19:375-81.

23 Husby VS, Helgerud J, Bjorgen S, et al. Early maximal strength training is an efficient treatment for patients operated with total hip arthroplasty. *Arch Phys Med Rehabil*. Oct 2009;90(10):1658-67.

24 Khan F, Ng L, Gonzales S, Hale T, Turner-Stokes L. Multidisciplinary rehabilitation programmes following joint replacement at the hip and knee in chronic arthropathy. *Cochrane Database of Systematic Reviews* 2008, Issue 2. Art. No. :CD004957. DOI: 10.1002/14651858.CD004957.pub3.

Smoking:

A systematic review of six databases found current smokers were more likely to have postoperative complications (RR 1.24, 95% CI 1.01 to 1.54) and death (RR 1.63, 95% CI 1.06-2.51) compared to non-smokers **25**. Advise firefighters awaiting surgery to stop smoking and offer support to do so.

25 Singh JA. Smoking and outcomes after knee and hip arthroplasty: a systematic review. *J Rheumatol.* 2011;38(9):1824-34.

Measuring Outcome after Arthroplasty:

Most measures of outcome after arthroplasty, and indeed after most orthopaedic interventions, rely on patient reports which are inevitably subjective. The only objective measures are of joint failure, or clear complications such as infection or restricted movement. Care needs to be taken when assessing reported outcomes as there is concern over the reliability of the tools currently in use **26**.

26 Alviar MJ, Olver J, Brand C, Tropea J, Hale T, Pirpiri M, Khan F. Do patient-reported outcome measures in hip and knee arthroplasty rehabilitation have robust measurement attributes? A systematic review. *J Rehabil Med.* 2011;43(7):572-83.

Osteoarthritis of the Knee:

Mechanical factors are likely to contribute to knee osteoarthritis where there is a pre-existing condition. Osteoarthritis is more common in individuals undertaking heavy manual work **27**. It is also more common in obesity. Obesity is a stronger predictor of bilateral knee osteoarthritis (odds ratio 6.6) than knee injury (3-3.5) **28**. The odds ratio of developing knee arthritis increases from 1 in the first tertile of BMI to 3.79 in the third tertile of Americans from the NHANES study from 1988-94 **29**. A follow-up of male medical students showed a threefold increase in knee arthritis 36 years later for those with a BMI 24.7-37.6 compared to those with a BMI 15.6-22.8 at the start of the study **30**, and BMI at age 20-29 was more predictive of future osteoarthritis than BMI at ages 30-39 or 40-49. Normal physical activity does not cause osteoarthritis; runners do not develop higher levels of osteoarthritis **31 32**.

Any degeneration will be accelerated by significant physical activity, and therefore puts firefighters at risk if they actively train to keep fit. Those already in service may continue if the arthritic changes are minor, grades 1-2, with advice to modify their training to avoid high impact activity. A specialist opinion should be sought for those with significant symptoms or grade 3-4 degenerative changes to ensure they are not at increased risk. Early redeployment should be considered.

Unicompartmental arthritis (usually the medial compartment) may be managed by a high tibial osteotomy in younger symptomatic patients, especially with earlier radiographic changes. This does allow return to manual labour but has limited efficacy.

Advanced arthritis is managed surgically with either uni-compartmental or total knee replacement as appropriate.

27 Lindberg H and Montgomery F. Heavy labor and the occurrence of gonarthrosis. Clin Orthop 1987;214:235-6.

28 Davis MA, Ettinger WH et al. The association of knee injury and obesity with unilateral and bilateral osteoarthritis of the knee. Am J Epidemiol. 1989;130(2):278-88.

29 Janssen I, Mark AE. Separate and combined influence of body mass index and waist circumference on arthritis and knee osteoarthritis. International Journal of Obesity 2006;30:1223-8.

30 Gelber AC, Hochberg MC et al. Body mass index in young men and the risk of knee and hip osteoarthritis. American Journal of Medicine 1999;107(6):542-8.

31 Lane NE et al. Running, osteoarthritis and bone density: Initial 2-year longitudinal study. Am J Med 1990;88(5): 452-9.

32 Konradsen L et al. Long distance running and osteoarthritis. Am J Sports Med 1990;18(4): 379-81

Anterior Cruciate Ligament (ACL) Injuries:

Studies have shown that although there may be a healing response following ACL rupture, the two ends of the torn ligament never reconnect after complete rupture. Research is currently looking at placement of a biological scaffold to initiate healing after a primary repair rather than reconstruction, particularly in adolescents **33**. Meanwhile the current surgical treatment is reconstruction usually using hamstring or patellar tendon grafts.

The incidence of ACL rupture is 20 per 100,000 per annum in UK. One third of these will have symptoms of disabling instability sufficient to warrant reconstruction, one third will have other symptoms that would justify reconstruction although this is not always carried out and it is thought that one third don't complain of symptoms. A ruptured ACL predisposes to meniscal damage and development of osteoarthritis. Following ACL rupture, only 17% are able to return to competitive sports other than cycling and cross-country skiing, while 50% can return to active work (including forestry and construction) and recreational sports such as tennis, basketball and downhill skiing **34**.

Where an untreated ACL rupture is identified in a recruit, this represents a significant risk of early knee degeneration and a risk of sudden instability in the knee and would

not normally be considered compatible with firefighting. Serving firefighters who have recurrent 'giving way' of an injured knee should be considered unfit for operational firefighting because of the immediate risk to themselves and others, and early treatment should be sought.

Surgical reconstruction of the ACL is recommended. No reconstruction is perfect and the biomechanics will always be altered, however this operation does allow elite sportsmen to return to top level sport, and should allow a firefighter to return to full operational fitness. ACL reconstruction with appropriate rehabilitation has a success rate of 75-90%. Firefighters will not be able to return to operational duty until completion of an accelerated rehabilitation programme. Rehabilitation training generally starts once the quadriceps strength has reached 65% of the opposite leg, usually at around 5-8 weeks post-surgery, and a motivated athlete adhering to a rehabilitation programme can usually return to sport training when the quadriceps has reached 80% strength, after 3-4 months. In most firefighters a return to duty would not be expected for 4-6 months.

The orthopaedic literature indicates that there may be a significant risk of long-term degeneration of the knee in those who have had ACL rupture, and the literature has so far not shown a significant deterioration in the rates of osteoarthritis following ACL reconstruction, with some studies even showing evidence that degeneration is more likely in the reconstructed knee than in the unreconstructed knee following ACL rupture **35 36**. These studies have followed up patients over a significant period of time with ACL reconstruction surgery performed over 10 years ago, often after a significant trial period of non-operative treatment. There are some shorter-term studies of more modern ACL reconstructive techniques showing a reduction in meniscal injuries which may in the longer term lead to a reduction in osteoarthritis.

It is likely that development of arthritis is inevitable regardless of occupation, and the short-term success of top sportsmen, particularly professional footballers who experience far greater and more frequent force and wear to their knees than firefighters, indicates that firefighting alone should not be responsible for long-term osteoarthritis. Any increased wear is likely to be due to recreational activities and choice of training rather than fireground training and activity. Advice should be given to avoid contact sports and high impact aerobics training.

A study of American National Football League players compared outcomes of those with meniscectomy alone, ACL reconstruction alone, and combined meniscectomy and ACL reconstruction. A history of meniscectomy, but not ACL reconstruction, shortened the expected career, and combined surgery was more detrimental than either surgery alone **37**.

Potential recruits should only be accepted if they have reconstruction of ACL deficient knees, and only then on the advice of their orthopaedic surgeon; they must understand that there are risks associated with the operation, and subsequent employment by the Fire Service is not guaranteed.

Revision of torn ACL grafts is possible but currently has a poor success rate. A review of ACL reconstruction in New York State found the risk of readmission within 90 days was 2.3%, but subsequent surgery within a year was 6.5%. Factors increasing risk within 90 days were male, age over 40, pre-existing comorbidity, operated on by a lower-volume surgeon. Factors increasing risk of subsequent knee surgery were female and being operated on by a lower volume surgeon. Factors increasing risk of further ACL reconstruction were age less than 40, concomitant meniscectomy or other knee surgery, and surgery in a lower volume hospital **38**.

Specialist opinion on prognosis for return to the high functional requirements of active firefighting should be sought in all cases. This will be dependent on the specific findings at arthroscopy including the state of the chondral surfaces and menisci.

33 Murray MM. Current status and potential of primary ACL repair. Clin Sports Med. 2009;28(1):51-61.

34 Gillquist J. Outcome measurement after anterior cruciate ligament reconstruction. pp 1187-94 In: Bulstrode C, Bowden G, Buckwalter J, Carr A, Fairbank J, Marsh L, Wilson-MacDonald J (Eds) The Oxford Textbook of Orthopaedics and Trauma. Oxford; Oxford University Press 2002.

35 Daniel DM et al. Fate of the ACL injured patient. A prospective outcome study. American Journal of Sports Medicine. 1994;22:632-44.

36 Allum R. The stiff knee following anterior cruciate ligament reconstruction. In: Allum RL, Fergusson CM, Thomas NP (Eds). Clinical Challenges in Orthopaedics: The Knee. London; Taylor & Francis 2000.

37 Brophy RH, Gill CS, Lyman S, Barnes RP, Rodeo SA, Warren RF. Effect of anterior cruciate ligament reconstruction and meniscectomy on length of career in National Football League athletes: a case control study. Am J Sports Med. Nov 2009;37(11):2102-7.

38 Lyman S, Koulouvaris P, Sherman S, Do H, Mandl LA, Marx RG. Epidemiology of anterior cruciate ligament reconstruction: trends, readmissions, and subsequent knee surgery. J Bone Joint Surg Am. Oct 2009;91(10):2321-8.

Posterior Cruciate Ligament (PCL) Injuries:

Posterior cruciate ligament rupture in isolation is rare, occurring in around 3.5% of knee ligament injuries. In most cases it is seen as part of a major disruption to the knee, either as a result of sporting injury or a motor vehicle crash. One study showed a mean age of 27.5 +/- 9.9 years, with traffic crashes responsible for 45% (motorcycle 28%) and athletic injuries 40% (soccer 25%) the main causes. Isolated PCL rupture is more common in sport injuries **39**.

A long-term follow-up of ACL and PCL injuries after conservative treatment found between 77% and 93% of PCL ruptures regained continuity, suggesting natural healing does occur in most cases **40**.

Most patients do not have symptomatic instability and may be able to return to the pre-injury functional level after rehabilitation. PCL is diagnosed clinically by identifying posterior instability, with reduction of the 'step off' position of the normal medial tibial plateau 1cm anterior to the medial femoral condyle. A reduction in step-off of 0-5mm is Grade I, 5-10mm is Grade II and greater than 10mm is a Grade III injury. An isolated Grade I or II injury can usually be treated successfully with rehabilitation, while a Grade III injury often requires surgical reconstruction **41**.

Rehabilitation treatment involves initial splinting, followed by quadriceps and hamstring training with eccentric exercise **42**. After conservative treatment, a patient can generally return to normal activities after four weeks. Outcomes vary depending on the nature of injury, with one study finding 47/55 sports-related PCL ruptures having a good long-term functional result while only 5/61 road trauma PCL ruptures had good results without surgery, and a further nine having good results after surgery. Overall, 80% had good or excellent results following treatment **43**. The PCL deficient knee may be at risk for medial and patello-femoral compartment arthritis **44 45**.

Post-surgery rehabilitation can take longer for PCL than ACL, as hamstring loading should be avoided for around four months. Specialist advice should be obtained before returning to active firefighting duties.

Combined ligament injuries especially the postero-lateral corner has been recognized as a potent source of on-going instability **46 47**. A recent review of bicruciate knee ligament injuries in elite athletes found that 19 out of 24 returned to sports with a good functional outcome and ligamentous stability, but only 8 out of 24 reached their preinjury sports activity level **48**. This suggests that a good outcome and return to firefighting is possible after combined ACL and PCL repair.

39 Schulz MS, Russe K, Weiler A, et al. Epidemiology of posterior cruciate ligament injuries. Arch Orthop Trauma Surg. May 2003;123(4):186-91.

40 Boks SS, Vroegindewij D, Koes BW, Hunink MG, Bierma-Zeinstra SM. Follow-up of posttraumatic ligamentous and meniscal knee lesions detected at MR imaging: systematic review. Radiology. 2006;238(3):863-71.

41 Veltri DM, Warren RF. Isolated and combined posterior cruciate ligament injuries. J Am Acad Orthop Surg. Nov 1993;1(2):67-75.

42 MacLean CL, Taunton JE, Clement DB, et al. Eccentric and concentric isokinetic moment characteristics in the quadriceps and hamstrings of the chronic isolated posterior cruciate ligament injured knee. Br J Sports Med. Dec 1999;33(6):405-8.

43 Cross MJ, Powell JF. Long-term followup of posterior cruciate ligament rupture: a study of 116 cases. Am J Sports Med. Jul-Aug 1984;12(4):292-7.

- 44** Bisson LJ, Clancy WG. Posterior cruciate ligament injuries. pp 879-91. In: Insall JN (Ed) Insall & Scott. Surgery of the Knee. Vol 1 3rd Edn. New York; Churchill Livingstone 2001.
- 45** Dowd GSE. The patient with a torn posterior cruciate ligament. In: Allum RL, Fergusson CM, Thomas NP (Eds). Clinical Challenges in Orthopaedics: The Knee. London; Taylor & Francis 2000.
- 46** Bisson LJ, Clancy WG. Posterior cruciate ligament injuries. pp 879-91. In: Insall JN (Ed) Insall & Scott. Surgery of the Knee. Vol 1 3rd Edn. New York; Churchill Livingstone 2001.
- 47** Dowd GSE. The patient with a torn posterior cruciate ligament. In: Allum RL, Fergusson CM, Thomas NP (Eds). Clinical Challenges in Orthopaedics: The Knee. London; Taylor & Francis 2000.
- 48** Hirschmann MT, Iranpour F, Muller W, Friederich NF. Surgical treatment of complex bicruciate knee ligament injuries in elite athletes: what long-term outcome can we expect? Am J Sports Med. 2010;38(6):1103-9.

Collateral Ligament Injuries:

Isolated partial tears of the collateral ligaments recover completely with conservative management. They should be treated initially with bracing, partial weight-bearing on crutches and physiotherapy. If clinically indicated, co-existing cruciate ligament and meniscal injuries should be ruled out by MRI or arthroscopy. Once an individual has a full range of movement, no effusion and 80% of normal strength they can safely return to operational firefighting.

A non-operative approach is also adopted for complete rupture of the medial collateral ligament with a good prognosis. A longer period of bracing and physiotherapy is required. Isolated lateral collateral ligament injuries are treated in a similar fashion.

Anterior Knee Pain, Chondromalacia Patellae (CP):

Anterior (or retropatellar) knee pain is a common symptom in physically active adolescents and young adults and is frequently bilateral. Incidence is reported in UK as between 3 and 40% of adolescents **65**. In severe or chronic cases, it may progress to oedema and damage to the hyaline cartilage of the retropatellar surface (Chondromalacia Patellae, CP).

Typically, there is pain on walking and running as well as rising from a chair or climbing stairs. An effusion may be present but is particularly evident after impact exercise such as running. The subject is usually reluctant to relax the quadriceps and allow full examination of the knee and when the patella is rubbed along the femoral groove a painful crepitus may be felt. A Q-angle greater than 15° in a male indicates abnormal patellar tracking.

Where CP has been diagnosed there is likely to be long-term risk of continuing pain and sometimes osteoarthritis. Recruits who have been symptom free for over a year while undertaking activity similar to firefighter training are likely to remain fit for service but require careful assessment. The presence of crepitus and pain on examination is indicative of continued underlying pathology which is likely to prevent the individual from training effectively. Recruits are therefore very unlikely to complete the training course. Serving firefighters should be assessed by a specialist, however if the symptoms continue for more than six months, redeployment would be the best option. Surgery does help in some individuals.

65 Callaghan M, Selfe J. Has the incidence or prevalence of patellofemoral pain in the general population in the United Kingdom been properly evaluated? *Physical Therapy in Sport* 2006; 8(1):37-43

Patellar Instability:

Patellar instability commonly (but not inevitably) follows direct violence to a flexed knee. Following a traumatic patella dislocation, the majority of individuals will recover fully following an appropriate rehabilitation programme. The dislocation is more likely to recur if the quadriceps muscle has not been redeveloped or the torn medial capsule and medial patello-femoral ligament has not healed satisfactorily. Some individuals may then go on to experience recurrent dislocation.

There is a significant risk of sudden dislocation while operational; therefore a history of recurrent dislocation would generally be incompatible with operational firefighting. Patellar stabilization procedures have an 85% success rate and should be considered in potential recruits/active firefighters with recurrent instability. A history of single dislocation or a good result from surgery and/or physiotherapy may be compatible with firefighting.

History of Osgood-Schlatter's Disease:

This is a common condition in young adolescents that usually results from a traction injury of the patellar tendon on the tibial tubercle. It occurs in around 20% of adolescents who are active in sport compared to around 5% of non-athletes **66**. The condition is bilateral in 20-30% of cases.

Spontaneous recovery usually occurs. The residual bump may cause problems with kneeling. This condition rarely presents after age 19/20 years. A history of Osgood-Schlatter's disease without any other knee problems and no significant symptoms for two years should generally be regarded as of minimal significance when assessing fitness for firefighting.

66 Kujala, UM, Kvist, M, Heinonen, O. Osgood-Schlatter's disease in adolescent athletes. Retrospective study of incidence and duration. Am J Sports Med 1985; 13:236.

Knee Joint Replacement:

There are a number of studies in the literature looking at return to work after knee arthroplasty, but very few define 'work'. While many measure success in returning to work, it is likely that the patient had already found a less physically demanding role to enable them to cope with an increasingly painful degenerate knee joint. There are some studies looking at return to sport, and these may be more useful when considering whether firefighting might be compatible with knee arthroplasty. Firefighters may be able to return to adjusted duties, and evidence on rehabilitation as well as longer term prognosis is included below.

Cemented prostheses can weight-bear immediately after surgery, while cementless prostheses generally need six weeks of partial weight-bearing to allow bony ingrowth. The quadriceps is crucial to stability of the new knee, and a weak quadriceps can result in pain, and lead to excessive stress on the new joint **67**. Exercise should be maintained prior to joint replacement to ensure maximum quadriceps strength before surgery, and exercising post-surgery may need to follow careful rules to ensure the knee remains stable while the quadriceps is strengthened. Knee immobilisers may be used.

Some studies have looked at return to sporting activities after knee replacement. Unicompartmental knee replacements (UKA) do better than total knee replacements (TKA). In one study 96.7% returned to low-impact sport after UKA while only 63.6% returned after TKA. Average time before resuming sport was 4.1 months after TKA and 3.6 months after UKA **68**. 'Sport' in this context included golf and bowls which does not equate to firefighting.

There is a difference between the loads from training and the loads from operational firefighting. Training to keep fit generally involves aerobic activity at relatively high power with multiple repetitions. Operational firefighting may involve intense physical activity but generally only for a few repetitions. The wear on a joint prosthesis from operational firefighting is therefore likely to be negligible compared to the wear from general physical training. When assessing the risk of wear, it is important to look at the engineering stresses involved. When jogging the high joint loads arise at 40-60 degrees of flexion where high polyethylene inlay stress will occur, with a significant risk of delamination and polyethylene destruction **69**. Patients keeping fit through aerobic exercise should therefore be encouraged to avoid jogging and other impact activities.

Return to athletic activity after TKA is less viable than after THA. Most can return to low impact activities such as walking and cycling, but few return to high impact activities such as jogging and racquet sports. Patient weight is a significant factor in high wear rates. The American Knee Society produced guidelines after their 1999 Survey for activities allowed, allowed with experience and not recommended following TKA. Activities allowed with experience included road cycling, rowing,

cross-country skiing, tennis and weight machines. Jogging, ball and racket sports were not recommended **70**.

Return to high levels of occupational activity and sport has been recorded, and one large study found 25% of participants coping with farming, construction, cycling, tennis and downhill skiing **71**. This suggests that high levels of activity are compatible with firefighting but there is a risk. Arthroplasty may preclude kneeling and heavy impact activities may accelerate wear and produce early failure **72 73**. Many patients who have had a TKA will be unable to reach the fitness standards required for firefighting, particularly the ability to kneel, crawl and manoeuvre through the fireground. It is likely that only a few highly motivated individuals will meet the fitness standards after surgery and will wish to continue in an active firefighting role. Any final decision on fitness for firefighting should follow advice from the surgeon and discussions with management.

67 Andriacchi TP, Stanwyck TS, Galante JO. Knee biomechanics and total knee replacement. *J Arthroplasty*. 1986;1(3):211-9.

68 Hopper GP, Leach WJ. Participation in sporting activities following knee replacement: total versus unicompartmental. *Knee Surg Sports Traumatol Arthrosc*. 2008;16(10):973-9.

69 Kuster MS. Exercise recommendations after total joint replacement: a review of the current literature and proposal of scientifically based guidelines. *Sports Med*. 2002;32(7):433-45.

70 Golant A, Christoforou DC, Slover JD, Zuckerman JD. Athletic participation after hip and knee arthroplasty. *Bulletin of the NYU Hospital for Joint Diseases* 2010;68(2):76-83.

71 Diduch DR, Insall JN, Scott WN, Total knee replacement in young, active patients. Long-term follow-up and functional outcome. *J Bone Joint Surg Am*. 1997;79(4):575-82.

72 Walsh M et al. Physical impairments and functional limitations: a comparison of individuals 1 year after total knee arthroplasty with control subjects. *Phys Ther* 1998 Mar;78(3):248-58.

73 Diduch DR et al. Total knee replacement in young active patients: long term follow-up and functional outcome. *Journal of Bone and Joint Surgery, American Volume* 1997;79(4):575-82.

Unicondylar Knee Arthroplasty:

The advantage of unicondylar arthroplasty (UKA) is the preservation of the normal knee anatomy including cruciate and collateral ligaments. The result should be a more stable knee with better biomechanics than a TKR. Studies have shown more patients returning to sport after UKA than TKA with more achieving their pre-operative level than those with TKA **74**.

Recovery and return to work is faster with minimally invasive UKA compared to standard UKA or TKA whose recovery times are no different **75**.

While there is little evidence on return to occupational activity after UKA, this suggests that a return to firefighting is more likely than after TKA and should not be ruled out until the individual has completed rehabilitation. Again, any final decision on fitness for firefighting should follow advice from the surgeon and discussions with management.

74 Golant A, Christoforou DC, Slover JD, Zuckerman JD. Athletic participation after hip and knee arthroplasty. *Bulletin of the NYU Hospital for Joint Diseases* 2010;68(2):76-83.

75 Lombardi AV, Berend KR, Walter CA, Aziz-Jacobo J. Is recovery faster for mobile-bearing unicompartmental than total knee arthroplasty? *Clin Orthop Relat Res.* 2009;467:1450-1457.

Patellofemoral Arthroplasty:

Patellofemoral arthroplasty (PFA) is not a new technique, but it has developed significantly recently. Early work involved cemented polyethylene implants on the patellar surface with or without a metal femoral resurfacing. Patellar tracking is very sensitive to altered biomechanics, and early implants probably failed because of difficulties with alignment and poor design of the trochlear component.

The outcomes from patellofemoral arthroplasty (PFA) are variable. Improvements have been noted for newer generation PFAs **76**. A recent meta-analysis found that there was a higher likelihood of complications and revision following first generation PFA, but there was no difference between second generation PFA and TKA **77**.

A review of patients under 60 returning to work found that fewer succeeded than those with TKA or UKA and those who did took longer to return **78**.

It is likely that many firefighters will be unable to cope with the role after a PFA, but of those that do, a return to the role should not be ruled out until after completion of rehabilitation. Again, any final decision on fitness for firefighting should follow advice from the surgeon and discussions with management.

76 Lonner JH. Patellofemoral arthroplasty: the impact of design on outcomes. *Orthop Clin North Am.* Jul 2008;39(3):347-54, vi.

77 Dy CJ, Franco N, Ma Y, Mazumdar M, McCarthy MM, Gonzales Della Valle A. Complications after patello-femoral versus total knee replacement in the treatment of isolated patellofemoral osteoarthritis. A meta-analysis. *Knee Surg Sports Traumatol Arthrosc.* 2011; Oct 11 epub ahead of print.

78 Foote JA, Smith HK, Jonas SC, Greenwood R, Weale AE. Return to work following knee arthroplasty. *Knee* 2010;17(1):19-22.

Gender Issues in Knee Arthroplasty:

There are significant gender differences in knee anatomy and function. A review of studies comparing gender specific TKA to unisex TKA found no significant difference in outcome [79](#).

79 Johnson AJ, Costa CR, Mont MA. Do we need gender-specific total joint arthroplasty?. Clin Orthop Relat Res. 2011;468(7):1852-8.

The Ankle

Ruptured Tendon Achilles

Rupture usually occurs only if the tendon is degenerate (avascular); therefore most patients are aged over 40. Incomplete tears are uncommon. Recurrence is unlikely after satisfactory recovery after repair or conservative treatment. Recovery normally takes at least six months.

Ankle Instability

This may be diagnosed on history confirmed by stress x-rays. Mildly unstable ankles may occur as a result of ligament strain and may be treated with strapping. More serious ligament tears are treated with physiotherapy and proprioceptive exercises. Surgery for ruptured external collateral ligaments has a good success rate.

Firefighters are not generally at increased risk of ankle injuries while wearing boots; however injuries during training are not uncommon. Once recovered, individuals should avoid contact sports and take care on uneven ground. Successful operational return depends on confidence in proprioception. Individuals with persistent severe instability are unlikely to develop sufficient confidence to return to operational firefighting.

Intra-Articular Fractures

Intra-articular fractures are of particular importance because of involvement of the articular cartilage and the supporting ligaments around the joints. Fractures through joints can affect the stability, range of motion and possible development of post traumatic osteoarthritis. The incidence of post traumatic osteoarthritis depends on the joint involved and the nature of the fracture [80](#).

The outcome for any particular intra-articular fracture depends upon the original injury and the nature of the treatment. Early stable fixation allowing prompt mobilisation will reduce stiffness. Early mobilisation with insufficient fixation may lead to osteoarthritis.

There needs to be a distinction made between subsequent function of a joint and a diagnosis of radiological arthritis. A firefighter with X ray evidence of arthritis, e.g. in a wrist, may have stiffness, no pain and a functionally normal joint.

It is not always possible to predict the eventual progression of arthritis or whether particular physical activities will exacerbate the condition. Post-fracture arthritis

depends upon joint congruity, joint stability and maintenance of normal movement, and survival of articular cartilage following a blunt injury. Direct trauma to cartilage may produce chondrocyte death (chondrolysis) even in the absence of fracture and instability.

Comparison of outcomes of articular fractures between different joints is meaningless and each must be considered individually. Most research into long-term outcome of fractures relies on scoring systems which are different for different parts of the body, and are based on measurements of range of movement, strength, mal-alignment or x-ray appearances.

Each individual should be assessed on their own merits, with the benefit of a specialist report. The emphasis on assessment should be on functional capability, and the likelihood of future employment contributing to any degenerative process.

80 Wright V. Post traumatic osteoarthritis - a medico-legal minefield. British Journal of Rheumatology 1990;29(6):474–8.

Post Traumatic Osteoarthritis

Post traumatic osteoarthritis seen radiographically is usually functionally detrimental. Impairment of function is often a combination of an objective deficit (i.e. loss of movement) and a collection of symptoms which are subjective (i.e. pain). The combination of these produces a functional limitation or handicap, which varies from individual to individual.

Factors Leading to Post Traumatic Osteoarthritis after Trauma

Features predisposing to post traumatic arthritis include a residual gap or step in the joint surface, abnormal soft tissue stability, malalignment or any combination of these features. The progression of arthritis and the significance of it depend on the site of injury. Not all osteoarthritis is significantly symptomatic. A combination of radiological and clinical examination is required in most cases when assessing fitness for work. Factors associated with poor outcome from articular damage include older age and conservative as opposed to surgical management.

Specific Sites of Injury

- [Shoulder](#)
- [Elbow](#)
- [Wrist Fractures](#)
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Shoulder Fractures

The majority of shoulder fractures are extra-articular and function is determined by the concomitant soft tissue injury [81](#). Articular fractures have a high incidence of avascular necrosis particularly when displaced. Avascular necrosis occurs in less than 10% of extraarticular fractures but in more than 60% of displaced articular fractures [82](#).

81 Neer CS. Displaced proximal humeral fractures. Part 1. Classification and evaluation. J Bone Joint Surg Am 1970;52(6):1077-89.

82 Sturzenegger M, Fornaro E, Jakob RP. Results of surgical treatment of multifragmented fractures of the humeral head. Archives of Orthopaedics and Traumatic Surgery 1982;100(4):249-59.

Elbow Fractures

Fractures of the distal humerus in the working population are often high energy injuries. However, 75% of patients have satisfactory results after internal fixation [83](#). Significant post traumatic osteoarthritis occurs in approximately 12% of patients at 6 year follow-up. Fractures of the radial head and ulnar are extremely common and are usually caused by lower energy injuries. Ulnar olecranon injuries are invariably treated with internal fixation and early movement with the majority returning to full activities. Radial head fractures are common and caused by a fall onto the outstretched hand. These are classified by Mason into three types [84](#):

Type 1 – an undisplaced segmental fracture of radial head.

Type II – the fracture segment is displaced with a step of greater than 1mm

Type III – Gross comminution of the radial head

Radial head fractures are often treated non-surgically except for Type II fractures which are frequently internally fixed. Almost all Type I fractures will heal with minimal functional impairment. 80% of patients with Type II fractures whether treated surgically or conservatively will return to their previous employment but with some restriction in range of motion. Despite good clinical recovery from this injury degenerative changes are seen in over half of patients on x-ray. The outcome from Type III fractures is generally poor.

83 Wildburger R, Mohring M, Hofer HP. Supraintercondylar fractures of the distal humerus: results of internal fixation. Journal of Orthopaedic Trauma 1991;5(3):301-7.

84 Mason ML. Some observations on fractures of the head of the radius with a review of one hundred cases. British Journal of Surgery 1954;42(172):123-32

Wrist Fractures

Extra-articular fractures whether of the Colles type (dorsal displacement) or the Smith's type (volar displacement) make a good functional recovery. 75% of patients experience subjective discomfort following such injuries for up to a year and up to 10% describe fatigability. Fractures that include an intra-articular extension however have a significantly worse outcome [85](#) [86](#). Comminuted fractures have only 50% satisfactory outcome and this is reduced if the radio-ulnar distal joint is involved. Factors associated with a poor outcome include a dorsal radial tilt of over 10°, radial deviation of greater than 10° and older age.

Up to 18% of fractures of the distal radius result in post traumatic arthritis. In younger adults with higher energy injuries arthritis is reported on x-ray in up to 65% although only 30% of patients with radiological evidence are symptomatic.

85 Lidstrom A. Fractures of the distal end of the radius. A clinical and statistical study of end results. Acta Orthopaedica Scandinavica 1959;Suppl 41:1-118.

86 Knirk JL, Jupiter JB. Intra-articular fractures of the distal end of the radius in young adults. J Bone Joint Surg Am 1986;68(5):647-59.

Hip Fractures

Fractures of the hip comprise two main groups.

- Acetabular fractures
- Femoral head fractures

Acetabular Fractures

Significant fractures of the acetabulum are those which include the weight-bearing dome. Comminution of this area is a significant prognostic sign and presence of a joint articular step exceeding 2-3mm is significant [87](#). A combined acetabular and femoral head fracture has a poor prognosis. Patients over the age of 40 have worse results. Following acetabular fractures an accurate prognosis may be given approximately one year following injury. The functional recovery at 12 months reflects the final outcome.

Femoral Head Fractures

The majority of fractures of the femur in the population of working age are extra-capsular (and therefore extra-articular). Intracapsular fractures which are also mainly extra-articular are rare but are often of high impact origin. Minimally displaced fractures (Garden stages I and II) are internally fixed in situ whereas displaced fractures (Garden III and IV) need reduction and then internal fixation and have a high risk of avascular necrosis. Fractures of the femoral neck under 50 years of age

are rare because of strong sub-cortical bone and if they occur are a sign of high energy impact.

The incidence of avascular necrosis is 14% in Garden I and II fractures and 30% in Garden III and IV fractures. Confirmation of bony union cannot be confirmed until 6 months post-injury and any subsequent arthritis should be evident within one year. Late segmental collapse of the femoral head can occur beyond one year in up to 18%. Some reports in younger patients suggest avascular necrosis as high as 40% in the overall group [88](#).

87 Letournal E, Judet R Fractures of the acetabulum. Translated and edited by R A Elson. Springer-Verlag, Berlin 1981.

88 Barnes R, Brown JT, Garden RS, Nicoll EA. Subcapital fractures of the femur. A prospective review. J Bone Joint Surg Br 1976;58(1):2-24.

Knee Fractures

Laubenthal [89](#) advised that average knee movement necessary for sitting is approximately 90°, for climbing stairs 100°, crouching 120° but for unrestricted movement for the majority of activities 125° is ideal. Intra-articular distal femoral fractures transgressing the knee inevitably produce a degree of loss of movement. Recovery producing less than 90° of flexion or with a varus/valgus deformity greater than 15° result in significant disability.

Open reduction and rigid internal fixation produce the most satisfactory results [90](#). Anatomical realignment and early movement should obtain good function in more than 90% of individuals. The most significant predictor for the development of post traumatic osteoarthritis is an articular surface step of greater than 3mm. Often arthritis affects the patello-femoral joint rather than the tibio-femoral joint.

Tibial Plateau Fractures

Tibial plateau fractures are caused mainly as a result of a fall from a height involving a combination of axial loading and a valgus stress. Most of the remaining injuries are caused by lateral impact to the knee such as a strike by the bumper of a car. The most widely used classification [91](#) has six types of fracture depending on location of joint surface depression and cleavage of the plateau. Those of a splint compression type with displacement less than 5mm had 66% excellent results after internal fixation. Medial plateau fractures are often of high energy impact and have the worst results and are often in poor bone in the older population. Long term prognosis is significantly worse if there is co-incidental ligament and meniscal injury.

89 Laubenthal RN, Smidt GL, Kettelkamp DB. A quantitative analysis of knee motion during activities of daily living. Physical Therapy 1972;52(1):34-43.

90 Schatzker J, Lambert DC Supracondylar fractures of the femur. Clinical Orthopaedics 1979;138:77-83.

91 Schatzker J, McBroom R, Bruce D. The tibial plateau fracture. The Toronto experience 1968-1975. *Clinical Orthopaedics* 1979;138:94-104.

Ankle Fractures

Ankle fracture accounts for approximately 10% of all fractures. It is the most commonly injured weight bearing joint and fracture is frequent in the working age population. Ankle fractures are of two main types, malleolar fractures and tibial plafond or pilon fractures.

Malleolar Fractures

Malleolar fractures may involve the lateral malleolus, the medial malleolus and the posterior malleolus either individually or in combination. The mechanism and severity of the injuring force gives a direct indication of the likely outcome. Precise reduction of malleolar fractures is essential in obtaining a good result.

Following the treatment of an ankle injury Lindsjo [92](#) concluded that arthritic change will have occurred by 18 months post-injury and is entirely dependent on the congruity and stability of the joint. Following accepted principals of internal fixation 90% of individuals return to the same occupation, 80% continue with sport at the pre-injury level and recovery in male and female patients is similar. It is evident that an associated fracture to the posterior malleolus is a poor prognostic factor. Arthritis is evident in 30-40% of such patients in the long term.

Tibial Plafond/Pilon Fractures

These injuries are usually more severe than malleolar fractures, particularly when combined with the above. Recovery is slower and permanent articular surface damage more likely. Good clinical results may still be achieved in 75% of patients following rigid internal fixation although non-weight bearing is often required for 3 months post-surgery and return to active service could be delayed by up to one year. Long term sequelae of this injury may not be evident or full recovery achieved for 18 months to 2 years.

92 Lindsjo U. Operative treatment of ankle fractures. *Acta Orthop Scand Suppl.*1981;189:1-131.

Foot Fractures

The most significant fracture of the foot for a firefighter is a calcaneal fracture. It is an occupational hazard for individuals who work at heights. Of all calcaneal fractures 75% are intra-articular. Displaced fractures are best treated by a specialist familiar with this particular injury and require internal fixation [93](#) [94](#). Treated appropriately, 60% will have a good outcome. The rest result in post traumatic osteoarthritis or shortening and widening of the heel, making boot fitting uncomfortable and walking on uneven surfaces hazardous. Residual symptoms of injury and recovery from the

surgery can take 18-36 months to settle and final assessment for return to full active duties may take 2 years.

93 Eastwood DM, Gregg PJ, Atkins RM. Intra articular fractures of the calcaneum. Part I: Pathological anatomy and classification. J Bone Joint Surg Br 1993;75(2):183-8.

94 Eastwood DM, Langmaher VG, Atkins RM. Intra-articular fractures of the calcaneum. Part II: Open reduction and internal fixation by the extended lateral transcalcaneal approach. J Bone Joint Surg Br 1993;75(2):189-95.

Metal Implants

The majority of metalwork is implanted for either fracture fixation or as a component of a joint replacement for the treatment of arthritis or tumour. A member of the Fire Service involved in full active service is unlikely to be able to continue full duties following replacement of a major joint. Each specific joint replacement will be discussed in the section related to arthritis.

The significant issue related to the active population employed by the fire service is metalwork implanted in the treatment of trauma. This population is a high risk group for fractures both in the service and during recreational sport. The commonest fractures requiring fixation are ankle, wrist and forearm fractures usually requiring fixation with plates and screws. Less common but more significant injuries are related to long bone shaft fractures requiring intramedullary nail fixation. These different types of fracture fixation have their own features and will be discussed separately.

There is no absolute indication for removal of metalwork in an asymptomatic patient. If removal of percutaneous wires or stabilising screws (such as diastasis screws in unstable ankle fractures or interlocking bolts in intramedullary nails) is an essential part of fracture management in the early stages, this will have occurred before fracture union. Some firefighters could return to light duties in a non active role at this stage but may still need crutches or be unable to drive or manage stairs safely.

Issues about removing periarticular metalwork usually relate to soft tissue irritation or restriction of movement. There is an argument that screws inserted in subchondral positions to support articular surfaces in weight bearing joints (such as tibial plateau or ankle pilon fracture) do alter the biomechanics of cartilage wear and tear and should be removed before full active service is resumed.

Following fracture union some prominent metalwork may need removing to allow full rehabilitation of joint mobility and muscle strength. Once rehabilitated there are very few indications to remove residual metalwork that is asymptomatic. There is more published literature on the complications associated with removing metalwork than of leaving it in situ.

Cervical Spine:

[Cervical Rib](#)

[Whiplash Associated Disorder](#)

[Cervical Spondylosis](#)

Cervical Rib

A cervical rib may go unrecognised. However, if known it is necessary to assess carefully as problems may present in a physically demanding job. Downward and backward traction on the shoulder wearing breathing apparatus sometimes results in pain and tingling in the arm. Therefore, a functional assessment is recommended.

Whiplash Associated Disorder:

'Whiplash' is a term used to describe a group of symptoms associated with an acute acceleration or deceleration injury to the neck. It may be used to describe the acute symptoms associated with soft tissue injury as well as the long-term symptoms where there is no demonstrable physiological or physical underlying cause. There is substantial involvement of psychosocial issues and secondary gain in many whiplash cases, and it is always important to investigate the likelihood of a biological component to the symptoms before giving any advice.

The great majority of cases of 'whiplash' seen are related to road traffic crashes. In almost all cases there will be no pathological findings; the diagnosis is based entirely on what the patient says and how they behave in clinic. There are now numerous papers on the subject, and while there is no doubt that people get symptoms after road traffic crashes, in the great majority of cases there is simply no evidence to show that they have sustained any actual harm. There are many papers showing that long-term whiplash without obvious trauma is unrecognised as a problem in countries where there is no mechanism for compensation, and where no-fault compensation schemes are in place as opposed to tort compensation schemes, the numbers of cases are substantially less, and the duration of symptoms shorter. In some countries whiplash only occurs after rear-end collisions while in others it can occur after any accident.

A very small number of individuals may have longer term damage to structures such as nerve roots; these injuries are best considered as separate entities as the prognosis and management is more specific and defined. Spondylosis may well be found, but unless a scan had been undertaken immediately prior to the accident it is not possible to attribute changes to an accident. Normal degenerative changes do not arise after a single event; they are degenerative and take time to evolve.

The evidence suggests that the normal course of 'whiplash' is significant pain for a few days, and discomfort for a few days more, but symptoms fully resolve if the individual continues with normal activities. There is no doubt that the 'compensation culture' plays a significant role, and this may be addressed by government action in the near future. Much of the

evidence is included in books such as Andrew Malleon's 'Whiplash and other useful disorders' **103**, and a limited selection is included below.

In one of the classic whiplash studies, in 14% the rear impacted car was a wreck and could not be driven, in 54% the damage was moderate and in 32% the damage was minor, a dent in bumper or wing. The incidence of neck pain was 52% where there was extensive damage but only 10% in those where the damage was minor indicating a clear dose-response relationship **104**. Care should be taken in interpreting the level of damage from the accident in relation to symptoms. The level of symptoms appears to be related to expectations of pain, rather than actual trauma, with one study showing symptoms developing after a 'sham accident' where no actual collision took place **105**. It is as important to tackle individual beliefs as it is to treat any actual physical injury in order to minimise long-term disability. It is, however, entirely reasonable and logical to advise that significant physical injury is most unlikely to have occurred where the damage to the vehicle was minor, and therefore that permanent disability should be neither expected nor supported.

Following acute whiplash injury, a study of 201 patients demonstrated that there is better pain reduction at six months for those who resume normal activities immediately than for those who remain off work and immobilized with a cervical collar for the first two weeks **106**. There is no evidence that whiplash accelerates the progression of degenerative changes in the cervical spine **107**.

There is significant evidence that the pursuit of compensation has an adverse effect on the outcome following whiplash. The change in the system of compensation in Saskatchewan, Canada to a no-fault compensation approach on 1 Jan 1995 resulted in a considerable reduction in morbidity from whiplash. The reduction in time to settlement from an average 433 days to 194 days was associated with an identical reduction in duration of symptoms **108**. Decisions on fitness should therefore be delayed until well after any litigation has been settled. A long-term follow-up of whiplash cases failed to find any link between the physical injury and subsequent morbidity and concluded that the symptoms were likely to be psychological and related to compensation **109**.

103 Malleon A. Whiplash and other useful illnesses. McGill-Queen's University Press:Montreal. 2002.

104 Obelieniene D et al. Pain after whiplash: a prospective controlled inception cohort study. J Neurol Neurosurg Psychiatry 1999;66:279-283,

105 Castro WH, Meyer SJ, Becke ME, et al. No stress-no whiplash? Prevalence of "whiplash" symptoms following exposure to a placebo rear-end collision. Int J Legal Med . 2001;114: 316-322.

106 Borchgrevink GE et al. Acute treatment of whiplash neck sprain injuries. A randomised trial of treatment during the first 14 days after a car accident. Spine 1998;23:25-31.

107 Hamer AJ et al. Whiplash injury and surgically treated cervical disc disease. Injury 1993;24:549-50.

108 Cassidy JD et al. Effect of eliminating compensation for pain and suffering on the outcome of insurance claims for whiplash injury. N Engl J Med 2000; 16:1179-86.

109 Joslin CC, Khan SN, Bannister GC,. Long term disability after neck injury. A comparative study. J Bone Joint SurgBr. 2004;86:1032-1034.

Cervical Spondylosis:

Cervical spondylosis is a specific term describing pathology in the degenerative cervical spine including disc degeneration, facet joint arthritis and ligamentous hypertrophy. Neck pain is a common symptom. Besides the mechanical pain associated with degeneration, pain and disability can be caused by compression of the spinal cord or nerve roots. Surgery may be a treatment option in some of these cases.

A recent review of neck pain found that disc degeneration was not a risk factor, while smoking, exposure to tobacco and psychological health were, as were age, gender and genetics. There was no association with neck pain in those wearing helmets for bicycling, hockey or skiing **110**.

There are two main symptomatic groups of concern with patients. Those with radiculopathy have numbness, pain associated with the distribution of one or more cervical nerve roots, occasionally with weakness and reduced reflexes. Those with myelopathy have damage to the spinal cord with associated spasticity and/or weakness in the lower limbs and may have 'numb and clumsy hands'.

As many as 12% of women and 9% of men experience pain in the neck at any one time, and 35% of the overall population can recall an episode of neck pain **111**. 80% of a population of industrial and forestry workers had a history of neck stiffness with arm pain. In a group of male workers in a broad spectrum of jobs 51% had a history of neck pain while 5.4% had spent some time off work as a result **112**.

Imaging is not always indicative of significant lesions. 16-26% of asymptomatic patients were found to have significant cervical spinal cord impingement on MR scans and 15% have root or cord compression **113**. Over half the population in middle age have radiological or pathological evidence of cervical spondylosis **114 115**. Similarly, 20% of clinically significant symptoms attributed to lumbar disc herniations may appear normal or with only spondylotic changes on MR scan **116** (see below).

The majority of symptomatic cases will not progress to significant disability and some individuals who are significantly disabled will remain static or improve without treatment **117 118**. The mean duration of pain in one study was 28-40 months with a range of 5-120 months **119**. There is evidence that surgery may contribute to long-term accelerated degeneration of the adjacent structures as well as the site of surgery **120**.

In a community based 15- year study, the annual age-adjusted incidence of cervical radiculopathy per 100,000 was 107.3 for males and 63.5 for females, reaching a peak of 202.9 in the age group 50-54 years. Of 561 patients with cervical radiculopathy, physical exertion or trauma preceded symptoms in only 14.8% of cases, and confirmed disc protrusion was responsible for symptoms in only 21.9% of cases. The condition recurred in 31.7% of patients over a 4.9-year period. Spontaneous improvement within 4.9 years was reported in 74% of patient **121**. At the end of the study, 90% of patients were either asymptomatic or only mildly incapacitated by their symptoms.

In most cases with pain, activity modification, isometric exercises and medication will result in significant improvement. Where pain is the main feature, manual therapy (low velocity passive movements within the normal range rather than high velocity low amplitude manipulation) is considered better than physiotherapy or pain relief **122**. Mobilisation and or manipulation when combined with exercise have short and long-term maintained benefits for subacute or chronic mechanical neck disorders **123**. The evidence did not favour manipulation and/or mobilisation done alone, and neither was superior to the other. There was insufficient evidence available to draw conclusions for neck disorder with radicular findings. There appears to be little scientific evidence for the effectiveness of multidisciplinary biopsychosocial rehabilitation compared with other rehabilitation facilities for neck and shoulder pain **124**.

A systematic review revealed relatively strong evidence supporting the effectiveness of proprioceptive exercises and dynamic resisted strengthening exercises of the neck-shoulder musculature for chronic neck disorders. There was no evidence identified to support the effectiveness of group exercise, neck schools or single sessions of extension-retraction exercise **125**.

In those with minor non-progressive neurological symptoms as opposed to just pain, simple neck immobilisation will result in improvement in 30-50% of cases **126**. A number of factors affect prognosis. Deterioration is more likely in females and those with significantly more cervical mobility **127**. Worse prognosis is also associated with older patients, significant disability at presentation, cord diameter, cord area, altered cord signal on MRI **128** and a congenitally narrowed spinal canal.

The outcomes for surgery in mild cases of chronic radiculopathy show little or no advantage to surgery over physiotherapy or soft collar treatment. Although there may be significant improvement in pain, limb paraesthesia, sensory loss and disability at 3-4 months, no difference was found at one or two years, while some studies show gait scores and the score of daily activities were better in conservatively treated patients **129 130**. The studies available do not show reliable evidence on the effects of surgery and it remains unclear whether the short-term risks of surgery are offset by any long-term benefit **131**.

Firefighters are expected to wear helmets and undergo significant physical stress. There is no evidence that this will cause early degeneration in the cervical spine in normal individuals. Applicants for firefighting service with signs or symptoms considered advanced for their age should only be accepted if supported by both a specialist report and a consultant occupational physician. Any history of significant radiculopathy or myelopathy confirmed by MRI will be associated with a significant risk of recurrence or degeneration; applicants should not therefore be accepted with this history.

Because of the widespread nature of the disease, asymptomatic individuals and individuals with minor symptoms associated with general degenerative disease who are already serving should be considered fit for active firefighting duties. It is important to differentiate between those with findings considered normal for their age and those with advanced disease or clear signs of neurological sequelae.

A judgement will be required where individuals have significant symptoms of degeneration particularly with associated ankylosis. Individuals with specific signs or symptoms of radiculopathy or myelopathy should however be assessed very carefully with advice from a specialist, although the widespread belief that patients with radicular symptoms will eventually develop overt myelopathy is not based on good evidence **132**. Where early

improvement of symptoms is noted, a return to active duty should be anticipated. Where symptoms fail to resolve after a year or so, the likelihood of a return to active firefighting is lower.

110 Hogg-Johnson S et al. The burden and determinants of neck pain in the general population: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine (Phila Pa 1976)*. 2008;33(4 Suppl):S39-51.

111 Hult L. Cervical, dorsal and lumbar spinal syndromes. *Acta Orthop Scand* 1954;17 (Suppl):1-102.

112 Hult L. The Munkfors investigation: a study of the frequency and causes of stiff neck-brachialgia and lumbago-sciatic syndromes, as well as observations on certain signs and symptoms from the dorsal spine and the joints of the extremities in industrial and forest workers. *Acta Orthop Scand* 1954;16 (Suppl):1.

113 Teresi LM et al. Asymptomatic degenerative disc disease and spondylosis of the cervical spine: MR imaging. *Radiology* 1987; 64:83-8.

114 Irvine DH et al. Prevalence of cervical spondylosis in a general practice. *Lancet* 1965;14:1089-92.

115 Hughes JT, Brownell B. Necropsy observations on the spinal cord in cervical spondylosis. *Riv Patol Nerv Ment* 1965;86:196-204.

116 Miller GM. Controversies, communication and diagnosis in lumbar disc disease. Presented at the Radiological Society of North America, Chicago, IL, Dec 1-6, 1991.

117 Lees F, Aldren Turner JW. Natural history and prognosis of cervical spondylosis. *BMJ* 1963; 5373:1607-1610.

118 Nurick S. Natural history and results of surgical treatment of the spinal cord disorder associated with cervical spondylosis. *Brain* 1972; 95:101-108.

119 Persson LC et al. Cervical radiculopathy: pain, muscle weakness and sensory loss in patients with cervical radiculopathy treated with surgery, physiotherapy or cervical collar. A prospective randomized controlled study. *European Spine Journal* 1997; 6:256-66.

120 Ebershold MJ et al. Surgical treatment for cervical spondylitic myelopathy. *Journal of Neurosurgery* 1995; 82:745-751.

121 Radhakrishnan K et al. Epidemiology of cervical radiculopathy. A population-based study from Rochester, Minnesota, 1976 through 1990. *Brain* 1994; 117:325-335.

122 Korthals-de Bos BC et al. Cost effectiveness of physiotherapy, manual therapy and general practitioner care for neck pain: economic evaluation alongside a randomised controlled trial. *BMJ* 2003; 326:911-6.

123 Gross AR, Hoving JL, Haines TA, Goldsmith CH, Kay T, Aker P, Bronfort G, Cervical overview group Manipulation and Mobilisation for Mechanical Neck Disorders (Cochrane Review). In: *The Cochrane Library*, Issue 1, 2004. Chichester, UK: John Wiley & Sons, Ltd.

124 Karjalainen K, Malmivaara A, van Tulder M, Roine R, Jauhiainen M, Hurri H, Koes B Multidisciplinary biopsychosocial rehabilitation for neck and shoulder pain among working

age adults (Cochrane Review). In: The Cochrane Library, Issue 1, 2004. Chichester, UK: John Wiley & Sons, Ltd.

125 Sarig-Bahat H Evidence for exercise therapy in mechanical neck disorders. Manual Therapy 2003;8(1):10-20.

126 McCormack BM, Weinstein PR. Cervical spondylosis. An update. West J Med 1996 ;165(1):43-51.

127 Barnes MP, Saunders M. The effect of cervical mobility on the natural history of cervical spondylotic myelopathy. J Neurol Neurosurg Psychiatry. 1984 47(1):17-20.

128 Mehalic TF et al. Magnetic resonance imaging and cervical spondylotic myelopathy. Neurosurgery 1990; 26(2):217-27.

129 Persson LC et al. Long-lasting cervical radicular pain managed with surgery, physiotherapy, or a cervical collar. Spine 1997 ;22:751-758.

130 Kadanka Z et al. Conservative treatment versus surgery in spondylotic cervical myelopathy: a prospective randomised study. Eur Spine J 2000;9(6):538-46.

131 Fouyas IP et al. Surgery for cervical radiculomyelopathy (Cochrane Review) In: The Cochrane Library, Issue 1, 2003. Oxford: Update Software.

132 Persson LC et al. Long-lasting cervical radicular pain managed with surgery, physiotherapy, or a cervical collar. Spine 1997 ;22:751-758.

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New Section for 2012

Lumbar Spine:

Low back pain is one of the commonest presenting symptoms in occupational medicine. Six percent of the population report constant disabling back pain over the past 12 months and 49-80% will have back pain at some time in their life **133**. The lifetime prevalence of 'sciatica' is 4-5%. There are major psychosocial factors affecting the presentation, course and prognosis of back pain and these frequently complicate rehabilitation and make ill-health retirement decisions difficult.

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[Recovery and Rehabilitation](#)

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[Spondylolisthesis](#)

[Spinal Fusion](#)

[Disc Arthroplasty](#)

[Posterior Motion Preserving Implants](#)

[Spina Bifida](#)

133 Klaber Moffett J et al. Back pain: its management and cost to society. York; Centre for Health Economics 1995.

History and Diagnosis

Medical Advisers will have to rely heavily on the history. It is common for the history to differ significantly on separate occasions, particularly if clinicians do not follow a standard assessment process. It is essential to exclude 'red flag' symptoms in every case, and it is useful to identify 'yellow flags' early so these can be addressed before they interfere significantly with rehabilitation [134](#).

Although identifying the cause may be difficult it is important to be proactive in health and safety, to avoid further injury to this individual or others, and for medico-legal reasons. It is also important to ensure that the cause suggested is reasonable. There must be a legitimate mechanism likely to lead to back pain. For example, a direct blow to the back (such as falling backwards in the supine position) is very unlikely to lead to disc lesions unless there is major trauma to other vertebral structures.

Most individuals with back pain are capable of working normally and most back pain symptoms recover quickly. In most cases specific treatment is not just unnecessary but can be harmful because it may cause worry and it may lead individuals to expect medical personnel to effect a cure rather than waiting for the natural recovery process to take place. Medical advisers must therefore be confident in assessing low back pain so they can reassure, and identify those few individuals who may benefit from a workplace rehabilitation programme, specific workplace treatment such as physiotherapy, or referral to a specialist clinician for advice or treatment.

A number of guidelines have been developed to assist clinicians in this process, and the Faculty of Occupational Medicine guidelines [135](#) should be the mainstay of assessment and management of low back pain in the workplace.

Patients present with symptoms, but with few signs, most of which are subjective. They rarely present with diagnoses, although when they do, these diagnoses are often incorrect. In the absence of any evidence of pathology, giving a diagnosis may well reinforce any belief that there is a 'back problem'. It can be better to say that the medical profession simply does not know why most back pain arises, and not offer the usual trite (mis)diagnosis of 'trapped nerve' or 'sciatica'. Although specific conditions are discussed below, in many cases a diagnosis will not be made, and Medical Advisers will have to base decisions largely on presenting history, symptoms and signs.

134 Carter JT, Birrell LN (Eds) Occupational health guidelines for the management of low back pain at work - principal recommendations. London; Faculty of Occupational Medicine 2000.

135 Carter JT, Birrell LN (Eds) Occupational health guidelines for the management of low back pain at work - principal recommendations. London; Faculty of Occupational Medicine 2000.

Applicants with a History of Back Pain

Back pain is very common, and most applicants for the fire service will have had some back pain in the past. Provided the episode of back pain was short lived, and led to little or no time off work or the individual remained able to participate in normal activities there should be no cause for concern.

Where the individual had more than six weeks off work, or was unable to participate in normal sport or recreational activities, a very careful history should be taken, with a supporting assessment by a specialist if there is any concern that there is an underlying problem that may be physical or psychological.

In applicants with a history of lumbar disc herniation it is the impact of symptoms that is important; this reflects the psychosocial as well as physical liability to future back problems. A history of absence from work for more than six weeks is a critical factor in determining future sickness patterns. In general, if the episode was five or more years ago and the individual has been undertaking normal physical activities since, they should be considered fit for firefighting.

Does Firefighting Cause Degenerative Disease in the Spine?

It has long been thought that physical activity leads to degenerative disease in the spine. Individuals may therefore claim that the degenerative disease in their backs has been caused by service as a firefighter. There is evidence that significant acute injury to the spine may be caused by a specific incident at work, such as a fall from a height with vertical impact on the base of the spine, particularly when there is clear

evidence of acute trauma at the time. A firefighter in these circumstances would be expected to have attended for acute medical care either as a result of back pain or as a result of other trauma, with demonstrable signs and symptoms of an acute injury.

There is, however, evidence that moderate or mixed physical loading results in the least pathology to the spine; symmetric disc degeneration is associated with sedentary rather than active work, while vertebral osteophytes are related to heavy work. Back pain, rather than back pathology, is however related to more active work [136](#). There are many studies that demonstrate a clear link between physical workload, including frequent bending and twisting, and low back pain. There is no evidence in most studies linking this work to degenerative conditions in the spine. One study in dock workers who are undergoing constant heavy manual work shows a link to degenerative conditions, although there is no evidence that a transfer to light duties slows the process of degenerative disease [137](#). Firefighting does involve heavy manual work at times, but would be best described as 'mixed physical loading' and therefore represents the optimal activity for the spine.

A recent review found no strong evidence supporting a causal relationship between any occupational physical activity considered and low back pain. A statistical association was found between low back pain and bending, twisting, lifting and pushing/pulling but not a causal link. Strong evidence against a causal relationship was found between low back pain and manual handling/assisting patients, awkward postures, carrying, sitting, standing and walking [138](#).

A study of USurban firefighters found 80% had reported at least one neck, back or shoulder problem. Frequency of aerobic exercise was significantly and negatively correlated with complaints [139](#). This suggests that regular aerobic exercise is protective.

136 Videman T et al. Lubar spinal pathology in cadaveric material in relation to history of back pain, occupation, and physical loading. *Spine* 1990; 15:728-40.

137 Waskiewicz J. The effect of heavy work on the musculoskeletal system of dockers. *Bull Inst Marit Trop Med Gdynia* 1996; 47:25-32.

138 Kwon BK, Roffey DM, Bishop PB, Dagenais S, Wai EK. Systematic review: occupational physical activity and low back pain. *Occupational Medicine* 2011; doi:10.1093/occmed/kqr092.

139 Beaton R et al. Neck, back and shoulder pain complaints in urban firefighters: the benefits of aerobic exercise. *J Musculoskelet Pain*. 2002;10(3):57-67.

Recovery and Rehabilitation

A number of factors affect the rate of recovery and rehabilitation besides the underlying physical cause. Individuals intending to litigate or in the process of litigation experience a much slower recovery [140](#). For this reason a number of

rehabilitation clinics are reluctant to take litigants because they do not respond to treatment. Smoking is also related to a slower recovery, as are a number of other psychosocial factors.

The main factor against successful rehabilitation is the development of illness behaviour and external factors reinforcing this behaviour, where secondary gain may be a key aspect [141](#) [142](#). The effect of a spouse can be very significant when illness behaviour is supported, and others such as workplace colleagues can also have a major impact in encouraging illness behaviour and reinforcing potential secondary gain. Although well-meaning, this may lead to a situation where the cause of an individual's pain is the reinforcing behaviour from spouse or colleagues rather than any initial injury.

Where the individual is caught in a 'downward spiral' of inappropriate coping mechanisms and illness behaviour, it can be extremely difficult to introduce a successful rehabilitation programme without a significant change to disrupt the spiral. One factor that may achieve this change is the clear statement that the individual is either not eligible for ill-health retirement because the condition is not permanent, or that there is insufficient evidence to support an injury on duty award. Great care must be taken in analyzing the history, mechanism of potential injury and evidence to support your assessment, in order to avoid further reinforcing illness behaviour.

140 Anderson JAD. Back pain and occupation. pp 16-37. In: Jayson MIV (ed) The lumbar spine and back pain. Edinburgh; Churchill Livingstone 1987.

141 Fordyce WE et al. Operant conditioning in the treatment of chronic pain. Arch Phys Med Rehabil 1973; 54:399-408.

142 Tollison CD et al. Psychological concepts of pain. In Mayer TG et al (Eds) Conservative Care for Painful Spinal Disorders. Lea & Febiger, Philadelphia 1991.

What Treatments should be tried before making a Final Decision?

Lumbar supports may be advocated and are often used for low back pain. There is evidence that shows they are no better than other forms of treatment for primary prevention, and no evidence that they are effective in secondary prevention. The results may be affected by poor compliance overall in the various studies and more, better, studies are needed [143](#).

Spinal manipulative therapy is often advocated, either through a physiotherapist, chiropractor or osteopath. Studies of its use in acute or chronic low back pain have shown that it is no more effective than analgesia, other physical therapies, exercises or back school, and the profession of the manipulator did not affect outcomes [144](#). It is not superior to other forms of treatment but may have a part to play in managing some individuals, particularly if they are known to respond well to this treatment.

The use of 'work conditioning' programs has been shown to be effective in treating chronic back pain but not acute back pain [145](#). These programs combine intensive physical training that includes aerobic capacity, muscle strength and endurance and coordination, in a process that is work related, with cognitive behavioural therapy.

Other treatments are covered below under the specific condition. The first line treatment from GPs should be analgesia with physiotherapy following the FOM guidelines or the guidelines from the Royal College of General Practitioners [146](#). Although treatment itself is not within the remit of the occupational physician, the evidence base behind various treatments is covered to enable the Medical Adviser to decide whether all options have been explored before definitive decisions on future employability are made.

143 Van Tulder et al. Lumbar supports for prevention and treatment of low back pain (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.

144 Assendelft WJJ et al. Spinal manipulative therapy for low back pain (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.

145 Schonstein E et al. Work conditioning, work hardening and functional restoration for workers with back and neck pain (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.

146 Waddell G, McIntosh A, Hutchinson A, Feder G, Lewis M, (1999) Low Back Pain Evidence Review London: Royal College of General Practitioners.

Fairbank-Hall Classification of Low Back Pain

One useful system of classification that has been validated was first proposed by Fairbank and Hall [147](#). It is outlined below:

Simple or non-specific low back pain

Attacks occur acutely, with or without obvious precipitating events. Precipitating events may be relatively minor and it is not always helpful to dwell too much on this aspect of the history. The patient's view of what led to the pain may be subjective and is often related to occupational factors although in practice sport, DIY or other home factors are frequent causes of acute low back pain.

The pain is generally limited to the lumbar spine and adjacent muscles. There may be some pain referral to buttocks and the back of the thighs, but pain is not felt below the knee. Many patients will describe their symptoms as 'sciatica' but this is not a useful descriptive term for referred pain that is classically confined largely to the lower back with radiation limited to above the knee. Pain tends to be worse when sitting and improves with activity.

Ninety percent of acute low back pain attacks settle within six weeks, regardless of treatment. Individuals may spend considerable amounts of money on private treatment that is not always necessary. Bed rest should not be prescribed, although individuals may feel so acutely disabled they require bed rest; in these circumstances it should be limited to 3 days. Analgesia and physical treatments are both useful and because of the short duration of symptoms, any intervention will, or will be perceived as having, a good effect [148](#).

There is moderate evidence that multidisciplinary rehabilitation is effective in treating sub-acute low back pain and a workplace visit and close liaison with occupational health providers increases effectiveness. These interventions may not prove cost-effective and more research is needed [149](#).

Although these attacks are self-limiting they may be recurrent. This does not imply an underlying defect or problem even though individuals may state they have a 'weak back' or a 'bad back'.

Chronic Back Pain or Mechanical Back Pain

There is no clear distinction between acute, simple back pain, and chronic back pain. Those with chronic pain tend to have persistent underlying pain or discomfort with occasional acute exacerbations. Some of these individuals have definitive signs from imaging tests that demonstrate degenerative disease within the lumbar spine, although most individuals with signs of degeneration of the spine in imaging tests are asymptomatic.

The distribution of pain is similar to that of simple back pain, predominantly in the lower back with some buttock and thigh radiation. Referred pain classically varies in distribution with intensity, being felt further down the leg the more severe the pain ('thermometer pain'). This history helps distinguish referred pain from root pain.

It is not helpful to regard chronic back pain as a purely physical ailment. It is best considered in terms of a biopsychosocial model as described by Waddell, with complex interactions between physical symptoms, mood, and illness behaviour [150](#). The relevance of all three is very important in determining long-term prognosis.

The older firefighter will inevitably develop a number of psychological issues with shift work, family commitments, having to accept that they are less physically able as they become older, and having to cope with the normal musculoskeletal aging process. These issues may well reinforce the symptoms of low back pain and need to be considered as an integral part of the management of chronic back pain in the older firefighter.

Physical treatment is in many cases unsuccessful because of the multimodal nature of the illness. Recent studies of acupuncture have shown some beneficial effect in reducing pain and improving function and although not much difference between acupuncture and sham acupuncture was seen, overall there was felt to be a cost-benefit advantage. There is no clear advantage from TENS or lumbar supports and

these are not recommended for non-specific back pain. Advice to stay active has small beneficial effects when used without other forms of treatment [151](#).

Psychological rehabilitation particularly using treatment programmes such as cognitive behavioural therapy is effective [152](#) [153](#). Combined physical and psychological programmes such as functional rehabilitation and pain management is also effective [154](#) [155](#), and the use of back schools in the occupational setting (such as the Penrith rehabilitation facility for firefighters) is thought to be effective [156](#).

Treatment for non-specific back pain, with accompanying evidence, is comprehensively considered in the NICE Guidelines published in 2009 [157](#).

Permanent disability in individuals with chronic back pain is not therefore automatic, and many will make a good functional recovery. Some individuals may have a psychological barrier to returning to active firefighting, but most of these should be capable of redeployment to more predictable employment that can include significant physical work.

Nerve Root Pain

In these patients, the predominant symptom tends to be pain in the leg or legs with a dermatomal distribution. This is classic 'sciatica'.

Nerve root	Location of symptoms
S1	Posterior calf and lateral side and sole of foot
L5	Lateral calf and dorsum of foot
L4	Medial calf
L3	Anterior thigh just above knee

There may initially be more back pain than leg pain, however in most cases after a few weeks or months the leg pain takes over as the most important symptom for the patient. It is not generally possible to distinguish between pain from lateral recess stenosis and pain from disc herniation on clinical assessment although a careful history may differentiate between them.

Pain must be distinguished from numbness which is a 'red flag' symptom. Always ask about saddle numbness and incontinence to exclude cauda equine syndrome which is a surgical emergency. Root pain may co-exist with referred pain, while in many cases root pain is felt in isolation with no back pain. Many of the psychosocial issues described above under chronic low back pain are just as relevant to nerve root pain.

The majority of individuals with nerve root pain, including those where disc prolapse is identified as the most likely cause, will recover in time and a complete resolution of

symptoms is the expected outcome. A return to normal duties and normal activities would be expected, and although there is some risk of recurrence, this is likely to happen whatever activities they undertake and would not be a reason to prevent a return to full duty.

Non-surgical treatment is not particularly successful. There is no evidence that bed rest [158](#), advice to stay active without other forms of treatment [159](#), traction [160](#), TENS, wearing a brace or corset, or manipulation [161](#) is more successful than placebo in treating nerve root pain. Epidural steroids may produce short-term relief but no long term functional benefit [162](#).

Treatment should therefore be holistic and multi-disciplinary with the expectation of gradual recovery with time. Exercises do not appear to be specifically beneficial in treatment but may be helpful to increase the return to normal daily activities and work [163](#).

Few individuals should be permanently unfit for firefighting, so any decision on permanent disability should only be made after all appropriate treatment options have been pursued, and you have specific advice to this effect from a specialist with expertise in spinal problems.

Neurogenic Claudication

In these patients, the leg pain is provoked by standing or walking, and resolves when they sit or lie down. The underlying condition of spinal stenosis may require nerve root blocks or surgery to relieve symptoms, but a third of patients will improve spontaneously.

Unclassifiable

Where symptoms are unusual, are not relieved by postural change or include rest pain or pain at night, these individuals may have a tumour or infection, an isolated fracture secondary to osteoporosis or steroid use, or psychogenic pain. This group includes a number of 'red flag' signs and symptoms as well as most 'yellow flag' symptoms.

147 Fairbank J. Clinical presentations of the Lumbar Spine pp 505-12. In: Bulstrode C, Bowden G, Buckwalter J, Carr A, Fairbank J, Marsh L, Wilson-MacDonald J (Eds) The Oxford Textbook of Orthopaedics and Trauma. Oxford; Oxford University Press 2002.

148 Waddell G. The back pain revolution. Edinburgh; Churchill Livingstone 1998.

149 Karjalainen K et al. Multidisciplinary biopsychosocial rehabilitation for subacute low back pain among working age adults (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.

150 Waddell G. Biopsychosocial analysis of low back pain. Baillieres Clin Rheumatol 1992;6:523-77.

- 151 Hilde G et al. Advice to stay active as a single treatment for low back pain and sciatica. (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.
- 152 Flor H et al. Efficacy of multidisciplinary pain treatment centers: a meta-analytic review. *Pain* 1992; 49:221-30.
- 153 Van-Tulder MW et al. Behavioural treatment for chronic low back pain (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.
- 154 Clinical Standards Advisory Group. Report on back pain. London; HMSO 1994.
- 155 Guzman J et al. Multidisciplinary bio-psycho-social rehabilitation for chronic low back pain (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.
- 156 Van-Tulder MW et al. Back schools for non-specific low back pain (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.
- 157 National Collaborating Centre for Primary Care. Low back pain: early management of persistent non-specific low back pain. National Institute for Clinical Excellence Guideline CG 88. RCGP 2009.
- 158 Vroomen P et al. Lack of effectiveness of bed rest for sciatica. *N Engl J Med* 1999; 340:418-23.
- 159 Hilde G et al. Advice to stay active as a single treatment for low back pain and sciatica. (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.
- 160 Werners R et al. Randomised trial comparing interferential therapy with motorised lumbar traction and massage in the management of low back pain in primary care. *Spine* 1999; 24:1579-84.
- 161 Koes B et al. Spinal manipulation and mobilisation of back and neck pain: a blinded review. *BMJ* 1991; 303:1298-1303.
- 162 Watts R, Silagy C. A meta-analysis of the efficacy of epidural corticosteroids in the treatment of sciatica. *Anaesthesia and Intensive Care* 1995; 23:564-9.
- 163 Van-Tulder MW et al. Exercise therapy for low back pain (Cochrane Review) In: The Cochrane Library, Issue 1, 2004. Oxford: Update Software.

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Causation

Acute low back pain with associated structural injury tends to follow fairly soon after an event or after trauma. There is often a delay of one to three days before pain

ensues, but rarely longer. Annular tears are not always painful, but when pain does arise it is usually within two weeks of injury. Longer delays would need a convincing explanation such as distracting fractures elsewhere. Root pain, or pain related to disc degeneration may be delayed for much longer.

The legal concept of causation differs from the scientific concept and is a particularly challenging area in low back pain [164](#). Degeneration is an ongoing process, and a disc may inevitably have prolapsed at some point, so a particular activity on a particular day may seem irrelevant scientifically if it represents say 0.01% of lifetime forces on the spine. If, however, the 'final straw' was a particular work activity, it may be argued that legally this caused the disc prolapse.

While it may be unlikely that a disc prolapse can be clearly attributed to one event at work, if it can an argument may well be made that this is a 'qualifying injury'. It is particularly important when taking a history at the time or shortly afterwards to identify all activities at or around the time of the alleged qualifying injury. Many firefighters have other employment that may be much more physical than their firefighting role. A firefighter who is at a fire on a Tuesday, then works as a roofer on Wednesday and Thursday, then has symptoms on Friday is more likely to have these as a result of his roofing activities rather than firefighting. On the other hand, if on the Tuesday he fell through a weakened floor and landed in a sitting position, experiencing significant symptoms and had to stop active firefighting on the Tuesday but managed to continue roofing on the Wednesday and Thursday, his subsequent symptoms may legitimately be related to his Fire Service duties.

The combination of unreliable memories and secondary gain should always be considered when taking a later history. Contemporaneous sources such as accident records and GP records should be considered before forming an opinion on causation.

164 Krawciw D. Spinal disorders causation. In Melhorn JM, Ackerman WE. Guides to the evaluation of disease and injury causation. 2008. American Medical Association.

Lumbar Disc Herniation

Lumbar disc herniation is common. At least 20% of individuals under the age of 60 have asymptomatic lumbar disc herniation seen on MRI and this number increases above this age [165](#). After one year, 60% of symptomatic patients were pain free, and remained pain free at 10 years, while of the small group treated with surgery, 92% were pain free at one year but this reduced to the same level of 60% at four and ten years. Of those with some pain, a return to work can be expected and 90% of both groups had returned to work after four years [166](#). It is important to appreciate that most studies include a subjective element and 'work' is not usually well defined. It is likely that fewer would have returned to heavy manual work.

Classic disc herniation occurs when the nucleus pulposus extrudes through and outside the annulus. This process is unlikely to occur in one single event, as there are twenty rings of fibres in the annulus running obliquely, with the fibres in each layer running in the crosswise direction of the adjacent layer. It is thought that the process of herniation is gradual, with the nucleus pulposus penetrating progressively further probably as a result of gradual degradation of the annulus structure combined with multiple sequential insults over time. It is then theoretically possible for a relatively small insult such as a sneeze or awkward bend or twist to produce the final rupture of the outermost fibrous ring and produce acute symptoms for the first time.

There is a nerve supply to the outer layer of the annulus, so incomplete annular tears may be painful, without any herniation. This may lead to acute or chronic back pain without any root symptoms. Although acute pain can be related to the tear in the annulus that precedes herniation, remaining symptoms are related predominantly to the effect of the disc material on nerve roots. There is evidence that an inflammatory process may be present, and direct pressure on the nerve roots may also cause symptoms. Chronic pain may come directly from damaged or degenerative discs particularly where there is evidence of inflammatory changes in or around the endplates (Modic I changes).

Sciatica caused by disc herniation is diagnosed by the classical signs of root pain (see above) combined with a similar radicular distribution of paraesthesia or numbness, a significantly reduced straight leg raise and a radicular distribution of any other neurological signs (power, reflexes, wasting) [167](#).

Lumbar disc herniation is not in itself a problem that should limit firefighting capability. Those who are symptomatic but able to continue with active firefighting should be allowed to do so. Where pain is the predominant symptom, it is reasonable to consider this aspect in isolation. Both low back pain and sciatic pain reflect central cortical processing rather than a disease process in the lower back [168](#) and are not necessarily proportional to the physical and inflammatory process in the lower back itself. Pain may be a very real problem for the individual but does not necessarily imply risk or harm from continued activity.

As above, most individuals can expect a recovery within a year sufficient to allow a return to normal duties. A small number will go on to have recurrences. Of those who have a second episode of sciatica, 90% will recover but 50% will have a recurrence of symptoms, while after a third episode, 90% will recover but almost all will have recurrent episodes [169](#). Individuals who fail to make a good recovery, or in whom symptoms return, may have problems with calcified disc remnants which may also become dislodged within the spinal canal, and should therefore be investigated with MRI. Individuals with more than one episode of sciatic symptoms are at significant risk of further symptoms through active firefighting. Applicants should not be recruited and firefighters should be carefully assessed after a second episode and redeployed after three separate episodes of sciatica unless clear supporting advice from a spine specialist is acceptable to the Medical Adviser and the Service.

165 Boden SD et al. Abnormal magnetic resonance scans of the lumbar spine in asymptomatic subjects. A prospective investigation. *J Bone Joint Surg Am* 1990; 72:403-8.

166 Weber H. Lumbar disc herniation: a controlled prospective study with 10 years of observation. *Spine* 183 8:131-40.

167 Waddell G. Evaluation of results in lumbar spine surgery. Clinical outcome measures – assessment of severity. *Acta Ortho Scand*. 1993 Suppl; 251:134-7.

168 Barr JS. Low back pain and sciatica. *J Bone Joint Surg Br* 1951; 33B:469.

169 Weber H. Lumbar disc herniation: a controlled prospective study with 10 years of observation. *Spine* 183 8:131-40.

Smoking and Back Pain

Several studies have shown that smoking significantly increases the risk of intervertebral disc degeneration. Disc degeneration and low back pain are significantly increased in patients with aortic calcification and lumbar artery atheroma linked to smoking and high cholesterol levels [170](#). A recent study showed that tobacco smoke condensate greatly induced an inflammatory response and gene expression of metalloproteinases, and reduced active matrix synthesis and expression of matrix structural genes in disc cells. This suggests a direct effect on human disc cell viability and metabolic activity [171](#).

There is a clear link between back pain and current and former smoking, although the effect was modest (OR 1.31, CI 1.02-1.55) in a meta-analysis [172](#). A study of construction workers in Japan found a clear link between low back pain and heavy smoking [173](#). A Norwegian study found a job involving heavy lifting and much standing was a strong predictor of low back pain in smokers four years later (OR 5.53, 95% CI 1.93-15.84) but was not associated with low back pain in non-smokers [174](#).

170 Kauppila LI. Atherosclerosis and disc degeneration/low back pain - a systematic review. *Eur J Vasc Endovasc Surg*. 2009;37(6):661-70.

171 Vo N et al. Differential effects of nicotine and tobacco smoke condensate on human annulus fibrosus cell metabolism. *J Orthop Res*. 2011;29(10):1585-91.

172 Shiri R et al. The association between smoking and low back pain: a meta-analysis. *Am J Med*. 2010;123(1):87.e7-35.

173 Ueno S et al. Association between musculoskeletal pain in Japanese construction workers and job age, alcohol consumption, and smoking. *Ind Health*. 1999;37(4):449-56.

174 Eriksen W, Natvig B, Bruusgaard D. Smoking, heavy physical work and low back pain: a four-year prospective study. *Occup Med.* 1999;49(3):155-60.

Obesity and Back Pain

Logically, an increase in long-term loading on the spine would be expected to increase degenerative changes. A recent study in Spain found a significant increase in incidence of Modic changes, disc contour abnormalities, spondylolisthesis and disc degeneration in obese patients with chronic back pain [175](#). Another study in Finland found a link between smoking, overweight and obesity and high physical activity with lumbar radicular pain [176](#). A clear association between BMI over 25 at young age and disc degeneration (RR 3.8, 95% CI 1.4-10.4) was shown in working middle-aged men [177](#).

175 Arana E et al. Modic changes and associated features in Southern European chronic low back patients. *Spine J.* 2011;11(5):402-11.

176 Shiri R et al. Cardiovascular and lifestyle risk factors in lumbar radicular pain or clinically defined sciatica: a systematic review. *Eur Spine J.* 2007;16(12):2043-54.

177 Like M et al. Disc degeneration of the lumbar spine in relation to overweight. *Int J Obes (Lond).* 2005;29(8):903-8.

Discectomy

Surgical treatment for disc herniation associated with sciatica has seen a significant improvement in technique over the past twenty years. The operating microscope is preferred by some, and the change in terminology merely reflects a change in tools rather than a different procedure. There is no good level 1 evidence that any method has a significant difference in size of incision, morbidity, shortened recovery times or outcomes. Athroscopic discectomy is an experimental alternative.

A 70-95% success rate can be expected from discectomy [178](#). Success is a combination of pain relief and functional improvement, and is largely subjective. It also depends on the parameters measured and the occupation of the individual; successful return to a desk job does not equate to successful return to active firefighting. Firefighters have successfully returned to operational firefighting duties; however a number have been unable to sustain this level of work for more than a few years.

There is a conflicting evidence base in relation to discectomy. This may reflect the fact that by the time many patients come to surgery any radiculopathy (or myelopathy related to cervical disc herniation) is not fully reversible, it may reflect the substantial psychosocial issues around back and neck pain, and it may reflect the fact that for many patients pain is the main troubling symptom and that is least likely to respond well to surgery while weakness and paraesthesia may improve. A recent

Cochrane study summed up the difficulties finding clear evidence to support the various surgical options for cervical radiculomyelopathy [179](#).

The natural course for lumbar disc disease is recovery with non-surgical management in 90% of cases. Surgery is considered for those small numbers with severe symptoms where immediate relief of pressure is necessary to avoid permanent damage. Surgery is also considered for those whose recovery is slow. Evidence does show faster relief from symptoms but it remained unclear whether there were any positive or negative benefits on the lifetime natural history of the underlying disc disease [180](#).

There is understandably little evidence for return to firefighting, but a recent study reviewing return to professional sport after lumbar disc herniation showed 82% overall returning to sport with an average career length of 3.4 years. Of those having surgery, 81% returned to play for an average of 3.3 years and there were no statistically significant differences between surgical and non-surgical groups. Survivorship analysis showed only 62% of players were expected to remain active 2 years after diagnosis [181](#). In another study, lumbar discectomy was tolerated well by professional athletes who were able to successfully return to full competition [182](#). Psychosocial issues are well recognised, and care should be taken when reviewing evidence where secondary gain is a significant issue. The very high levels of professional athletes returning to sport contrasts with much lower levels of employees receiving workers compensation who return to active work. One study showed only 26% returning to work two years after fusion compared to 67% of nonsurgical controls [183](#). Decisions on fitness to return to work, and on permanence of disability, should be based on what should be expected for that individual rather than their actual behaviour, taking into account all the circumstances of the case.

There is no evidence that rehabilitation treatment starting immediately after surgery is effective, however there is strong evidence that treatments starting four to six weeks after surgery are effective. Patients who participated in exercise programs reported slightly less short-term pain and disability than those with no treatment. Patients who participated in high intensity programs reported slightly less short-term pain and disability than those in low intensity programs. There was little or no difference between supervised and home exercise programs. There was no evidence that active programs increased the rate of repeated surgery, or that patients should restrict activities after lumbar disc surgery. Encouraging patients to return to normal activities including work as soon as possible after surgery are common approaches [184](#).

Where discectomy is undertaken with minimal disruption to surrounding tissues as a microdiscectomy with or without laminotomy, there is no reason to limit activity after surgery. A study in Stanford, USA followed up fifty volunteers who were encouraged to return to activities including work as soon as possible [185](#). Eleven who had surgery on a Friday were back at work on the Monday, the mean duration of absence was 1.7 weeks, and the mean time to return to full duties was 2.5 weeks for light manual work and 5.8 weeks for heavy manual work. Those receiving sick pay

took twice as long to return to full duties as those not in receipt of sick pay. This suggests that a phased return to work can start as soon as the firefighter wants to, certainly within a couple of weeks, and a return to full duties could be expected by six to eight weeks after surgery. Surgeons may well recommend longer periods of recovery, and a pragmatic approach may be needed.

A laminectomy will inevitably lead to some short-term weakening of the overall structure of the spine, but a full recovery would be expected.

Endoscopic discectomy is a relatively new technique and should theoretically be an improvement on other discectomy techniques because it is less invasive. One review of 55 patients showed all patients returning to their previous occupation at a mean time of 24.3 days (range 10-60 days) with a significant reduction in severity of lower back pain and lower limb symptoms [186](#). There is limited evidence available at present, insufficient to clearly show benefits over other techniques [187](#).

Applicants for the fire service with a history of microdiscectomy are at slightly increased risk of developing long-term problems as a part of the normal degenerative process, not specifically because of the physical nature of the job. They should therefore be very carefully assessed before advising on employment.

In the cervical spine, laminectomy can lead to post-laminectomy kyphosis in up to 20% of cases [188](#) and laminoplasty can lead to increased stiffness [189](#). While this may well produce symptoms, this does not mean the individual will be significantly compromised in their ability to function as a firefighter. Any decision on subsequent fitness will therefore be an individual one based on all the circumstances of the case.

178 Papavero L, Caspar W. The lumbar microdiscectomy. *Acta Ortho Scand* 1993; Suppl 251:34-7.

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180 Gibson JA, Waddell G. Surgical interventions for lumbar disc prolapse. *Cochrane Database of Systematic Reviews* 2007, Issue 2. Art. No.: CD001350. DOI: 10.1002/14651858.CD001350.pub4

181 Hsu WK, McCarthy KJ, Savage JW, Roberts DW, Roc GC, Micev AJ, Terry MA, Gryzlo SM, Shafer MF. The professional athlete spine initiative: outcomes after lumbar disc herniation in 342 elite professional athletes. *Spine J.* 2011;11(3):180-6.

182 Watkins RG IV, Williams LA, Watkins RG III: Microscopic lumbar discectomy results for 60 cases in professional and Olympic athletes. *Spine J.* 2003; 3:100--105.

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184 Ostelo RWJG, Costa LOPena, Maher CG, de Vet HCW, van Tulder MW. Rehabilitation after lumbar disc surgery. Cochrane Database of Systematic Reviews 2008, Issue 4. Art. No.: CD003007. DOI: 10.1002/14651858.CD003007.pub2

185 Carragee EJ et al. Are postoperative activity restrictions necessary after posterior lumbar discectomy? A prospective study of outcomes in 50 consecutive cases. Spine 1996; 21(16):1893-7

186 Peng CW, Yeo W, Tan SB. Percutaneous endoscopic lumbar discectomy: clinical and quality of life outcomes with a minimum 2 year follow-up. J Orthop Surg Res. 2009;4:20.

187 Hirsch JA, Singh V, Falco FJE, Benyamin RM, Manchikanti L. Automated percutaneous lumbar discectomy for the contained herniated lumbar disc: a systematic assessment of evidence. Pain Physician 2009;12:601-620.

188 Kaptain GJ, Simmons NE, Replogle RE, Pobereskin L: Incidence and outcome of kyphotic deformity following laminectomy for cervical spondylotic myelopathy. J Neurosurg 93: 199--204, 2000

189 Ratliff JK, Cooper PR: Cervical laminoplasty: a critical review. J Neurosurg 98:230--238, 2003

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Spondylolisthesis

Spondylolysis, a fracture of the vertebral arch (usually a stress fracture in those under 40 rather than following a single traumatic event), is present in 9% of the population. In some individuals spondylolisthesis, a displacement of the vertebral body, may occur. In older people, it usually occurs at L4/5 in association with disc degeneration and spondylolysis. Individuals are not at increased risk of trauma to the spine. The background incidence of pain in spondylolysis and spondylolisthesis is no different to that of the normal population.

The only study that followed a group of 30 subjects selected not on the basis of pain but simply because they were found to have spondylolysis or spondylolisthesis after screening 500 first grade children. They were followed up for 45 years and they all followed a clinical course similar to the general population. There was a marked slowing of slip progression with each decade and no subject reached a 40% slip [190](#).

Treatment for spondylolisthesis is usually conservative; it is often an incidental finding in an otherwise asymptomatic individual. Where there are signs of neurological compromise or intractable pain fixation may be required, usually with pedicle screw fixation and fusion, or with screws across the pars interarticularis. Any decision on spondylolisthesis depends on symptoms and the degree of displacement. An expert opinion should be sought before advising on employability.

190 Beutler WJ et al. The natural history of spondylolysis and spondylolisthesis: 45-year follow-up evaluation. Spine 2003;28(10):1027-1035.

Spinal Fusion

Spinal fusion is a procedure that should only be used to treat spinal instability. Instability is best defined as movement or displacement of the spine sufficient to result in neurological deficit, deformity or pain. It is an essential treatment where neurological deficit is occurring or likely to occur, but it is often used in an attempt to treat pain. While a successful result can be expected where treatment is intended to limit or prevent neurological deficit, there is much less success where the primary reason for surgery is pain prevention.

Neurological deficit may result from a bony instability such as spondylolisthesis, or following fracture, or as a result of neoplasia. It may also result from disc degeneration combined with limited space within the spinal canal or exit foramina, or from osteophytes intruding into the space around the cord or nerves. Procedures may involve just stabilisation, or a combination of stabilisation and decompression. Stabilisation is generally achieved through a combination of internal fixation and bone grafting. Internal fixation is generally used to achieve stability and allow for fusion through osteogenesis. In many cases, operative failure results when osteogenesis fails. Failure can result from a wide variety of factors, in part depending on the original problem. Extrinsic factors include malnutrition, irradiation, corticosteroid use and smoking. Intrinsic factors include neoplasia, diabetes, infection and osteoporosis. Smoking is of major significance; one study showed that fusion failed in 40% of smokers but only 8% of non-smokers [191](#). Where firefighters are awaiting spinal fusion surgery it is imperative that they are given as much support and encouragement as possible to stop smoking.

The main concern in the past following spinal fusion surgery is a theoretical adjacent segment degeneration. Fusion at one level will theoretically increase the biomechanical load at the two adjacent discs, accelerating degenerative change, but there is no objective evidence to support this, and future adjacent degeneration is most likely to be the natural evolution of degenerative change. Some surgeons undertake multi-level fusion where there are adjacent degenerative motor segments.

Lack of fitness and obesity is a factor during surgery, but one study showed 66% of obese patients returning to work within 12 months of surgery [192](#).

Following fusion surgery an early discharge is common, within 24-48 hours of surgery. Surgeons will commonly recommend avoiding exercise for the first three months, as this is the time bone takes to fully heal. Some rehabilitation can start within this period, and a study looking at early rehabilitation included core muscle training, leg muscle strength and endurance, stretching and cardiovascular fitness. One arm of the study also included psychomotor therapy focussing on modifying maladaptive pain cognitions, behaviour and motor control. Those treated with

psychomotor therapy saw significantly greater improvement in functional disability, self-efficacy, outcome expectancy and fear of movement at 3, 6, 12 months and 2-3 years after surgery [193](#).

There is no good evidence for an advantage of fusion over conservative treatments for degenerative disease where the primary problem is pain. There are four recent gold-standard randomised control studies, summarised by Mirza et al [194](#), who conclude 'surgery may be more efficacious than unstructured nonsurgical care for chronic back pain but may not be more efficacious than structured cognitive behavioural therapy. Methodological limitations of the randomized trials prevent firm conclusions'. These methodological limitations reflect the serious difficulties comparing a psychological therapy with a surgical therapy in a way that meets standard research criteria. There is no demonstrable advantage of surgery over good quality CBT.

Most patients will make a good functional recovery after spinal fusion and can return to normal levels of activity. Restrictions should depend on the anatomical location of fusion. Guidelines originally developed by Torg and Ramsey-Emrhein for athletes participating in contact sports appear to have withstood the test of time [195](#).

Fusion of the high cervical region, C1-2, places the individual at high risk because much of the neck rotation comes from this point, and fusion would place the athlete at a competitive disadvantage. While there would be no competitive disadvantage to a firefighter, restricted movement could affect functional capability. Fusion at one level is compatible with a return to full contact sports, so it is unlikely to be grounds to prevent a firefighter from returning to full duties. Multilevel fusion can lead to substantial restrictions in movement and substantial stresses above and below the level of fusion, and although two-level fusion remains compatible with contact sports, fusion at more than two levels is not.

Fusion of the thoracic spine makes little functional difference because the ribs provide substantial additional support and allow very little movement between the vertebral bodies. Although there is little space around the spinal cord in the thoracic spine compared to the cervical and lumbar segments, this is more than compensated for by the rigid structure at this level [196](#). Fusion across the cervicothoracic or thoracolumbar junctions could put the individual at significant biomechanical risk. Some surgeons advise against contact sports in these individuals and a similar approach may need to be taken with firefighters [197](#).

191 Brown CW, Orme TJ, Richardson HD. The rate of pseudarthrosis (surgical nonunion) in patients who are smokers and patients who are nonsmokers: a comparison study. *Spine*. Nov 1986;11(9):942-3.

192 Singh AK, Ramappa M, Bhatia CK, Krishna M. Less invasive posterior lumbar interbody fusion and obesity: clinical outcomes and return to work. *Spine (Phila Pa 1976)*. 2010;35(24):2116-20.

193 Abbott AD, Tyni-Lenné R, Hedlund R. Early rehabilitation targeting cognition, behavior, and motor function after lumbar fusion: a randomized controlled trial. *Spine (Phila Pa 1976)*. Apr 15 2010;35(8):848-57.

194 MirzaSK, Deyo RA. Systematic review of randomized trials comparing lumbar fusion surgery to nonoperative care for treatment of chronic back pain. *Spine* 2007;32(&):816-823.

195 Torg JS, Ramsey-Emrhein JA: Management guidelines for participation in collision activities with congenital, developmental, or postinjury lesions involving the cervical spine. *Clin J Sport Med* 1997;7:273--291

196 Watkins R IV, Watkins R III, Williams L, Ahlbrand S, Garcia R, Karamanian A, et al: Stability provided by the sternum and rib cage in the thoracic spine. *Spine* 30:1283--1286, 2005

197 Burnett MG, Sonntag VKH. Return to contact sports after spinal surgery. *Neurosurg Focus* 2006;21(4)E5

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Disc Arthroplasty

There are two main reasons to consider disc arthroplasty. The first is an alternative to fusion, as a treatment for spinal pain. The only reason for arthroplasty is to limit potential excess biomechanical stress on adjacent structures from fusion although evidence suggests adjacent segment degeneration is as common in disc replacement as in fusion. As movement will be retained, this is not an option if the pain is from anywhere other than the disc and endplates. Facet joint pain will inevitably continue if motion continues, and in patients where disc degeneration has already minimised segmental motion there is no advantage to disc arthroplasty over fusion.

The second potential reason is where a disc is degenerative and causing significant nerve root compromise. The simplest approach is to remove the affected disc. In some patients this may decrease space around the nerve roots further, and in the past a fusion procedure has been the only option to maintain space and stability around the nerve roots. An alternative is to introduce a prosthesis into the disc space or adjacent to it that both stabilises the two vertebrae and allows for some movement. If there is already significant nerve root compromise it is unlikely that such an approach would be attempted as an alternative to fusion.

A variety of different options have been used. Some replace the nucleus only, some the full disk. Examples of disc replacements are the Charite, ProDisc, Maverick and FlexiCore devices, with substantial differences between those developed for cervical and lumbar use. In one study of disc replacement for radiculopathy the results were at least as good as straightforward anterior cervical fusion [198](#). A ten-year follow-up review of one-level lumbar arthroplasty with the Charite prosthesis found 77.8% of

patients in 'hard labor level employment' returning to the same level of work [199](#). The Charite Disc has recently been withdrawn in UK for 'commercial reasons'.

A Cochrane review in 2005 concluded that preliminary data from three trials of disc arthroplasty did not permit any firm conclusions [200](#). A review in 2007 concluded that there was no definitive advantage to disc arthroplasty over fusion, with a number of significant additional risk factors from both the surgical procedure, and from complications after surgery [201](#). A review in 2011 comparing disc prosthesis with rehabilitation found significant differences in favour of surgery for pain, but not for return to work, and the clinical difference was not considered important [202](#). An accompanying editorial favoured conservative rehabilitation treatment over surgery because of the inherent risks, but suggested that there was a case for disc replacement over fusion [203](#).

In view of the lack of clear evidence, active rehabilitation should be favoured over surgery for firefighters with chronic low back pain. Any decision on surgical procedure should be a matter for the firefighter and the treating surgeon, but the firefighter should understand the evidence base, and the risks associated with disc replacement over fusion. There is no absolute reason why a firefighter should not return to active firefighting after successful disc arthroplasty but advice would be needed from the treating surgeon, with clear evidence of an excellent level of recovery. An applicant with a history of disc arthroplasty should probably be deferred for at a year to ensure the device is stable and functioning.

198 Lin EL, Wang JC. Total disk arthroplasty. *J Am Acad Orthop Surg*. Dec 2006;14(13):705-14.

199 David T. Long-term results of one-level lumbar arthroplasty: minimum 10-year follow-up of the CHARITE artificial disc in 106 patients. *Spine* 2007;32(6):661-666.

200 Gibson JA, Waddell G. Surgery for degenerative lumbar spondylosis. *Cochrane Database of Systematic Reviews* 2005, Issue 4. Art. No.: CD001352. DOI: 10.1002/14651858.CD001352.pub3

201 Resnick DK, Watters WC. Lumbar disc arthroplasty: a critical review. *Clinical Neurosurgery* 2007;54:83-87.

202 Hellum C, Johnsen LG, Storheim K, Nygaard OP, Brox JI, Rossvoll I, Ro M, Sandvik L, Grundnes O; Norwegian Spine Study Group. Surgery with disc prosthesis versus rehabilitation in patients with low back pain and degenerative disc: two year follow-up of randomised study. *BMJ* 2011;342:d2786.

203 Fairbank J. Total disc replacement for chronic low back pain. *BMJ* 2011;342:d2745.

Posterior Motion Preserving Implants

Besides disc arthroplasty, there are surgical options to stabilise the vertebrae while preserving motion using implants attached posteriorly, using either flexible rods or spring systems.

The Coflex implant is a titanium U-shaped alloy implant which stabilises the vertebra while maintaining the intervertebral disc space and offering some flexion-extension movement. The main indications are degenerative instability and spinal stenosis with or without disc herniation where there is a need to retain intervertebral height. The X-STOP is a titanium spacer that fits between the spinous processes without fixation, limiting compression when the spine is in extension.

There is limited evidence available for use of lumbar interspinous spacers. One review found that X-STOP may improve outcome compared to non-operative treatment in a select group of patients aged 50 or over with lumbar canal stenosis and neurogenic claudication. There was insufficient evidence to comment on use in lumbar degenerative disease [204](#).

Other devices provide postero-lateral stability, connecting pedicle screws with flexible cord systems. The Dynesys device is an example. The device is anchored with pedicle screws which are connected with nylon-like cords running through polyurethane spacers. The cords limit extension while the spacers limit flexion while retaining some movement, particularly rotation. There are a number of small studies but no evidence to show advantage or disadvantage over fusion in relation to return to work [205](#).

There is no evidence that posterior motion preserving implants should prevent a firefighter from resuming full duties. Advice should be sought from the surgeon.

204 Kabir SM, Gupta SR, Casey AT. Lumbar interspinous spacers: a systematic review of clinical and biomechanical evidence. *Spine (PhilaPa 1976)*. 2010;35(25):E1499-506.

205 Schwarzenback O, Berlemann U, Stoll TM, Dubois G. Posterior dynamic stabilization systems: DYNESYS. *Orthop Clin North Am*. 2005;36(3):363-72.

Spina Bifida

The incidence of spina bifida in Great Britain is approximately 3 per 100,000 live births. There is a wide variation in the severity of the condition. Spina bifida occulta may be found incidentally radiographically and the condition is by definition completely asymptomatic. Any decision to recruit depends entirely on symptoms and functional capability.

Some sub-headings as below.

Does Firefighting Cause Degenerative Disease in the Spine?

It has long been thought that physical activity leads to degenerative disease in the spine. Individuals may therefore claim that the degenerative disease in their backs has been caused by service as a firefighter. There is evidence that significant acute injury to the spine may be caused by a specific incident at work, such as a fall from a height with vertical impact

on the base of the spine, particularly when there is clear evidence of acute trauma at the time. A firefighter in these circumstances would be expected to have attended for acute medical care either as a result of back pain or as a result of other trauma, with demonstrable signs and symptoms of an acute injury.

There is, however, evidence that moderate or mixed physical loading results in the least pathology to the spine; symmetric disc degeneration is associated with sedentary rather than active work, while vertebral osteophytes are related to heavy work. Back pain, rather than back pathology, is however related to more active work **136**. There are many studies that demonstrate a clear link between physical workload, including frequent bending and twisting, and low back pain. There is no evidence in most studies linking this work to degenerative conditions in the spine. One study in dock workers who are undergoing constant heavy manual work shows a link to degenerative conditions, although there is no evidence that a transfer to light duties slows the process of degenerative disease **137**. Firefighting does involve heavy manual work at times but would be best described as 'mixed physical loading' and therefore represents the optimal activity for the spine.

A recent review found no strong evidence supporting a causal relationship between any occupational physical activity considered and low back pain. A statistical association was found between low back pain and bending, twisting, lifting and pushing/pulling but not a causal link. Strong evidence against a causal relationship was found between low back pain and manual handling/assisting patients, awkward postures, carrying, sitting, standing and walking **138**.

A study of US urban firefighters found 80% had reported at least one neck, back or shoulder problem. Frequency of aerobic exercise was significantly and negatively correlated with complaints **139**. This suggests that regular aerobic exercise is protective.

136 Videman T et al. Lubar spinal pathology in cadaveric material in relation to history of back pain, occupation, and physical loading. *Spine* 1990; 15:728-40.

137 Waskiewicz J. The effect of heavy work on the musculoskeletal system of dockers. *Bull Inst Marit Trop Med Gdynia* 1996; 47:25-32.

138 Kwon BK, Roffey DM, Bishop PB, Dagenais S, Wai EK. Systematic review: occupational physical activity and low back pain. *Occupational Medicine* 2011; doi:10.1093/occmed/kqr092.

139 Beaton R et al. Neck, back and shoulder pain complaints in urban firefighters: the benefits of aerobic exercise. *J Musculoskelet Pain*. 2002;10(3):57-67.

Causation:

Acute low back pain with associated structural injury tends to follow fairly soon after an event or after trauma. There is often a delay of one to three days before pain ensues, but rarely longer. Annular tears are not always painful, but when pain does arise it is usually within two weeks of injury. Longer delays would need a convincing explanation such as distracting fractures elsewhere. Root pain, or pain related to disc degeneration may be delayed for much longer.

The legal concept of causation differs from the scientific concept and is a particularly challenging area in low back pain **164**. Degeneration is an ongoing process, and a disc may inevitably have prolapsed at some point, so a particular activity on a particular day may seem irrelevant scientifically if it represents say 0.01% of lifetime forces on the spine. If, however, the 'final straw' was a particular work activity, it may be argued that legally this caused the disc prolapse.

While it may be unlikely that a disc prolapse can be clearly attributed to one event at work, if it can an argument may well be made that this is a 'qualifying injury'. It is particularly important when taking a history at the time or shortly afterwards to identify all activities at or around the time of the alleged qualifying injury. Many firefighters have other employment that may be much more physical than their firefighting role. A firefighter who is at a fire on a Tuesday, then works as a roofer on Wednesday and Thursday, then has symptoms on Friday is more likely to have these as a result of his roofing activities rather than firefighting. On the other hand, if on the Tuesday he fell through a weakened floor and landed in a sitting position, experiencing significant symptoms and had to stop active firefighting on the Tuesday but managed to continue roofing on the Wednesday and Thursday, his subsequent symptoms may legitimately be related to his Fire Service duties.

The combination of unreliable memories and secondary gain should always be considered when taking a later history. Contemporaneous sources such as accident records and GP records should be considered before forming an opinion on causation.

164 Krawciw D. Spinal disorders causation. In Melhorn JM, Ackerman WE. Guides to the evaluation of disease and injury causation. 2008. American Medical Association.

Smoking and Back Pain:

Several studies have shown that smoking significantly increases the risk of intervertebral disc degeneration. Disc degeneration and low back pain are significantly increased in patients with aortic calcification and lumbar artery atheroma linked to smoking and high cholesterol levels **170**. A recent study showed that tobacco smoke condensate greatly induced an inflammatory response and gene expression of metalloproteinases and reduced active matrix synthesis and expression of matrix structural genes in disc cells. This suggests a direct effect on human disc cell viability and metabolic activity **171**.

There is a clear link between back pain and current and former smoking, although the effect was modest (OR 1.31, CI 1.02-1.55) in a meta-analysis **172**. A study of construction workers in Japan found a clear link between low back pain and heavy smoking **173**. A Norwegian study found a job involving heavy lifting and much standing was a strong predictor of low back pain in smokers four years later (OR 5.53, 95% CI 1.93-15.84) but was not associated with low back pain in non-smokers **174**.

170 Kauppila LI. Atherosclerosis and disc degeneration/low back pain - a systematic review. *Eur J Vasc Endovasc Surg.* 2009;37(6):661-70.

171 Vo N et al. Differential effects of nicotine and tobacco smoke condensate on human annulus fibrosus cell metabolism. *J Orthop Res.* 2011;29(10):1585-91.

172 Shiri R et al. The association between smoking and low back pain: a meta-analysis. *Am J Med.* 2010;123(1):87.e7-35.

173 Ueno S et al. Association between musculoskeletal pain in Japanese construction workers and job age, alcohol consumption, and smoking. *Ind Health.* 1999;37(4):449-56.

174 Eriksen W, Natvig B, Bruusgaard D. Smoking, heavy physical work and low back pain: a four-year prospective study. *Occup Med.* 1999;49(3):155-60.

Obesity and Back Pain:

Logically, an increase in long-term loading on the spine would be expected to increase degenerative changes. A recent study in Spain found a significant increase in incidence of Modic changes, disc contour abnormalities, spondylolisthesis and disc degeneration in obese patients with chronic back pain **175**. Another study in Finland found a link between smoking, overweight and obesity and high physical activity with lumbar radicular pain **176**. A clear association between BMI over 25 at young age and disc degeneration (RR 3.8, 95% CI 1.4-10.4) was shown in working middle-aged men **177**.

175 Arana E et al. Modic changes and associated features in Southern European chronic low back patients. *Spine J.* 2011;11(5):402-11.

176 Shiri R et al. Cardiovascular and lifestyle risk factors in lumbar radicular pain or clinically defined sciatica: a systematic review. *Eur Spine J.* 2007;16(12):2043-54.

177 Like M et al. Disc degeneration of the lumbar spine in relation to overweight. *Int J Obes (Lond).* 2005;29(8):903-8.

Discectomy:

Surgical treatment for disc herniation associated with sciatica has seen a significant improvement in technique over the past twenty years. The operating microscope is preferred by some, and the change in terminology merely reflects a change in tools rather than a different procedure. There is no good level 1 evidence that any method has a significant difference in size of incision, morbidity, shortened recovery times or outcomes. Athroscopic discectomy is an experimental alternative.

A 70-95% success rate can be expected from discectomy **178**. Success is a combination of pain relief and functional improvement and is largely subjective. It also depends on the parameters measured and the occupation of the individual; successful return to a desk job

does not equate to successful return to active firefighting. Firefighters have successfully returned to operational firefighting duties; however, a number have been unable to sustain this level of work for more than a few years.

There is a conflicting evidence base in relation to discectomy. This may reflect the fact that by the time many patients come to surgery any radiculopathy (or myelopathy related to cervical disc herniation) is not fully reversible, it may reflect the substantial psychosocial issues around back and neck pain, and it may reflect the fact that for many patients pain is the main troubling symptom and that is least likely to respond well to surgery while weakness and paraesthesia may improve. A recent Cochrane study summed up the difficulties finding clear evidence to support the various surgical options for cervical radiculomyelopathy **179**.

The natural course for lumbar disc disease is recovery with non-surgical management in 90% of cases. Surgery is considered for those small numbers with severe symptoms where immediate relief of pressure is necessary to avoid permanent damage. Surgery is also considered for those whose recovery is slow. Evidence does show faster relief from symptoms but it remained unclear whether there were any positive or negative benefits on the lifetime natural history of the underlying disc disease **180**.

There is understandably little evidence for return to firefighting, but a recent study reviewing return to professional sport after lumbar disc herniation showed 82% overall returning to sport with an average career length of 3.4 years. Of those having surgery, 81% returned to play for an average of 3.3 years and there were no statistically significant differences between surgical and non-surgical groups. Survivorship analysis showed only 62% of players were expected to remain active 2 years after diagnosis **181**. In another study, lumbar discectomy was tolerated well by professional athletes who were able to successfully return to full competition **182**. Psychosocial issues are well recognised, and care should be taken when reviewing evidence where secondary gain is a significant issue. The very high levels of professional athletes returning to sport contrasts with much lower levels of employees receiving workers compensation who return to active work. One study showed only 26% returning to work two years after fusion compared to 67% of nonsurgical controls **183**. Decisions on fitness to return to work, and on permanence of disability, should be based on what should be expected for that individual rather than their actual behaviour, taking into account all the circumstances of the case.

There is no evidence that rehabilitation treatment starting immediately after surgery is effective, however there is strong evidence that treatments starting four to six weeks after surgery are effective. Patients who participated in exercise programs reported slightly less short-term pain and disability than those with no treatment. Patients who participated in high intensity programs reported slightly less short-term pain and disability than those in low intensity programs. There was little or no difference between supervised and home exercise programs. There was no evidence that active programs increased the rate of repeated surgery, or that patients should restrict activities after lumbar disc surgery. Encouraging patients to return to normal activities including work as soon as possible after surgery are common approaches **184**.

Where discectomy is undertaken with minimal disruption to surrounding tissues as a microdiscectomy with or without laminotomy, there is no reason to limit activity after surgery. A study in Stanford, USA followed up fifty volunteers who were encouraged to return to activities including work as soon as possible **185**. Eleven who had surgery on a Friday were

back at work on the Monday, the mean duration of absence was 1.7 weeks, and the mean time to return to full duties was 2.5 weeks for light manual work and 5.8 weeks for heavy manual work. Those receiving sick pay took twice as long to return to full duties as those not in receipt of sick pay. This suggests that a phased return to work can start as soon as the firefighter wants to, certainly within a couple of weeks, and a return to full duties could be expected by six to eight weeks after surgery. Surgeons may well recommend longer periods of recovery, and a pragmatic approach may be needed.

A laminectomy will inevitably lead to some short-term weakening of the overall structure of the spine, but a full recovery would be expected.

Endoscopic discectomy is a relatively new technique and should theoretically be an improvement on other discectomy techniques because it is less invasive. One review of 55 patients showed all patients returning to their previous occupation at a mean time of 24.3 days (range 10-60 days) with a significant reduction in severity of lower back pain and lower limb symptoms **186**. There is limited evidence available at present, insufficient to clearly show benefits over other techniques **187**.

Applicants for the fire service with a history of microdiscectomy are at slightly increased risk of developing long-term problems as a part of the normal degenerative process, not specifically because of the physical nature of the job. They should therefore be very carefully assessed before advising on employment.

In the cervical spine, laminectomy can lead to post-laminectomy kyphosis in up to 20% of cases **188** and laminoplasty can lead to increased stiffness **189**. While this may well produce symptoms, this does not mean the individual will be significantly compromised in their ability to function as a firefighter. Any decision on subsequent fitness will therefore be an individual one based on all the circumstances of the case.

178 Papavero L, Caspar W. The lumbar microdiscectomy. *Acta Ortho Scand* 1993; Suppl 251:34-7.

179 Nikolaidis I, Fouyas IP, Sandercock PAG, Statham PF. Surgery for cervical radiculopathy or myelopathy. *Cochrane Database of Systematic Reviews* 2010, Issue 1. Art. No.: CD001466. DOI: 10.1002/14651858.CD001466.pub3

180 Gibson JA, Waddell G. Surgical interventions for lumbar disc prolapse. *Cochrane Database of Systematic Reviews* 2007, Issue 2. Art. No.: CD001350. DOI: 10.1002/14651858.CD001350.pub4

181 Hsu WK, McCarthy KJ, Savage JW, Roberts DW, Roc GC, Micev AJ, Terry MA, Gryzlo SM, Shafer MF. The professional athlete spine initiative: outcomes after lumbar disc herniation in 342 elite professional athletes. *Spine J.* 2011;11(3):180-6.

182 Watkins RG IV, Williams LA, Watkins RG III: Microscopic lumbar discectomy results for 60 cases in professional and Olympic athletes. *Spine J.* 2003; 3:100--105.

183 Nguyen TH, Randolph DC, Talmage J, Succop P, Travis R. Long-term outcomes of lumbar fusion among workers' compensation subjects: a historical cohort study.

184 Ostelo RWJG, Costa LOPena, Maher CG, de Vet HCW, van Tulder MW. Rehabilitation after lumbar disc surgery. Cochrane Database of Systematic Reviews 2008, Issue 4. Art. No.: CD003007. DOI: 10.1002/14651858.CD003007.pub2

185 Carragee EJ et al. Are postoperative activity restrictions necessary after posterior lumbar discectomy? A prospective study of outcomes in 50 consecutive cases. Spine 1996; 21(16):1893-7

186 Peng CW, Yeo W, Tan SB. Percutaneous endoscopic lumbar discectomy: clinical and quality of life outcomes with a minimum 2 year follow-up. J Orthop Surg Res. 2009;4:20.

187 Hirsch JA, Singh V, Falco FJE, Benyamin RM, Manchikanti L. Automated percutaneous lumbar discectomy for the contained herniated lumbar disc: a systematic assessment of evidence. Pain Physician 2009;12:601-620.

188 Kaptain GJ, Simmons NE, Replogle RE, Pobereskin L: Incidence and outcome of kyphotic deformity following laminectomy for cervical spondylotic myelopathy. J Neurosurg 93: 199--204, 2000

189 Ratliff JK, Cooper PR: Cervical laminoplasty: a critical review. J Neurosurg 98:230--238, 2003

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Spondylolisthesis:

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190 Beutler WJ et al. The natural history of spondylolysis and spondylolisthesis: 45-year follow-up evaluation. Spine 2003;28(10):1027-1035.

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There is no good evidence for an advantage of fusion over conservative treatments for degenerative disease where the primary problem is pain. There are four recent gold-standard randomised control studies, summarised by Mirza et al **194**, who conclude 'surgery may be more efficacious than unstructured nonsurgical care for chronic back pain but may not be more efficacious than structured cognitive behavioural therapy. Methodological limitations of the randomized trials prevent firm conclusions. These methodological limitations reflect the serious difficulties comparing a psychological therapy with a surgical therapy in a way that meets standard research criteria. There is no demonstrable advantage of surgery over good quality CBT.

Most patients will make a good functional recovery after spinal fusion and can return to normal levels of activity. Restrictions should depend on the anatomical location of fusion. Guidelines originally developed by Torg and Ramsey-Emrhein for athletes participating in contact sports appear to have withstood the test of time **195**.

Fusion of the high cervical region, C1-2, places the individual at high risk because much of the neck rotation comes from this point, and fusion would place the athlete at a competitive disadvantage. While there would be no competitive disadvantage to a firefighter, restricted movement could affect functional capability. Fusion at one level is compatible with a return to full contact sports, so it is unlikely to be grounds to prevent a firefighter from returning to full duties. Multilevel fusion can lead to substantial restrictions in movement and substantial stresses above and below the level of fusion, and although two-level fusion remains compatible with contact sports, fusion at more than two levels is not.

Fusion of the thoracic spine makes little functional difference because the ribs provide substantial additional support and allow very little movement between the vertebral bodies. Although there is little space around the spinal cord in the thoracic spine compared to the cervical and lumbar segments, this is more than compensated for by the rigid structure at this level **196**. Fusion across the cervicothoracic or thoracolumbar junctions could put the individual at significant biomechanical risk. Some surgeons advise against contact sports in these individuals and a similar approach may need to be taken with firefighters **197**.

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Disc Arthroplasty:

There are two main reasons to consider disc arthroplasty. The first is an alternative to fusion, as a treatment for spinal pain. The only reason for arthroplasty is to limit potential excess biomechanical stress on adjacent structures from fusion although evidence suggests adjacent segment degeneration is as common in disc replacement as in fusion. As movement will be retained, this is not an option if the pain is from anywhere other than the disc and endplates. Facet joint pain will inevitably continue if motion continues, and in patients where disc degeneration has already minimised segmental motion there is no advantage to disc arthroplasty over fusion.

The second potential reason is where a disc is degenerative and causing significant nerve root compromise. The simplest approach is to remove the affected disc. In some patients this may decrease space around the nerve roots further, and in the past a fusion procedure has been the only option to maintain space and stability around the nerve roots. An alternative is to introduce a prosthesis into the disc space or adjacent to it that both stabilises the two vertebrae and allows for some movement. If there is already significant nerve root compromise it is unlikely that such an approach would be attempted as an alternative to fusion.

A variety of different options have been used. Some replace the nucleus only, some the full disk. Examples of disc replacements are the Charite, ProDisc, Maverick and FlexiCore

devices, with substantial differences between those developed for cervical and lumbar use. In one study of disc replacement for radiculopathy the results were at least as good as straightforward anterior cervical fusion **198**. A ten-year follow-up review of one-level lumbar arthroplasty with the Charite prosthesis found 77.8% of patients in 'hard labor level employment' returning to the same level of work **199**. The Charite Disc has recently been withdrawn inUK for 'commercial reasons'.

A Cochrane review in 2005 concluded that preliminary data from three trials of disc arthroplasty did not permit any firm conclusions **200**. A review in 2007 concluded that there was no definitive advantage to disc arthroplasty over fusion, with a number of significant additional risk factors from both the surgical procedure, and from complications after surgery **201**. A review in 2011 comparing disc prosthesis with rehabilitation found significant differences in favour of surgery for pain, but not for return to work, and the clinical difference was not considered important **202**. An accompanying editorial favoured conservative rehabilitation treatment over surgery because of the inherent risks, but suggested that there was a case for disc replacement over fusion **203**.

In view of the lack of clear evidence, active rehabilitation should be favoured over surgery for firefighters with chronic low back pain. Any decision on surgical procedure should be a matter for the firefighter and the treating surgeon, but the firefighter should understand the evidence base, and the risks associated with disc replacement over fusion. There is no absolute reason why a firefighter should not return to active firefighting after successful disc arthroplasty, but advice would be needed from the treating surgeon, with clear evidence of an excellent level of recovery. An applicant with a history of disc arthroplasty should probably be deferred for at a year to ensure the device is stable and functioning.

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Posterior Motion Preserving Implants:

Besides disc arthroplasty, there are surgical options to stabilise the vertebrae while preserving motion using implants attached posteriorly, using either flexible rods or spring systems.

The Coflex implant is a titanium U-shaped alloy implant which stabilises the vertebra while maintaining the intervertebral disc space and offering some flexion-extension movement. The main indications are degenerative instability and spinal stenosis with or without disc herniation where there is a need to retain intervertebral height. The X-STOP is a titanium spacer that fits between the spinous processes without fixation, limiting compression when the spine is in extension.

There is limited evidence available for use of lumbar interspinous spacers. One review found that X-STOP may improve outcome compared to non-operative treatment in a select group of patients aged 50 or over with lumbar canal stenosis and neurogenic claudication. There was insufficient evidence to comment on use in lumbar degenerative disease [204](#).

Other devices provide postero-lateral stability, connecting pedicle screws with flexible cord systems. The Dynesys device is an example. The device is anchored with pedicle screws which are connected with nylon-like cords running through polyurethane spacers. The cords limit extension while the spacers limit flexion while retaining some movement, particularly rotation. There are a number of small studies but no evidence to show advantage or disadvantage over fusion in relation to return to work [205](#).

There is no evidence that posterior motion preserving implants should prevent a firefighter from resuming full duties. Advice should be sought from the surgeon.

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Spina Bifida:

The incidence of spina bifida in Great Britain is approximately 3 per 100,000 live births. There is a wide variation in the severity of the condition. Spina bifida occulta may be found incidentally radiographically and the condition is by definition completely asymptomatic. Any decision to recruit depends entirely on symptoms and functional capability.

New Section for 2012

Amputations:

Most of the research literature and evidence base of functional outcome following amputation in working-age individuals involves survivors of military trauma. There are many anecdotes of amputees who have successfully returned to physically demanding occupations and sports, but little statistical research.

The evidence base includes significant numbers for vascular pathology and other disorders where co-morbidity would make it most unlikely that the individual could be considered for firefighting. Substantial numbers of individuals will be unable to cope with the activity levels required of a firefighter, so the main objective of this study is to consider whether any individuals could cope. What factors need to be considered when deciding if a recruit with an amputation could function effectively as a firefighter, and can a current firefighter return to duty after an amputation?

When considering operational capability of a firefighter wearing a limb prosthesis, there are a number of considerations. The most obvious is their capability to undertake firefighting tasks wearing a prosthesis. Other factors are problems with the stump related to mechanical stress combined with sweating in a hot environment, co-morbidities from the original trauma both physical and psychological, and co-morbidities such as phantom limb pain. The final consideration is the nature of the prosthesis. Substantial advances have been made recently in the design and function of prosthetic limbs.

Complete loss of a limb is not compatible with firefighting, even if replaced with a prosthesis. There is evidence that loss of one limb leads to an increased sensory threshold in the contralateral limb, which could have a negative on proprioception and balance [206](#). This suggests central changes which could affect operational capability in a firefighter, but it is important, in the era of the Equality Act, to look at what the person can do, not what they can't do, and whether what they can do meets the fitness criteria for firefighting.

[Upper Limb Amputation](#)

[Lower Limb Amputation](#)

[Overall Guidance](#)

206 Kavounoudias A et al. Bilateral changes in somatosensory sensibility after unilateral below-knee amputation. Arch Phys Med Rehabil. 2005;86(4):633-40.

Upper Limb Amputation:

The requirement for manual dexterity combined with the need for substantial upper limb power and strength makes it very unlikely that anyone with a significant upper limb amputation (i.e., amputation proximal to the wrist, or partial hand amputations which would significantly impair dexterity or grip) would be able to cope with firefighting duties. Loss of one or two fingers may be compatible, or the distal phalanx of the thumb in certain circumstances.

Lower Limb Amputation:

Lower limb amputations are likely to be more compatible with service as a firefighter. There is anecdotal evidence from the US [207](#) and UK [208](#) of a number of firefighters with transtibial or other lower extremity amputations who have been fully employed in their role. No specific references were found for an above-knee amputee successfully working as a firefighter. The main challenge is likely to be to climb ladders, the ability to crawl with equipment, and to

manoeuvre on hands and knees. This is a capability issue, and it should be borne in mind that there are many obese firefighters in operational roles who will inevitably be slow and will have difficulty moving around obstructions.

The level of amputation is important, as this will inevitably affect mobility and proprioception. Historically amputation through joints has been avoided, but this was mostly because of potential difficulties creating an artificial joint adjacent to the stump. The evidence for functional outcomes of individuals following through the ankle and through the knee amputations for trauma does not obviously support this, and the outcomes after trauma are likely to be substantially different to those requiring amputation for disease, particularly vascular disease where stump failure may relate more to the underlying pathology rather than the level of amputation. The capacity to climb a ladder in a leg over leg pattern would be limited because of loss of power in the affected limb and the tendency for prosthetic equipment to collide with the ladder and equipment. The entanglement of prosthetic systems with equipment, particularly ladders may be greater in the Through Knee (knee disarticulation) prosthesis. The prosthetic knee system protrudes further forward than the contralateral knee when flexed. The presence of the residual knee reduces the space for the knee system to be fitted, leading to a different level at which the two knees hinge. Although the TK amputee tends to have higher levels of functional capacity the discrepancy in knee hinging could lead to functional impairment in both ladder climbs and crawling.

There are many studies published of small numbers or single cases, but few larger reviews or meta-analyses to provide robust statistical evidence. Nevertheless there are sufficient studies to clearly demonstrate that many amputees have recovered to the point where they are more than capable of coping with activities equivalent to operational firefighting duties, and the statistics for military casualties suggest that up to half of those who have sustained a below knee amputation following trauma or localised pathology could return to active firefighting duties.

Energy expenditure walking can be significantly more following amputation, and the higher the level of amputation the greater the energy needed **209**. This is unlikely to be a major factor for firefighting, as distances walked are not great, and an amputee who is fitter than his colleagues should have a sufficient reserve to meet the physical standards of stair and ladder climbing, lifting and carrying.

Strength is a concern in a role involving heavy manual handling, however a study of lower limb strength found the strength asymmetry between hips was only 8% and 14% at 60 and 120 degrees respectively, with peak torques in the residual limb significantly greater than able-bodied controls, suggesting that overall there is no major imbalance in strength that might affect capability **210**.

While many amputees will have complications, and firefighting may be a step too far, there is substantial anecdotal evidence mostly from sports and outdoor activities to show that lower limb amputees can be capable of achieving substantially more than able-bodied colleagues. This suggests that any decision on fitness should be based on individual capability and motivation. The likelihood of a bilateral amputee coping with the rigours of firefighting is substantially less than a unilateral amputee.

Specific Problems Following Amputation

Toe amputation can lead to significant disability in some, but unless there are significant complications impairment should not be significant when wearing firefighting boots.

Amputation of Hallux will lead to loss of toe-off in walking and may impair balance, proprioception and control particularly when working at height or on ladders. Loss of the second toe can lead to hallux valgus and post-operative scar problems but loss of the smaller toes is unlikely to have any significant impact.

Pain directly associated with the amputation, or as a result of altered stresses on the rest of the body, can be a problem. While symptoms are seen commonly, most amputees cope, they will not be harmed by activity and in many cases activity can lead to a reduction in symptoms. Concurrent medication use may pose a problem e.g., Amitriptyline, Gabapentin and opiates.

An Iranian study of 27 unilateral amputations of the foot and ankle found 40.7% with phantom sensation, 22.2% with phantom pain, 44.4% with stump pain, 44.4% with back pain, 33.3% with contralateral knee pain and 14.8% with ipsilateral knee pain **211**.

An Iranian study of 96 unilateral transtibial amputees found 54% had phantom sensations, 17% had phantom pain, 42% had stump pain, 44% had lower back pain, 38% had contralateral knee pain and 13% had ipsilateral knee pain. 54% reported psychological problems and 26% were currently using psychological support services. 65% were or had been in regular long-term employment after injury **212**.

What can be achieved by Lower Limb Amputees?

A review of US combat veterans from Iraq assessed functional outcome against a scale of 1-7, with 6 equating to low impact activities such as swimming and golf and 7 equating to high impact activities such as basketball and skiing. Those amputees achieving level 7 were foot 4/8 (50%), ankle 0/1, transtibial 29/93 (31.2%), through the knee 1/2 (50%), transfemoral 12/63 (19.1%) **213**. While normal downhill skiing requires significant flexion and rotational control, there is at least one example of a telemark skier successfully returning to the sport after a transfemoral amputation, a sport requiring a high level of prosthesis performance.

Unilateral lower limb amputation, even transfemoral, will not necessarily prevent an individual from ladder climbing or manoeuvring over rough terrain and through buildings however there will be some functional impairment, proportional to how proximal the amputation is. A study looking at energy expenditure of three experienced rock climbers with transfemoral amputation showed that, while they used 15% more energy with a full articulated prosthesis they were still able to climb a 9.14m indoor rock wall at 5.9 Yosemite Decimal Scale rating **214**.

One concern is detachment of the prosthetic limb during physical activity. There are a number of mechanisms of providing a secure fit for a prosthesis, and accidental loss of a limb even in high activity sports is rare **215**. It should not be an issue of substantial significance for firefighters. It will be necessary to ensure that the suspension system can withstand the rigours of operational firefighting, with appropriate protection for vulnerable release mechanisms and controls. This may require a combination of systems – such as silicon liner systems with additional belts if necessary.

Prosthesis Design:

A crucial factor in enabling firefighting after lower limb amputation is design of the prosthesis. There is insufficient opportunity here to explain the detailed criteria and biomechanics of prosthetic design, but there are a number of factors to consider.

There are various support mechanisms, including stabilising belts and harnesses, but many modern prostheses designed for active use are held to the stump by suction, with a two-piece mechanism with an inner silicone liner sitting snugly in an outer shell to maximise grip and eliminate rotational movement. This requires a reasonable stump length. Consideration needs to be given to the distribution of force to the stump, to ensure both stability and good blood flow within the stump. The use of suction involves systems to release suction, and there is potential for these to be activated unintentionally. It should not be difficult to ensure a protective cover or repositioning of these systems to minimise the risk. Where an inner sleeve attaches to the main prosthesis through a coupling, again it should be possible to protect the release mechanism.

There are new above knee prostheses available with a proximal intra-osseous fitting direct to the femoral shaft. This eliminates the problems of stump shrinkage and loosening but will put significant torque on the remaining femur. These approaches remain experimental.

Through knee or above knee amputees will require a prosthesis with a knee hinge. The usual design is a passive motion joint with stance and swing phase control (SNS) to ensure that the knee does not excessively flex during the forward swing, and locks during weight bearing. Various additional control mechanisms can be added to enable greater control with activity, including pneumatic, hydraulic and microprocessor systems. Modern SNS systems are sufficiently robust to enable the individual to run marathons, climb mountains, ski and play football, so there is no mechanical reason why they should fail in an operational firefighting role.

The pylon connecting knee to foot can be a simple shell or tube, but modern designs include systems to store and release energy to allow jumping and landing as well as running, and a degree of axial rotation.

The foot may be connected via an ankle joint to allow some motion. This may help as a shock-absorber and to give better stability over uneven terrain.

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Overall Guidance:

As a general principle an uncomplicated trans-tibial amputation could be compatible with firefighting, but it is important to ensure that a firefighter with any amputation and particularly a through knee or above knee amputation has full and appropriate tests of functional capacity. For applicants, care should be taken to balance the requirement not to discriminate against the likelihood that the applicant will be able to provide regular and effective service for a reasonable period of time.

The likelihood of a fit, motivated applicant with a below knee amputation meeting full criteria for service may well be in the order of 30%, but the likelihood of an applicant with a through-knee or above knee amputation meeting the criteria will be much lower. It is particularly important to appreciate that work as a firefighter is both demanding and unpredictable. Amputees may achieve high levels of sporting excellence in a highly controlled environment with a prosthesis designed specifically for the task, but may well not be able to adapt to the varied pressures and demands of the fireground. Any applicant needs to appreciate that the safety of themselves, colleagues and the public depend on them being fit, capable and reliable in all situations.

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Nervous System

Neurological disease may have an adverse impact on an individual's career in terms of:

- Mobility
- Risk of sudden incapacity
- Cognition – including the perception of danger.
- Communication – expressive and receptive

There may be an increased tendency towards sickness absence and a heightened risk that a full career term will not be completed.

The assessment of an individual requires each of these areas to be reviewed with regard to knowledge of the severity of the disorder and its likely rate of progression or resolution. There may be profound health and safety concerns in relation to firefighters but relatively few concerns in other areas of the Service. Whilst this may preclude working as a firefighter, it does allow for firefighters affected by neurological disease to be retrained into other roles with or without reasonable adjustment.

Topics include:

[Epilepsy](#)

[Brain Injury](#)

[Degenerative Neurological Disease](#)

Epilepsy:

The term epilepsy covers conditions which may lead to a sudden disturbance in consciousness. Three broad topics will be discussed here:

[Febrile Convulsions](#)

[Childhood Syndromes](#)

[Major Generalised Epilepsy](#)

A risk assessment should be made in each individual case, based on a report from a specialist. It is essential to consider the long-term history of the condition in relation

to periods of pressure or stress, and shift work as well as the response to medication. Where the risk is considered low it may be safe for these individuals to undertake operational firefighting. Individuals should have been fit-free for at least one year, with a low risk in relation to the pressures of work. Any changes in medication should be accompanied by a suitable period away from operational firefighting to ensure the individual remains fit-free.

Febrile Convulsions:

Generalised convulsions are more common in the first five years of life than at any other time. Febrile convulsions occur in 3% of children and demonstrate an idiopathic susceptibility to convulsions. There is a genetic component. They are rare below the age of six months or above the age of five years. About 90% of febrile convulsions occur within the first 24 hrs of a febrile illness, typically when the rate of temperature rise is greatest.

When assessing the likelihood of brain damage and susceptibility to adult epilepsy, the age of the child at the time of the febrile convulsion is important. Convulsions in the younger child tend to be more damaging. The chance of a severe seizure (longer than 15 minutes) falls after the age of two.

The risk of epilepsy amongst children who have not suffered a febrile convulsion is 0.5% [1](#). The incidence of epilepsy following febrile convulsion ranges from 5-10% and the epilepsy generally appears by the age of seven years [2](#).

Convulsions associated with a febrile illness after the age of five years have the same significance as a non-febrile convulsion and carry a 16% risk of late onset epilepsy [3](#).

It is difficult to justify precluding an individual from a particular uniformed role for what might become a problem, based on an event many years previously. The vast majority of early febrile convulsions that result in epilepsy do so by the age of seven. An individual with a history of febrile convulsions but clear of epilepsy by the age of 25 should be viewed as having the same risk as the general population. A history of multiple or severe febrile convulsions may warrant delay in recruitment until after the age of 25.

A history of late onset febrile convulsion with or without residual brain damage should be viewed with extreme caution in relation to safety critical roles. Advice from a specialist should be sought, and careful consideration given to the effectiveness of treatment and the overall risk of an event at work.

1 Nelson KB, Ellenberg JH. Predictors of epilepsy in children who have experienced febrile convulsions. *New England Journal of Medicine* 1976; 295:1029-33.

2 Hauser WA, Annegers JF, Kurland JT. Febrile Convulsions: prognosis for subsequent seizures. *Neurology* 1977;27:341.

3 Pavone L, Cavazzuti GB, Incorpora G et al. Late febrile convulsions: a clinical follow-up. *Brain and Development*. 1989; 11: 183-5.

Childhood Epilepsy Syndromes:

Childhood Absence Epilepsy (petit mal)

Childhood absence epilepsy, formerly known as 'petit mal' is an interruption of consciousness typically occurring between 5-12 years of age and frequently precipitated by hyperventilation. It is generally benign and resolves spontaneously although there is a distinction to be made between simple absences seizures and absences occurring as part of a temporal lobe epilepsy.

Some researchers have shown that up to 56% of children with absence seizures continue to have attacks after the age of 21 years [4](#) although most put the prevalence at a much lower figure. Livingston found that of 15,000 children with epilepsy, only 2.3% had 'pure' petit mal. Of those children with the 'pure' form, 92 of 117 patients followed up ceased to have either EEG abnormality or seizures by the time they were 20 years and only 17 children continued to have absence seizures in adulthood. However, of those 100 children who recovered from 'pure petit mal', 54 developed grand mal epilepsy in adolescence or adulthood, particularly if the onset of petit mal occurred after the age of ten years [5](#). Roger also found an unfavourable prognosis if the onset was after the age of ten years or before the age of five, with an overall favourable result in 48% of patients studied [6](#).

Benign Focal Epilepsy (Rolandic or Sylvian Epilepsy):

Benign Focal Epilepsy, also referred to as Rolandic or Sylvian Epilepsy, is a partial epilepsy which originates in the same well-defined area of the brain. The manifestation may be simple or quite complex and it is the commonest partial epilepsy of childhood, accounting for up to 16% of childhood epilepsy.

Simple focal epilepsy is usually motor, with conservation of consciousness, although some patients suffer from somatosensory changes as well. These changes may be confused with an aura of a complex partial seizure (temporal lobe epilepsy).

Onset is typically between five and ten years and rarely after 12 years. The condition predominantly affects boys and there is no neurological or intellectual deficit. Attacks

occur only during sleep in 75-80% of cases and the condition resolves spontaneously during adolescence [7](#).

There is a strong genetic component and most children with benign focal epilepsy recover by their mid-teens and do not go on to develop any other form of epilepsy [8](#). The incidence of further seizures in this group is estimated at 2% [9](#).

Complex Partial Epilepsy:

This is amongst the commonest and most intractable forms of epilepsies. Its onset is typically before 20 years of age. The lesion may be in the temporal lobe but in some children the lesion is extra-temporal.

About a third of cases have a cause such as birth trauma, head trauma or meningitis. Another third have an identifiable severe seizure – such as a severe febrile convulsion whilst the final third have no identifiable cause. There appears to be no genetic link other than amongst those whose temporal lobe epilepsy followed a febrile convulsion.

Most complex partial seizures are generally paroxysmal, beginning and ending abruptly. Déjà vu phenomena and auditory and olfactory hallucinations are common as are changes in affect.

Exact incidence is difficult to quantify given the range of possible manifestations, but it is thought to range between 10-25% of all epilepsies of childhood. Chronicity is common and the appearance of disturbing automatisms and degeneration of cognitive-intellectual function gives such epilepsy a poor prognosis. Patients with complex partial seizures tend to suffer more frequent attacks, require more drugs and suffer more psychosocial stress than people with generalised seizures [10](#). A follow up study in 1966 showed that 62% of persons with childhood temporal lobe epilepsy were dependant on others for all or part of their care. In a more recent study, only 10% of sufferers managed on drug treatment alone were free of seizures after 6 years [11](#).

Neurosurgery may be indicated in some and this is usually carried out in children prior to adolescence so as to maximise their chances of learning during their school age. Any such individual applying for the Service in any operational or control role should be reviewed on the basis of function and the absence of seizures for ten years.

4 Currier RD, Kooi KA, Saidman LJ. Prognosis of pure petit mal. A follow up study. *Neurology* 1963;13:959-67.

5 Livingston S, Torres I, Pauli LL, Rider RV. Petit mal epilepsy: results of a prolonged follow-up of 117 patients. *JAMA* 1965;194:227-32.

6 Roger J. Prognostic features of petit mal absence. *Epilepsia* 1974;15:433.

7 Lerman P, Kivity S. Benign focal epilepsies of childhood. Recent advances in epilepsy. Churchill Livingstone, Edinburgh 1986. pp 137.

8 Beaussart M, Faou R. Evolution of epilepsy with Rolandic paroxysmal foci: a study of 324 cases. *Epilepsia* 1978; 19: 337-42.

9 Loiseau P, Duche B. Benign childhood epilepsy with centrotemporal spikes. *Cleveland clinic Journal of Medicine*. 1989; 56 (supp 1): S17-22.

10 Reynolds EH. Interictal behaviour in temporal lobe epilepsy. *BMJ* 1983;21:22

11 Harbord MG, Manson JL. Temporal Lobe Epilepsy in childhood. A reappraisal of etiology and outcome. *Pediatric Neurology* 1987; 3: 263-8.

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Major Generalised Epilepsy:

Major Generalised Epilepsy includes grand mal epilepsy and is characterised by loss of consciousness. There may be tonic-clonic convulsions, a non-convulsive absence or massive bilateral myoclonic jerks followed by a post-ictal state. It is the commonest epilepsy of childhood affecting about 80% of children with epilepsy, either alone or in tandem with another form of epilepsy.

Primary grand mal epilepsy may occur at any stage of life but usually after the age of five years and before adolescence. There is a strong genetic component when the disease starts in early childhood and remission rates of over 90% have been reported in such cases. However, when absence attacks or other forms of epilepsy are present, or when the onset is in adolescence or later (secondary grand mal), the prognosis is not so good [12](#).

In general, primary grand mal epilepsy is the generalised epilepsy most likely to remit and least likely to relapse later, although it may relapse even after a long period of remission. Secondary grand mal epilepsy however is a much commoner manifestation of childhood epilepsy than are primary grand mal attacks. A family history is usually absent in secondary epilepsy and the individual frequently has a history of partial seizures or severe febrile convulsion. MR scans may show signs of structural brain lesions. Secondary epilepsies are more likely to be resistant to anticonvulsant medication and they therefore carry a poor prognosis.

12 Oller-Daurella L, Oller FV. Epilepsy with generalised tonic clonic seizures in childhood. Does a childhood 'grand-mal' syndrome exist? *Epileptic Syndromes in Infancy, Childhood and Adolescence*. (Eds J Roger, M Bureau, C Dravet et al) John Libbey, London 1992. pp. 161.

Brain Injury:

Head Injury:

Head Injury affects approximately 250/100 000 people and most typically results from road traffic crashes or assaults. The peak incidence is amongst men in the 15-24 age group. The most common sites of injury are the frontal and temporal lobes thereby affecting higher cognitive functions such as planning & sequencing, speech, hearing and memory tasks including recognition of colleagues. There may also be behavioural changes and some loss of motor co-ordination.

In general, whilst the primary causes of brain injury may last seconds and the secondary causes hours or days, the extent of permanent damage will not become clear for 12-18 months afterwards as repair and restoration of function take place. The vast majority of head injuries are minor and the individual suffers no long term consequence. Such persons may be accepted or return to duty after between one- and three-months convalescence, depending on residual fatigue and executive function.

In major head injury, employability decisions should be reserved until at least 12 months post-injury. The decision should be based on which higher and lower functions have been affected. Occupational Health staff should obtain clinical reports including an educational psychologist's report of cognitive ability and a careful assessment of functional capability should be made by line managers.

Cerebral Palsy:

Cerebral palsy affects approximately two per 1000 adults and leads to a wide range of disabilities. Each case must be assessed on its merits and relative weaknesses. Intellect, mobility, communication, behavioural concerns and the requirement for medication to control spasms or epilepsy needs to be taken into account. Should employment be offered, all appropriate reasonable adjustments must be considered.

Cerebrovascular Accident:

Strokes are relatively common after the age of 50 and about 60% of stroke victims have residual neurological signs. Like cerebral palsy, the range of disability following CVA is enormous, however, as few as 20% of sufferers eventually return to

work [13](#). The likelihood of a return to work is dependent on the degree of functional loss and the onset of anxiety which accompanies a profound loss of confidence.

13 Holbrook M. Stroke: Social and emotional outcome. JR Coll Physicians Lond 1982;16:100-4.

Degenerative Neurological Disease:

An assessment of current function and the job characteristics must be carefully balanced in relation to the likely rate of progression. The employer's decision must take into account Health & Safety issues and may also include the cost of redeployment after five to ten years.

Multiple Sclerosis:

Multiple Sclerosis affects between 50-125 people per 100 000. Its progression is usually gradual and in one study there was a more than even chance of the individual remaining employed 15 years after diagnosis, although transfer to sedentary occupations is normal [14](#). Placement is clearly dependant on level of function, the frequency of relapses and level of sickness absence. Loss of manual dexterity and visual problems are likely to have a profound effect on employability and redeployment should be considered early.

Motor Neurone Disease:

Motor Neurone Disease affects five per 100 000 adults. It typically affects those over 50 but there are progressive forms which occur in younger age groups. Progressive weakness predominates and the early consideration of redeployment will prolong the working life of the individual.

Parkinson's Disease:

Parkinson's Disease affects about 160 people per 100 000, typically striking after the age of 45 years. The rate of progression and level of functional loss is not readily apparent and so management of each case must be on an individual basis.

14 Mitchell JN. Multiple Sclerosis and the prospects for employment. J Soc Occ Med. 1981;31:134-8.

References:

1 Nelson KB, Ellenberg JH. Predictors of epilepsy in children who have experienced febrile convulsions. New England Journal of Medicine 1976; 295:1029-33.

- 2 Hauser WA, Annegers JF, Kurland JT. Febrile Convulsions: prognosis for subsequent seizures. *Neurology* 1977;27:341.
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- 8 Beaussart M, Faou R. Evolution of epilepsy with Rolandic paroxysmal foci: a study of 324 cases. *Epilepsia* 1978; 19: 337-42.
- 9 Loiseau P, Duche B. Benign childhood epilepsy with centrotemporal spikes. *Cleveland clinic Journal of Medicine*. 1989; 56 (supp 1): S17-22.
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- 11 Harbord MG, Manson JL. Temporal Lobe Epilepsy in childhood. A reappraisal of etiology and outcome. *Pediatric Neurology* 1987; 3: 263-8.
- 12 Oller-Daurella L, Oller FV. Epilepsy with generalised tonic clonic seizures in childhood. Does a childhood 'grand-mal' syndrome exist? *Epileptic Syndromes in Infancy, Childhood and Adolescence*. (Eds J Roger, M Bureau, C Dravet et al) John Libbey, London 1992. pp. 161.
- 13 Holbrook M. Stroke: Social and emotional outcome. *JR Coll Physicians Lond* 1982;16:100-4.
- 14 Mitchell JN. Multiple Sclerosis and the prospects for employment. *J Soc Occ Med*. 1981;31:134-8.

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Pregnancy

As the result of legislative changes throughout the 1970s, more and more women are now entering what was previously considered male-dominated areas of employment. This has given rise to a number of difficult questions on the issue of pregnancy and work especially where there is a potential for foetal damage occurring as a result of workplace exposure to chemicals and physical agents. There is some considerable difficulty in reconciling the desire for equal opportunities for women and the concerns for adverse pregnancy outcomes in what is an increasingly litigious society. Compounding this problem (when it comes to making policy decisions) is the limited scientific evidence concerning the adverse reproductive effects of exposure to an increasing number of chemical and physical agents.

- [Legislation](#)
- [Hazards and Effects](#)
- [Physical \(Non-Chemical Hazards\)](#)
- [Chemical Hazards](#)
- [Current Practice and Policy](#)

Legislation

Equal Pay Act 1970 (amended 1984)

Women must be paid the same as men when they are doing the same (or broadly similar) work, or work which is of equal value.

Sex Discrimination Act 1975

This makes it unlawful for employers to discriminate on grounds of gender, marital status or because someone intends to undergo, is undergoing or has undergone gender reassignment.

Employment Act 1989

This includes an exemption from the operation of the Sex Discrimination Act for acts done in connection with employment or vocational training to comply with certain specified statutory provisions relating to the protection of women at work. Examples are the Code of Practice on Lead at Work and the Ionising Radiation Regulations.

Employment Rights Act 1996

This includes the following rights:

The right not to be unfairly dismissed. A dismissal is automatically unfair if it is for a reason related to pregnancy, childbirth, maternity leave, parental leave, or time off for dependants.

The right to maternity leave.

The right to paid time off for ante-natal care.

The right to unpaid time off to care for or to arrange care for dependants where the dependant is ill, injured, assaulted, gives birth or dies; if arrangements for the care of a dependant break down; or if there is an unexpected incident involving a child at school.

The right to be offered suitable alternative work on terms and conditions no less favourable than her normal terms and conditions. if a legislative requirement or a health and safety recommendation prohibits a woman from doing her usual job because she is pregnant, has recently given birth or is breastfeeding.

The right to be suspended on full pay if a woman is unable to do her usual job on maternity grounds as described above and no suitable alternative work is available.

Management of Health and Safety at Work Regulations 1999

These require employers to carry out risk assessments. There are specific obligations on employers to assess risk where there are women of childbearing age at work. Employers may have to alter working conditions or hours of work, offer suitable alternative work or suspend an expectant or new mother on full pay if necessary to avoid risk to her or her baby.

These regulations implement the European Directive on Pregnant Workers (SI No. 2865), Council Directive 92/85/EEC, putting a duty of care on employers for a safe system of work to all women of reproductive age, their unborn children, and all working mothers who are breast feeding.

Maternity and Parental Leave etc Regulations 1999

These contain the detail of the rights to maternity and parental leave contained in the Employment Rights Act 1996 (ERA). They also prescribe the circumstances in which a dismissal will be automatically unfair for the purposes of the ERA if the dismissal is for a reason related to pregnancy, childbirth, maternity leave, parental leave, or time off for dependants.

Most employees have the right to take up to four weeks unpaid parental leave per child (usually under 5 years of age) in any one calendar year (to a total of 13 weeks per child) provided they have given their employer 21 days notice and the employer has agreed. They are also entitled to take reasonable periods of time off work at short notice to deal with an emergency involving a dependant. The determination of what is and what is not reasonable is for management to determine and advise the employee accordingly.

HSG 122 New and Expectant Mothers at Work

The Health and Safety Executive have produced clear guidance to employers, HSG 122, which outlines the relevant legislation and explains the risk assessment process needed.

Summary of Application of Legislation by Medical Advisers

Much of the legislation is directed at the employer, however you will be expected to understand it in order to manage individuals who either have psychological problems in relation to potential sex discrimination or pressure placed on them contrary to the legal requirements outlined above.

You will also be expected to advise in relation to specific requirements. The risk assessment required by the Management of Health and Safety at Work Regulations is a management responsibility, but you may advise on working hours or activities. In many cases the issue is subjective, for example working hours where some pregnant women are quite happy to continue to work shifts or do night work, while others are having difficulty and need to change working hours.

In some cases where there are complications with pregnancy you will be expected to advise whether maternity leave should start early, rather than recommending sick leave.

In-Vitro Fertilisation

Some individuals working for the Fire Service may undergo in-vitro fertilization. This is a sensitive issue and requires some flexibility to allow them to attend hospital for preparation and for the procedure itself. This should not represent a significant period of absence, and Medical Advisers may wish to discuss the requirements with the specialist in order to be able to advise management appropriately.

Hazards and Effects

Firefighting is a potentially hazardous occupation and some of these hazards are of particular concern to the pregnant firefighter. There is the potential to be exposed to a spectrum of potential reproductive hazards including physical hazards such as extremes of temperature and ionising radiation, ergonomic and psychological stress, biological agents and chemical agents including irritant gases, asphyxiant gases and other toxins such as mutagens and teratogens.

In many of the situations in which firefighters are called to work, it is impossible to analyse or quantify the possible exposures. However, they can be considered under two major headings, physical (non-chemical) hazards and chemical hazards.

Physical (Non-Chemical Hazards)

[Pregnancy and Physical Exertion](#)

[Pregnancy and Psychological Stress](#)

[Pregnancy and Hyperthermia](#)

[Pregnancy and Noise](#)

[Pregnancy and Radiation](#)

[Pregnancy and Biological Agents](#)

Physical Exertion

The physiological changes that occur during a normal pregnancy make many types of physical activity difficult. During pregnancy, increased physical demands affect mainly the cardiovascular and musculo-skeletal systems. Pregnancy is marked by a number of changes to the cardiovascular system including increased cardiac output and blood volume and decreased venous return to the heart and peripheral pooling. Pregnant women are more susceptible to dizziness and syncope especially after prolonged standing or working in hot environments. This is of obvious concern to pregnant firefighters since severe injury could occur from loss of consciousness or equilibrium.

There is also a degree of debate as to whether in theory the foetus could be subject to hypoxia as a result of vigorous exercise by the mother shunting blood away from the placenta. The degree to which this is significant in humans is unknown. During sustained firefighting, heart rates in the 85%-100% maximum range have been described. This is also aggravated by the use of breathing apparatus whilst working in an oxygen-deficient or toxic environment. Such high levels of exertion could have an adverse effect on the foetus, especially in later pregnancy.

The strenuous nature of firefighting also adversely affects the musculo-skeletal system. With the weight gain and the increasing abdominal girth associated with pregnancy, pelvic lordosis and thoracic kyphosis occur. The sacroiliac joints become more mobile and during the second trimester low back pain occurs. This can adversely affect manoeuvrability in performing duties such as climbing ladders. During the third trimester, strenuous activity would be severely limited.

One study [1](#) analysed spontaneous abortions occurring at less than 10 weeks, mid-term (10-16 weeks) and late (16-28 weeks) and stillbirths (more than 28 weeks) and showed a statistically increased ratio of observed to expected outcomes in occupations involving heavy weights (more than 15 times daily) and/or other physical effort.

1 Eskenazi B et al. Physical exertion as a risk factor for spontaneous abortion. *Epidemiology* 1994 Jan;5(1):4-5

Psychological Stress

Fire and Rescue Service staff may experience stress related to the characteristics or demands of the job, including the unpredictable and emergency nature of the work, erratic work schedules and prevalent hazards. Various indicators of psychological distress have been documented for firefighters involved in major disasters and potentially toxic exposures. Psychological distress has been examined in a limited number of studies with potential reproductive effects affecting both males and

females. The literature regarding work-related stress in pregnancy outcome is sparse.

Shift work, one factor that could contribute to the level of job stress of the firefighter, was found in one study of Swedish laboratory workers to be associated with increased rates of miscarriage. However, other studies have failed to support this conclusion. Other studies have however shown that babies born to non-smoking women, who worked irregular work schedules, evenings or rotating shifts during the second and third trimesters had a significantly lower birth weight than infants of non-smoking mothers who worked during the day only.

It is reasonable to assume that excessive pressure leading to stress is an important aspect of risk. A subjective assessment of stress levels should therefore be made if the individual wishes to continue working shifts. In general if a pregnant woman does not wish to work long or late/night shifts you should recommend alternative arrangements to Management.

Hyperthermia

Heat exposure is known to cause adverse reproductive effects in humans and based on available evidence a limit of 38.9°C has been considered the minimum core temperature likely to pose a teratogenic hazard to the human embryo or foetus. The routine heat exposures encountered by firefighters are probably safe for the developing foetus. However, firefighters are not always able to regulate their exposure to heat and some studies have shown that 2.1% of fire injuries are due to heat exhaustion. Pregnancy also decreases heat tolerance.

Noise

Sources of noise in a firefighters work environment include sirens, air horns, vehicles and auxiliary power equipment. There have been a number of studies which have concentrated on the potential adverse effects of noise on pregnancy outcomes. Several laboratory investigations have been carried out on pregnant rodents exposed in most cases to very loud noise levels (usually at more than 100 dBA of continuous or intermittent noise). Findings have supported an exposure effect manifested most often by increased litter absorption, increased foetal mortality and decreased foetal weight.

Foetal malformations have been demonstrated less consistently. It is unknown whether this effect is due to a direct effect on the developing embryo or if they are caused by the maternal psychological response to the stress of noise exposure. The appropriateness of these species as models for the prediction of human reproductive response to noise is similarly unknown.

The association between occupational noise exposure and reproductive outcome has not been thoroughly investigated, although one group has reported an increased risk of high frequency hearing loss (more than 10 dBA at 4,000 Hz) in children whose mothers were exposed during their pregnancy to an 8 hour time weighted average of 85-95 dBA. Studies to date have concentrated on industrial job exposures and have not consistently addressed possible social or economic influences. However, if their results are confirmed they could be relevant to the pregnant firefighters whose level of noise exposures may be comparable.

Radiation

The well documented human reproductive effects of ionising radiation justify protection of any potentially exposed worker and pregnant workers in particular. It must be stressed, however, that exposure opportunities in firefighting are very uncommon, thus constituting only an infrequent and relatively unusual hazard for the firefighter.

Biological Agents

Although not predominantly a hazard of firefighting, exposure to biological agents may arise out of emergency medical response duties. Obviously there would be a range of effects both to the pregnant woman and to the foetus if infection resulted. However exposure opportunities for pregnant firefighters are limited and are minimised through adequate procedural policies.

Chemical Hazards

Research shows that the toxicity is dominated by effects arising from carbon monoxide and/or hydrogen cyanide or products with high irritancy such as hydrogen chloride, oxides of nitrogen and substances such as formaldehyde and acrolein in oxidised hydrocarbon atmospheres [2](#).

However, the pyrolysis and combustion products of fires contain hundreds of compounds, some of which are common to all fires and others of which are formed to a varying degree depending on such factors as the composition of the materials burned and the temperature and the amount of oxygen present. The toxic gases found in the fire environment can be categorised as irritants, asphyxiants or other gases with a wide array of effects that may include carcinogenesis, mutagenesis and teratogenesis.

Irritant Gases

A large number of irritant gases are found in the fire environment including hydrogen chloride, ammonia, acrolein, sulphur dioxide, isocyanates, halogen acids and nitrogen oxides. These compounds act primarily by damaging the epithelial surfaces of the respiratory tract and are absorbed peripherally to varying degrees. Though

acrolein has teratogenic potential when ingested or injected into experimental animals, the chief known danger to the foetus posed by this group of compounds is the potentially life threatening maternal chemical pneumonitis that may follow acute exposure.

Asphyxiant Gases

The most common toxic hazard faced by firefighters is carbon monoxide. Measures of carboxyhaemoglobin levels have been shown to be consistently higher in firefighters than in non-exposed control subjects matched for smoking status. The levels of carboxyhaemoglobin demonstrated pose a health hazard to any unprotected woman firefighter and the foetus. Acute exposure to carbon monoxide has been associated with foetal loss. A more difficult problem is the assessment of risk to the foetus of a mother chronically exposed to low levels of carboxyhaemoglobin.

There have been a number of conflicting studies on these effects, most of which have concentrated on mothers who smoked. Smoking has been shown to increase the level of carboxyhaemoglobin in both the foetus and the mother. Smoking during pregnancy is associated with the increased incidence of pre-term births, low birth weights, increase in neonatal mortality, retarded intrauterine growth, spontaneous abortions and bleeding disorders.

In summary, firefighters are sometimes exposed to levels of carbon monoxide that could lead to acute anoxic damage to the foetus of an unprotected mother. The foetus of an active firefighter is also at increased risk of chronic anoxia because of the elevated carboxyhaemoglobin levels. The foetus of an active firefighter who smokes is at special risk since the effects of smoking and carbon monoxide exposure is additive. The risk of chronic anoxia in the foetus of a firefighter is certainly greater than the risk to the foetus of a non-smoking mother who is not routinely exposed to carbon monoxide.

The risk to the foetus of a non-smoking firefighter who consistently uses breathing apparatus is probably less than the risk to the foetus of a smoker that is not otherwise exposed to carbon monoxide. Although a firefighter can significantly reduce the risk of carbon monoxide exposure to the foetus by wearing breathing apparatus, the problem is that this may in some cases increase the risk of heat exertion.

The other asphyxiant gas of concern is hydrogen cyanide which is present at low levels in fire atmospheres. Firefighters have been shown to have significantly higher levels of metabolites of hydrogen cyanide in their blood than in controlled subjects not exposed to fire atmospheres. Exposure to hydrogen cyanide occurs much less frequently than carbon monoxide exposure and although still controversial, hydrogen cyanide exposures are generally thought not to pose an acute health hazard to firefighters. The risks of hydrogen cyanide to a foetus are not quantified, but hydrogen cyanide exposure would be expected to exacerbate the asphyxiant effects of carbon monoxide exposure.

Other Toxins

The growing use of plastics and other synthetic substances in buildings and homes has increased the uncertainties of assessing the risks posed by toxic exposures to firefighters. A number of pyrolysis and combustion products are known or are suspected carcinogens, mutagens or teratogens. Little data is available to document the level of these exposures.

2 Work undertaken by D A Purser at the Department of Inhalation Toxicology Huntington Research Centre and W D Woolley at the Fire Research Station, Borehamwood and presented in 1982 at the conference – “Smoke and Toxic Products from Burning Polymers”

Current Practice and Policy

There are a number of conflicts in attempting to ensure reproductive health whilst providing equal opportunities for women. The ideal solution to the conflict is to make the worksite safe for both sexes since many, if not all, reproductive hazards affect both men and women.

Evanoff and Rosenstock, having reviewed reproductive hazards in the workplace recommended that pregnant firefighters should cease active firefighting during the second trimester of pregnancy. They additionally recommended that special attention should be paid to adequate respiratory protection in toxic atmospheres.

This policy may well be adequate, however, there are a number of other issues that should be given active consideration:

The foetus is at its most vulnerable during the first trimester and especially during the first six weeks of gestation when the woman herself may be unaware or only suspect that she is pregnant. Modern pregnancy testing is however now accurate at a very early stage.

There is already a high risk of spontaneous abortion (1 in 5) within the general population and we are now living in an increasing litigious society where any abortion, pre-term birth or congenital disability could be the subject of litigation.

Recommendations for Pregnant Applicants and Employees of the Fire and Rescue Service:

Pregnant applicants to be firefighters should undertake all the normal pre-employment selection tests excluding those for fitness and aptitude. If the applicant is successful these tests should be deferred until pregnancy or breast feeding has come to an end. Where it is believed that a woman has failed a fitness test because of pregnancy she should be allowed to undergo reassessment at a suitable later date.

Pregnant officers should be required to notify their Officer in Charge or the Medical Adviser as soon as pregnancy is suspected, as under The Management of Health and Safety at Work Regulations an employer is only obliged to take any action, other

than action resulting from the risk assessment for all employees, once he has received written notification from the new or expectant mother. If a woman fails for any reason to inform Management or the Medical Adviser, no penalties or sanctions should be imposed.

The pregnant officer should then be accommodated on non-operational day duties after a risk assessment and any appropriate reasonable adjustments. Terms and conditions of employment and allowances should otherwise be fully maintained.

If for any reason the pregnancy does not proceed to term (miscarriage, termination etc) the woman should be assessed by the Medical Adviser prior to returning to full operational duties on shifts. It may be necessary for temporary redeployment or reasonable adjustments to be made (following a risk assessment) for a suitable period of time before return to normal duties. Absence related to miscarriage should no count towards the employees sickness absence.

Following the usual maternity leave whether breast feeding or not the woman may return to non-operational day duties. In the case of breast feeding these duties should continue until breast feeding ceases, and in all cases women must be assessed by the Medical Adviser prior to returning to full operational duties on shifts. Any employment during this period should be subject to a risk assessment and reasonable adjustment to accommodate breast feeding.

References

1 Eskenazi B et al. Physical exertion as a risk factor for spontaneous abortion. *Epidemiology* 1994 Jan;5(1):4-5

2 Work undertaken by D A Purser at the Department of Inhalation Toxicology Huntington Research Centre and W D Woolley at the Fire Research Station, Borehamwood and presented in 1982 at the conference – “Smoke and Toxic Products from Burning Polymers”

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Respiratory

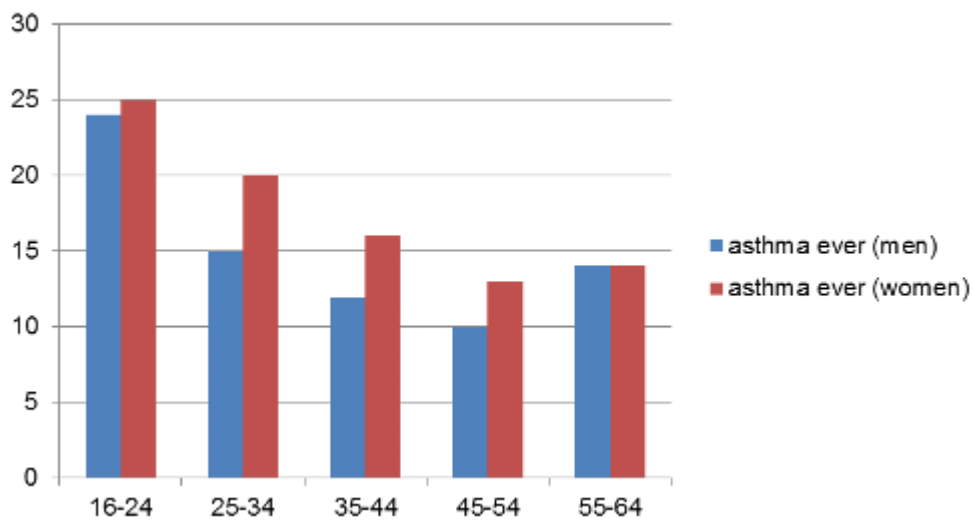
The lungs are the main organs responsible for gaseous exchange. An adequate intake of oxygen is essential when carrying out firefighting duties which can require considerable exertion over long hours of duty.

The early use of breathing apparatus protects the lungs from many of the hazardous fumes found at fires but a disease-free respiratory system is essential for a healthy firefighter.

Asthma

Asthma is a disease characterised by variable constriction of the airways causing an increased resistance to air flow leading to reductions in ventilation and hyperinflation of the lungs. A diagnosis of asthma is common in United Kingdom populations. Findings from the Health Survey for England in 2001 [1](#), suggest that about one quarter of men and women aged between 16 and 24 years have at some point been diagnosed with the disease; the proportions are generally lower in older persons (see Figure 1), probably reflecting a birth cohort effect, and at all adult ages are higher in women. Since a characteristic of asthma is its tendency to remit (and relapse) and since its symptoms are not specific, none of these figures necessarily reflects the age-specific prevalence of current disease.

Figure 1



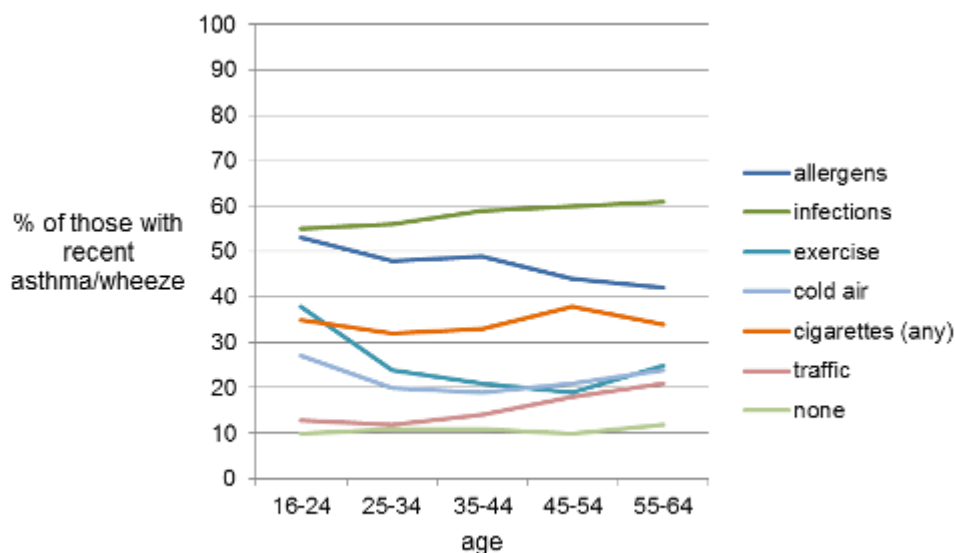
The incidence of asthma is highest in the first years of life but approximately two thirds of children with asthma will be asymptomatic by the age of 15. Remission is more common in males, in those whose asthma started after the age of 5, in those without accompanying rhinitis or eczema and in those with no family history of asthma. About a third of those whose childhood asthma has remitted will have a relapse before the age of 35 but this is seldom severe and is usually controlled with reliever medication alone.

A proportion - probably small - of those with remitted childhood asthma will have asymptomatic bronchial hyper-reactivity in adulthood. This can be detected using a variety of non-specific provocation tests. There is limited evidence that persisting hyper-reactivity increases the risk of subsequent symptomatic relapse.

The symptoms of asthma are not entirely specific and the disease has no unambiguous or universally accepted definition. Thus diagnoses, and reports of diagnoses, will include alternative respiratory conditions; most authorities, however, consider a doctor's diagnosis to be more specific than otherwise self-reported disease. Conversely, a diagnosis of asthma may not be recalled, especially when it was made in early childhood and the disease has since remitted. Treatments used in asthma are also used for other respiratory diseases, commonly for infection-related wheeze at any age and, later in life, for chronic obstructive pulmonary disease; reports of such treatment are not necessarily confirmation of asthma.

The symptoms of asthma vary from a dry cough to an audible wheeze with shortness of breath. The disease is characterised by variability and by the provocation of symptoms in response to environmental triggers. Most asthma arising in childhood is accompanied by atopy, a tendency to develop immediate-type sensitivity to environmental aeroallergens which frequently persists; around half of adults with asthma report symptoms that are provoked by specific allergens (Figure 2). Other common triggers include respiratory infections, cigarette smoke, exercise and cold air. Around one in ten adults with asthma recognise no specific provoking factor(s).

Figure 2



Most UK adults with asthma have disease that requires treatment with only an as-needed β_2 agonist or a regular inhaled corticosteroid at low doses. Each year about 10% of them will have an exacerbation that will require treatment with prednisolone (2), usually provoked by a respiratory infection. Severe, unpredictable attacks of asthma are rare and are generally reported only by those with a history of such.

Current treatments for asthma are, if used properly, very effective in maintaining disease stability and, in most individuals, freedom from symptoms for most of the time. Poor asthma control often reflects under-treatment, frequently from poor adherence.

The inter-individual variability in asthma is far smaller than the variation between adults with the disease; thus while the prevalence of the condition is high among professional athletes, others (albeit few) with the disease are severely disabled by breathlessness and it is plain that a diagnosis of 'asthma' covers both a spectrum of severities and a variety of phenotypes. This has two important consequences. First, it is essential that individuals with asthma are assessed on a case-by-case basis; and second, the best predictor of future performance is provided by consideration of the recent past [2](#).

Given the above, it is clear that the needs of recruits with a history of asthma (current or past) should be considered individually with a focus on the severity, stability and predictability of the disease. Most of the necessary information can be collected through a simple history of current and recent symptoms, recent exacerbations and current treatment use. While the last of these is commonly used as a measure of asthma severity this may not be appropriate and a distinction between treatment 'use' and treatment 'requirement' needs to be made. Spirometry will detect airflow obstruction but is often normal in young adults with well-controlled asthma and in any case is a poor predictor of functional ability. Measurement of residual bronchial hyperreactivity through non-specific provocation testing in a hospital laboratory may be helpful in determining the likely response to respiratory irritants and the probability of a relapse in the future.

Bronchoconstriction after exercise is common in those with inadequately treated asthma; but rarely severe in those whose disease is mild and treated appropriately, and unusual in those with a history of childhood disease that is in remission. Exercise-induced asthma can be identified through a clinical history and confirmed through formal exercise testing although the test is difficult to standardise and may not reflect working conditions well.

Recruits with a clear history of severe or moderate asthma with inadequate symptom control and frequent exacerbations – especially when these are unpredictable – should not be routinely exposed to irritant or volatile vapours or fumes (including smoke) or strenuous exertion. Those whose disease is more mild and requires treatment only during periods of respiratory infection, or is well-controlled by the use of a regular inhaled corticosteroid at low doses with no or rare need for treatment with as-needed β_2 agonist, are likely to have few difficulties with active firefighting. This includes the use of breathing apparatus.

Guidance

There should be no bar to employment based on the diagnosis of asthma alone. Recruits with a history of asthma, past or current, require individual assessment. Assessment should include a careful history that focusses on current symptoms and

treatment requirements; triggering factors including exercise and irritant exposures; and the frequency and history of exacerbations.

Recruits with a history of childhood asthma that was never severe and responded well to treatment with a β 2 agonist with or without an inhaled corticosteroid, who have been symptom free in recent years and who have passed their standard fitness tests without difficulty can be employed in all fire-fighting roles. There is no bar to their using breathing apparatus.

Recruits with current asthma that is controlled by the use of a β 2 agonist with or without an inhaled corticosteroid and in whom any symptoms are mild, predictable and provoked by factors unrelated to the work environment, and exacerbations provoked by infection or seasonal allergy are infrequent can be employed in all fire-fighting roles. There is no bar to their using breathing apparatus.

Recruits whose asthma causes symptoms with exercise or exposure to common irritants such as cold air, smoke or fumes (ie triggers that are likely to be encountered at work) irrespective of the treatment they are using, and those with frequent exacerbations provoked by infection or seasonal allergy should not be employed in active fire-fighting roles. They may benefit from a specialist review of their current treatment. Specialist respiratory assessment is required in doubtful cases. Such assessment should include, as appropriate, direct a or indirect b tests of bronchial hyperreactivity.

a usually with inhaled histamine, mannitol or metacholine

b most suitably with exercise

1. Department of Health. [Health Survey for England 2001](#). The Stationery Office, Norwich 2003.

2. Cullinan P. Evidence-based guidance for the assessment of new employees with asthma; a report to the British Occupational Health Research Foundation. Please use this link to [download a copy of the pdf](#).

Adult-Onset Asthma

Asthma with an onset in adulthood is, in general, uncommon and more often it reflects a history of childhood disease that has been forgotten. True adult onset should raise the question of 'occupational' asthma arising from new sensitisation to an airborne biological or chemical agent in the workplace or, more rarely, as a result of a single, high-dose exposure to an irritant fume (Reactive Airways Dysfunction Syndrome, or RADS).

The diagnosis of occupational asthma is complex and warrants careful investigation; referral to a respiratory physician with a special interest in occupation is advised. Occupational asthma that reflects a specific sensitisation is usually managed through exposure control which often requires redeployment. RADS is managed in the same way as other forms of adult asthma although it may be relatively resistant to standard

pharmacological therapies. Serving uniformed fire personnel with severe RADS should not be exposed to smoke or fumes, so the development of this condition in a firefighter may necessitate redeployment.

Smoke Inhalation

- [Acute Effects](#)
- [Chronic Effects](#)

Acute Effects

Acute smoke inhalation will result in pneumonitis and may result in pulmonary oedema requiring ventilation. Subsequent management should include assessment for RADS.

Chronic Effects

It has been suggested for many years that the conditions under which firefighters work might cause permanent lung damage. Most longitudinal studies in firefighters have failed to show any long term deterioration in lung functions when smoking was allowed for compared with other groups of workers [17](#) [18](#) [19](#) [20](#). In a study of firefighters in 1991 deaths from all types of respiratory disease, including growths occurred less often than expected [21](#). This is perhaps surprising given the potential exposure of the firefighter to organic carcinogens and asbestos. One small French study does show some long-term deterioration in small airways function and decrease in permeability [22](#).

These abnormalities were worse in firefighters who smoked. The study suggests that monitoring lung function in all professional firefighters is necessary. The routine lung functions carried out now under recommendations in Fire & Rescue Service Circulars should give valuable information and be a safeguard to their health.

17 Musk A.W Pulmonary functions in firefighters: a six year follow up in the Boston Fire Department. American Journal Industrial Medicine 1982;3(1):3-9.

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21 Beaumont J J et al. An epidemiological study of cancer and other causes of mortality in San Francisco firefighters. American Journal of Industrial Medicine 1991;19(3):357-72.

22 Barthelemy L et al. Abnormalities of respiratory function in civil defence firefighter submarine divers. *Rev Pneurnol Clin* 1990;46(6):271-6.

Restrictive Lung Disease

Conditions giving rise to a restrictive pattern of lung disease are much rarer than those producing obstructive lesions but in general are likely to have more serious consequences. Restrictive lesions affect the lung tissue itself, interfere with gaseous exchange and make the lungs stiffer. They can occur in acute or chronic forms and the main symptom is breathlessness. Lung function tests show a reduced FVC with no evidence of airways obstruction and more sophisticated tests will show a reduced transfer factor with decreasing compliance and decreased oxygen levels in the blood.

Although firefighters may be exposed to a variety of substances that can cause restrictive disease as a result of secondary occupation or hobbies, the only exposure of significance in firefighting is to asbestos. Firefighters would normally use BA on the fireground when exposed to smoke or fume and therefore significant asbestos exposure is very rare. There is a greater risk in fire investigation where significant dust is present. There is no statutory requirement for health surveillance following asbestos exposure in firefighters and no clinical justification for implementing any surveillance. As there is a known link between smoking, asbestos exposure and the development of restrictive lung disease and tumours, firefighters should be given advice and support to help stop smoking.

Although most causes of restrictive disease are chronic, sarcoidosis frequently resolves spontaneously over a period of 12-18 months. Any redeployment may therefore be temporary unless the condition becomes chronic.

Any condition affecting gaseous exchange is likely to be incompatible with firefighting duties. All cases of firefighters suffering with restrictive lung disease will need regular monitoring. It should be remembered that oxygen saturation may fall markedly on exertion when showing almost normal levels at rest.

Spontaneous Pneumothorax

It is not generally possible to predict susceptibility to spontaneous pneumothorax. There is a need for careful rehabilitation after the initial episode. A return to full duties with lifting and carrying should be delayed for at least three months. Any recurrence should be fully investigated in order to exclude bullae when pleurodesis may be required.

Pulmonary Embolism

Any recommendation to employ an individual with a history of pulmonary embolism depends on the underlying medical condition that led to thrombosis and embolism. Information on occupational issues of anticoagulation will be found in the section on the cardiovascular system.

Once individuals have stopped taking anticoagulants, fitness for employment depends on the lung function and any other underlying conditions.

Growths in the Lung

- [Benign Growths](#)
- [Malignant Growths](#)

Benign Growths

Benign growths of the lung are rare and after resection it is likely that a firefighter will be able to continue normal duties.

Malignant Growths

Even if a satisfactory resection is possible and sufficient pulmonary function remains, great care should be taken before returning individuals to active duties. There is a high risk of metastasising to the brain giving rise to the possibility of sudden haemorrhage and unconsciousness or epilepsy.

References

- 1 Department of Health. [Health Survey for England 2001](#). The Stationery Office, Norwich 2003.
- 2 Cullinan P. Evidence-based guidance for the assessment of new employees with asthma; a report to the British Occupational Health Research Foundation. Please use this link to [download a copy of the pdf](#).
- 17 Musk A.W Pulmonary functions in firefighters: a six year follow up in the Boston Fire Department. American Journal Industrial Medicine 1982;3(1):3-9.
- 18 Shephard D et al. Acute effects of routine fire fighting on lung functions. American Journal Industrial Medicine 1986;9(4):333-40.
- 19 Douglas D B et al. Pulmonary function of London firemen. British Journal Industrial Medicine 1985 Jan;42(1):55.-8.
- 20 Horsfield K et al. Lung function in West Sussex firemen – a four year study. British Journal Industrial Medicine 1988 Feb;45(2):116-21.
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Skin

Overall, skin problems are a common cause of occupational morbidity. Around 10% of reported cases of occupationally related disease or injury compiled by OPRA [1](#) are skin conditions, however sickness absence related to skin conditions is considerably lower.

Firefighting involves the exposure to a variety of chemicals which have varying rates of penetration of the skin. In addition, this occupational group are routinely exposed to hot and humid conditions and water itself can lead to a form of contact dermatitis. Fire Investigators are also exposed to a variety of chemicals with varying degrees of skin penetration and different toxic characteristics. Chronically broken skin may reduce the effectiveness of this physical barrier and lead to greater absorption than otherwise anticipated.

Although unusual, firefighters will occasionally have to attend chemical spills and may be exposed before the hazard is identified and full chemical protective clothing and equipment can be used. There is therefore a significant risk for firefighters who have chronic damage to the skin structure and careful assessment is needed for all applicants, and for serving firefighters who develop skin conditions.

[Eczemas](#)

[Occupational Dermatitis](#)

[Psoriasis](#)

[Other Conditions](#)

1 Occupational Physicians Reporting Activity. Various quarterly reports. University of Manchester.

Eczemas

Seborrhoeic Eczema

Typically seborrhoeic eczema affects the head and neck, the axillae and groin. Sufferers are not as susceptible to contact irritants as atopic individuals but dusty environments can exacerbate the condition. Hot and humid environments may cause extension from the usual sites.

Varicose Eczema

Varicose eczema occurs as a result of stasis in dependant engorged leg veins. This reduces blood flow to the skin, typically around the ankle, and is aggravated by occupations requiring standing for long periods. Varicose ulcers may develop and these may require time away from work in order to maintain hygiene and for surgical dressing. Individuals with prominent varicose veins may develop a tendency towards

varicose eczema and therefore may require support stockings or compression bandaging which may be uncomfortable in hot and humid conditions.

Atopic Eczema

Atopic skin disease renders an individual more susceptible to irritant chemicals because of the thin, relatively permeable stratum corneum and the cracking and fissuring which accompany the disease. This means that people with atopic eczema should be carefully assessed prior to any employment which may expose them to irritant chemicals as there is an increased susceptibility to contact irritant dermatitis. About 75% of people with moderate childhood eczema develop an irritant occupational dermatitis [2](#). A history of atopy should also raise questions regarding the individual's lung function (underlying atopic asthma).

On the other hand, there is no evidence that atopic individuals with unbroken skin are at any greater risk of developing contact allergic dermatitis [3](#). However, about 8% of atopics have to change their jobs because of troublesome eczema and this is clearly more likely in jobs where exposure to irritants is common [4](#). Problems with eczema at work usually arise in people who suffered from childhood hand eczema.

Individuals with a significant history of atopic eczema, including those who only had a significant problem during childhood, are at risk of developing further problems if they become operational firefighters. Specialist opinion should therefore be sought, and only those who are at low risk should be considered fit for firefighting duties.

Discoïd (nummular) Eczema

This condition affects any part of the body but classically the hands, arms and legs. It consists of coin shaped plaques, usually on the extensor surfaces and may form serous crusting. It is commonest in middle age but can occur at any age. It is unrelated to atopic eczema and can sometimes be difficult to distinguish from contact irritant dermatitis when it affects the hands, however the distinction is important with regard to cause, treatment and prognosis. There are few implications for employment.

Pompholyx

Pompholyx consists of a pruritic vesicular reaction affecting the palms and soles. Typically, the vesicles are deep and over a few days they discolour to a dark red/purple colour. Widespread superficial peeling may occur as the lesions heal. It is related to dishydrosis and therefore occurs more commonly in summer months. It may also be associated with bacterial and fungus skin infections [5](#) or as a result of exposure to nickel, chromium and cobalt salts [6](#). In the latter scenario, patch testing is often negative and ingestion of very small quantities of metal salt solution may be tried [7](#).

The cause of pompholyx is believed to be multifactorial. Following treatment of the underlying cause it heals. If metal allergy is demonstrated then protection from exposure is the treatment of choice.

- 2 Rystedt I. Work related hand eczema in atopics. *Contact Dermatitis* 1985;12:164-71.
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- 4 Rystedt I. Factors influencing the occurrence of hand eczema in adults with a history of atopic dermatitis in childhood. *Contact Dermatitis*. 1985;12:185-91.
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- 7 Veien NK, Hattel T, Justesen O, Norholm A. Oral challenge with metal salts. (I). Vesicular patch-test-negative hand eczema. *Contact Dermatitis*. 1983 Sep;9(5):402-6.

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Occupational Dermatitis

Collated reports from dermatologists and occupational physicians in the 3 month period July-Sep 2003 showed that of 2130 case reports, over 13% of all reported occupational disease involved the skin. 57% of dermatological cases were contact dermatitis [8](#).

Contact Irritant Dermatitis

Three quarters of all occupational dermatoses are of this type. Irritants produce a direct effect on skin and include compounds which increase the permeability of the skin such as detergents, surfactants and alkalis. Apart from chemical irritants, water itself is an irritant after prolonged contact, even in non-atopic individuals.

Contact irritant dermatitis classically consists of erythema, fissures and scaling. It typically follows a glove distribution on the hands and forearms. Irritant dermatitis is unusual elsewhere on the body. Barrier creams may help once the skin of the hands has recovered but frequently, once the dermatitis has become established, removal from the work involved is necessary.

Allergic Contact Dermatitis

This accounts for 15-20% of occupational skin disorders. It is usually a response to one specific agent and is usually a Type IV delayed hypersensitivity reaction involving antigens combining with epidermal proteins. The initial sensitizing contact

may be for several hours, although subsequent contacts may only be transient and yet produce a skin reaction.

Latex allergy is a well known problem in the health service and is a Type I allergic response to natural rubber latex proteins, producing an immediate response which causes contact urticaria that may lead to anaphylaxis.

Allergic contact dermatitis produces a reddened weal at the site of contact with blistering and later fissuring. Long term dermatitis produces a thickening of the skin with a mixed picture often difficult to distinguish from contact irritant dermatitis. Whilst allergic contact dermatitis may develop on any part of the body, it is usually found on the hands, head and neck.

There are few specific known allergens in frequent usage by Fire and Rescue Services. Hazard data sheets may need to be reviewed to determine the presence of allergens or sensitizers. Individuals who are clearly at significant risk from a known sensitizer should avoid exposure, and applicants should be assessed for risk. Individuals who develop problems in service may require referral for patch testing.

Occasional contact may be acceptable to the individual and to the Service but repeated contact should be avoided and this may necessitate redeployment. Because of the occasional and usually unquantified nature of exposure, it is rarely possible to correlate sensitisation to specific occupational exposures. In most cases where sensitisation is identified, the substance, such as nickel or chromium, is so commonly encountered that great care should be taken before attributing the sensitisation to an occupational cause.

8 OPRA Quarterly Report Dec 2003. University of Manchester.

Psoriasis

Guttate Psoriasis

This affects children and young adults and may follow a streptococcal sore throat. It typically affects the trunk and resolves spontaneously although classical psoriasis may develop subsequently. In the absence of predictive factors for late onset disease, guttate psoriasis can be ignored.

Classical Psoriasis

Psoriasis affects 2% of adults in NW Europe and about 30% of sufferers have a family history of the disease. The condition may be aggravated by physical or chemical trauma and some individuals find their disease exacerbated by bacterial sore throats [9](#). Clearly, if exacerbation occurs with certain physical or chemical stimuli, there will be manual occupations which are not suited to a person with established psoriasis.

Unlike atopic eczema, psoriasis leads to a thickening of the stratum corneum and so any predisposition to irritant dermatitis is less marked and most psoriasis sufferers

have reasonably stable disease. Men in lower paid, predominantly manual jobs, have the greatest difficulty with their psoriasis [10](#) [11](#). A British study of 150 patients with severe psoriasis and currently working found almost 60% had lost a mean of 26 days from work during the preceding year because of their psoriasis [12](#).

A number of studies have looked at the relationship of stress with both the onset and exacerbation of psoriasis. Unlike other skin diseases, there seems to be clear correlation between stressful events and the onset and aggravation of the condition [13](#).

In summary therefore, whilst mild psoriasis is unlikely to result in excessive sickness absence or predispose the individual to irritant dermatitis, severe forms of the disease may. In addition there does appear to be evidence of a link with stressful events and manual work, which in the case of severe psoriasis may result in excessive absenteeism and work related skin disease.

Therefore, only severe forms of the disease need be reviewed with care, with specialist advice where appropriate.

Psoriatic Arthropathy

Psoriatic arthropathy resembles rheumatoid arthritis in that it usually affects the distal finger joints and the large joints of the limbs. It occurs in 5-10% of psoriasis sufferers and its effects can be severe, affecting both peripheral joints and causing spondylitis of the spine. There is a direct link with HLA B27. Management is based on the degree and severity of symptoms. Those in physical roles should be protected from excessive forces which will aggravate the condition.

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Other Conditions

Severe Acne

Acne Vulgaris affects most adolescents and many adults. In general, mild cases predominantly affecting the face and resulting in occasional pustules can be discounted. Severe acne however, with multiple pustules and cysts, results in severe disfigurement and may involve the face, neck and trunk. It is made worse by hot or humid conditions and close fitting clothing. For this reason, an applicant with severe acne may quite reasonably have entry deferred until a course of a retinoid compound has been completed.

Certain occupational exposures such as mineral oils, PCBs and chemical spillages may cause halogen acne but prolonged exposures are unlikely in the Fire Service.

Acne Rosacea

This is an inflammatory dermatosis of unknown aetiology. The condition tends to be worsened by heat. Individuals with a history of severe acne rosacea may find operational firefighting causes an unacceptable exacerbation of their symptoms and care should be taken in accepting them for firefighter training. Serving firefighters should be assessed on an individual basis.

Dermatomycoses

These fungal conditions may be endemic where shared showering facilities are available. The condition may also be aggravated by wearing heavy footwear for long periods in humid conditions. Both these scenarios apply to firefighters and although this condition would not normally bar new recruits or existing firefighters from work, the condition should at least be recognised. It is associated with pompholyx of the palms and soles.

Tinea unguum may lead to onychogryphosis and be very difficult to eradicate. Other than its association with pompholyx, there is little occupational caution in relation to fire service work.

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New section for 2012

Sleep

Sleepiness has potentially great significance at work. Falling asleep can be catastrophic when the employee is in charge of a vehicle or machinery. Feeling sleepy can reduce concentration and focus, leading to poor performance, poor decision making and failure to complete tasks safely.

In practice there is little risk of a firefighter falling asleep while driving in an emergency or while actually firefighting. A tired firefighter, however, may not perform as fast or as effectively as an alert and refreshed firefighter which may also affect safe driving, and may not sustain a high physical workload as long. The risk is likely to be substantially greater at other times. When driving longer distances, commuting to work or travelling to a meeting or training venue and particularly driving home after a night shift, it is important that the driver is refreshed and not at risk of falling asleep. During training, particularly classroom training, sleepiness substantially reduces concentration. During routine maintenance of equipment, sleepiness can lead to failure to maintain the equipment safely, and failure to complete safety checks.

The firefighter who is unfit for their primary role through illness or lack of physical fitness may be more at risk of sleep disorders, so care should be taken when considering fitness for all tasks being undertaken by all staff. Particular emphasis should be placed on fitness to drive, a point emphasised by the Department for Transport [1](#).

[Factors Increasing the Risk of Sleepiness](#)

[Natural Sleep Pattern](#)

[Obstructive Sleep Apnoea \(OSA\)](#)

1 <http://www.dft.gov.uk/pgr/roadsafety/drs/fitnesstodrive/fitnesstodrive.pdf>

Factors Increasing the Risk of Sleepiness

There are a number of factors that increase the risk of sleepiness. Many firefighters have other jobs, and may arrive at the start of a shift already physically or mentally fatigued by this. Shiftwork is known to lead to sleepiness either directly because of lack of sufficient sleep prior to the start of the shift or indirectly through disruption of the circadian rhythm (as determined by the natural sleep body clock). This is primarily a management matter to ensure that firefighters do not undertake other work that prevents them from getting sufficient sleep, and to ensure that any shift pattern is designed to minimise the risk from circadian rhythm disruption (see HSE guidelines on shift work rotas [2](#)).

Firefighters who travel for example to support search and rescue operations overseas will need to ensure they get sufficient rest before, during and after travel, and during any rescue operation, to ensure that safety and effectiveness on site is not significantly compromised.

Besides the effects of work and shift patterns there are a number of underlying medical conditions that can increase sleepiness. By far the most important is obstructive sleep apnoea. Narcolepsy is rare, and incompatible with firefighting because of the obvious risk of sudden incapacitation due to irresistible sleepiness and “drop attacks” known as cataplexy.

2 <http://www.hse.gov.uk/pubns/priced/hsg256.pdf>

Natural Sleep Pattern

Sleep is best observed electrophysiologically in a sleep laboratory with electroencephalogram (EEG) measurements. Sleep starts with an unstable phase of drowsiness characterised by dynamic changes of wake and sleep phases over a period of a few minutes. Individuals then enter a stable phase of sleep called Non Rapid Eye Movement (Non-REM) sleep lasting up to an hour and a half. This is then followed by a period of Rapid Eye Movement (REM) sleep characterised by detecting eye movements with sensors known as an electro-oculogram (EOG).

The cycle of non-REM, then REM sleep is continued through the period of sleep with the non-REM periods becoming shorter and REM periods longer. Each cycle can last up to 90 to 120 minutes. A part of Non-REM is characterised by an EEG signal called slow-wave sleep, regarded as “deep sleep”. It is associated with a number of physiological changes including release of anabolic hormones, cytokines and an increase in cellular mitosis. REM sleep is associated with dreaming and physiological arousal. Most adults require six to eight hours of sleep to fully refresh and maintain optimum physiological performance.

Non-REM sleep is essential for body repair and effective immune responses. Lack of sufficient non-REM sleep leads to tiredness the next day, and persistently insufficient

non-REM sleep leads to progressively increased levels of tiredness and physiological degradation.

Obstructive Sleep Apnoea (OSA)

Partial or complete obstruction of the upper airway during sleep can lead to temporary breathing cessation. Apnoea is defined as a complete cessation of airflow for more than ten seconds, while hypopnoea is a partial reduction of airflow for more than ten seconds accompanied with a drop in oxygen saturation. The pause may be for ten seconds or up to a minute or more. The result is a gradual reduction in oxygen saturation, and eventually a central response increasing arousal to start normal breathing again. These breath-holds can cause multiple subconscious disturbances of sleep by virtue of the repetitive EEG arousals. Where an apnoeic episode only happens a few times during sleep this will not significantly affect the individual, but where the episodes happen several times an hour, the disruptive effect substantially reduces non-REM and REM sleep. The presence of repeated episodes of apnoea related to obstruction in an individual is clinically known as obstructive sleep apnoea (OSA).

There are two main factors leading to obstruction of the upper airway by the soft palate or tongue. The airway itself may be narrowed, and the muscles which normally hold the airway open may relax during sleep. Airway narrowing can be structural, related to the jaw shape and position, size of the tongue and shape of the palate, it can very rarely be caused by increase in size of the tonsils or adenoids, and it can be caused by increases in fat around the airway in obesity. Sleep position may also be important, with a higher risk for those sleeping on their backs.

OSA may therefore be seen in individuals with other predisposing factors, but is much more common in obese individuals. As obesity tends to increase with age, and other factors become more obvious with age, there is a significant increase in prevalence of sleep apnoea with age [3](#). OSA is 2-3 times more common in men than women [4](#) probably because of the difference in fat distribution between the sexes.

There is a wide variation in figures quoted for the prevalence of OSA in the general population, partly depending on the definition used for OSA. The UK prevalence of moderate to severe disease is probably 0.5% of men mean age 48.2 with a mean BMI of 24.9, increasing to 1.5% in men mean age 52 with a mean BMI of 27.1. If a wider definition including mild disease is used, the prevalence in US males with a BMI of 30 is around 24% [5](#). The prevalence increases to 20% of men with type 2 diabetes [6](#). One study showed a prevalence of moderate to severe OSA in 3% in those with a BMI less than 24, 4.8% in those with a BMI 24-26.9, 14% in those with a BMI 27-30.9 and 20% in those with a BMI greater than or equal to 31 [7](#).

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Muscoskeletal section

Amputations

Most of the research literature and evidence base of functional outcome following amputation in working-age individuals involves survivors of military trauma. There are many anecdotes of amputees who have successfully returned to physically demanding occupations and sports, but little statistical research.

The evidence base includes significant numbers for vascular pathology and other disorders where co-morbidity would make it most unlikely that the individual could be considered for firefighting. Substantial numbers of individuals will be unable to cope with the activity levels required of a firefighter, so the main objective of this study is to consider whether any individuals could cope. What factors need to be considered when deciding if a recruit with an amputation could function effectively as a firefighter, and can a current firefighter return to duty after an amputation?

When considering operational capability of a firefighter wearing a limb prosthesis, there are a number of considerations. The most obvious is their capability to undertake firefighting tasks wearing a prosthesis. Other factors are problems with the stump related to mechanical stress combined with sweating in a hot environment, co-morbidities from the original trauma both physical and psychological, and co-morbidities such as phantom limb pain. The final consideration is the nature of the prosthesis. Substantial advances have been made recently in the design and function of prosthetic limbs.

Complete loss of a limb is not compatible with firefighting, even if replaced with a prosthesis. There is evidence that loss of one limb leads to an increased sensory threshold in the contralateral limb, which could have a negative on proprioception and balance [206](#). This suggests central changes which could affect operational capability in a firefighter, but it is important, in the era of the Equality Act, to look at what the person can do, not what they can't do, and whether what they can do meets the fitness criteria for firefighting.

[Upper Limb Amputation](#)

[Lower Limb Amputation](#)

[Overall Guidance](#)

206 Kavounoudias A et al. Bilateral changes in somatosensory sensibility after unilateral below-knee amputation. Arch Phys Med Rehabil. 2005;86(4):633-40.

Under Cardiovascular

Anticoagulants and Antiplatelet Therapy

Anticoagulants and antiplatelet drugs are prescribed for a number of conditions and have proved lifesaving. Common reasons include atrial fibrillation and clotting disorders.

There is an inherent risk from anticoagulant use that any internal or external bleeding may be prolonged. External bleeding can generally be controlled with simple pressure bandaging, and the blood loss in someone on normal therapeutic doses of anticoagulant is unlikely to be significant. Internal bleeding may be an issue, but where there is a substantial risk of haemorrhagic shock the underlying cause is likely to be major trauma or pathology where the additional risk from anticoagulant medication will be only marginal.

The most obvious and insidious risk is from intracranial bleeding where only a relatively small amount of bleeding can have catastrophic effects on brain tissue. The primary concern from anticoagulant use is therefore intracranial bleeding from head injury, where operational firefighting may represent an increased risk. It is important to ensure that a proper risk assessment is undertaken before deciding whether the risk is acceptable, or whether the employer's duty of care overrides the right of the individual to remain in employment as an operational firefighter. Any risk assessment should consider how frequently firefighters have sustained a head injury on operations, and whether they would have been at greater risk had they been taking anticoagulant or antiplatelet therapy. This can be readily assessed from accident and injury reports held by the Fire and Rescue Service. There will be a substantial risk reduction from wearing helmets.

Clotting involves two processes: platelet aggregation and the formation of fibrin. Arterial thrombus formation usually occurs on the surface of atheroma, and the thrombus is mainly platelets. The primary mechanism is platelet adherence to the damaged endothelium or contents of ruptured atheromatous plaque leading to a white platelet thrombus. Venous thrombus formation generally arises where blood is static, often where there is increased coagulability, where the resulting thrombus is primarily fibrin with red blood cells trapped between (red clot). Thus because the mechanisms of clot formation are different, the treatments required are different. Antiplatelet drugs are used successfully to prevent arterial, but have minimal effect on venous thrombus formation where anticoagulants are efficacious.

[Antiplatelet Drugs](#)

[Thrombin Inhibitors](#)

[Anticoagulants likely to be used by firefighters](#)

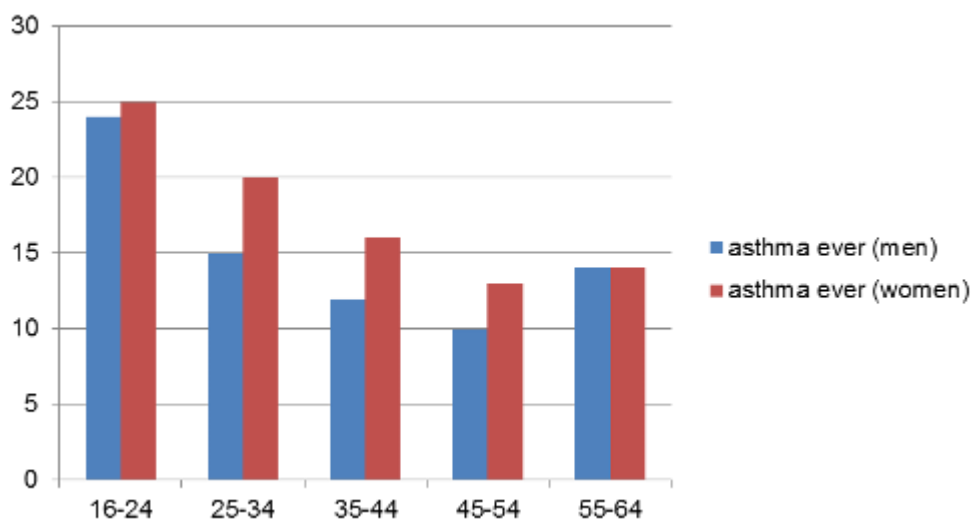
[Conclusions](#)

Under Respiratory

Asthma

Asthma is a disease characterised by variable constriction of the airways causing an increased resistance to air flow leading to reductions in ventilation and hyperinflation of the lungs. A diagnosis of asthma is common in United Kingdom populations. Findings from the Health Survey for England in 2001 [1](#), suggest that about one quarter of men and women aged between 16 and 24 years have at some point been diagnosed with the disease; the proportions are generally lower in older persons (see Figure 1), probably reflecting a birth cohort effect, and at all adult ages are higher in women. Since a characteristic of asthma is its tendency to remit (and relapse) and since its symptoms are not specific, none of these figures necessarily reflects the age-specific prevalence of current disease.

Figure 1



The incidence of asthma is highest in the first years of life but approximately two thirds of children with asthma will be asymptomatic by the age of 15. Remission is more common in males, in those whose asthma started after the age of 5, in those without accompanying rhinitis or eczema and in those with no family history of asthma. About a third of those whose childhood asthma has remitted will have a relapse before the age of 35 but this is seldom severe and is usually controlled with reliever medication alone.

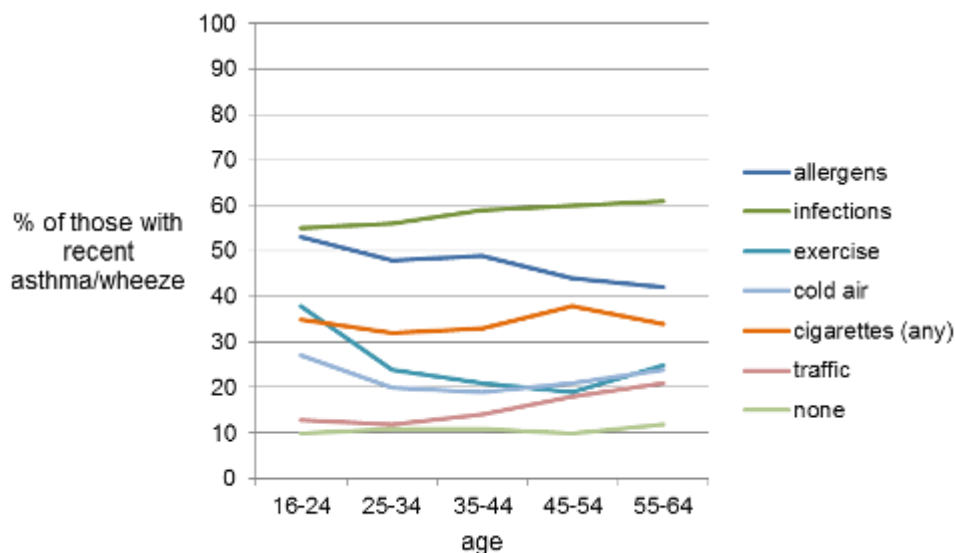
A proportion - probably small - of those with remitted childhood asthma will have asymptomatic bronchial hyper-reactivity in adulthood. This can be detected using a variety of non-specific provocation tests. There is limited evidence that persisting hyper-reactivity increases the risk of subsequent symptomatic relapse.

The symptoms of asthma are not entirely specific and the disease has no unambiguous or universally accepted definition. Thus diagnoses, and reports of diagnoses, will include alternative respiratory conditions; most authorities, however,

consider a doctor's diagnosis to be more specific than otherwise self-reported disease. Conversely, a diagnosis of asthma may not be recalled, especially when it was made in early childhood and the disease has since remitted. Treatments used in asthma are also used for other respiratory diseases, commonly for infection-related wheeze at any age and, later in life, for chronic obstructive pulmonary disease; reports of such treatment are not necessarily confirmation of asthma.

The symptoms of asthma vary from a dry cough to an audible wheeze with shortness of breath. The disease is characterised by variability and by the provocation of symptoms in response to environmental triggers. Most asthma arising in childhood is accompanied by atopy, a tendency to develop immediate-type sensitivity to environmental aeroallergens which frequently persists; around half of adults with asthma report symptoms that are provoked by specific allergens (Figure 2). Other common triggers include respiratory infections, cigarette smoke, exercise and cold air. Around one in ten adults with asthma recognise no specific provoking factor(s).

Figure 2



Most UK adults with asthma have disease that requires treatment with only an as-needed β_2 agonist or a regular inhaled corticosteroid at low doses. Each year about 10% of them will have an exacerbation that will require treatment with prednisolone (2), usually provoked by a respiratory infection. Severe, unpredictable attacks of asthma are rare and are generally reported only by those with a history of such. Current treatments for asthma are, if used properly, very effective in maintaining disease stability and, in most individuals, freedom from symptoms for most of the time. Poor asthma control often reflects under-treatment, frequently from poor adherence.

The inter-individual variability in asthma is far smaller than the variation between adults with the disease; thus while the prevalence of the condition is high among professional athletes, others (albeit few) with the disease are severely disabled by

breathlessness and it is plain that a diagnosis of 'asthma' covers both a spectrum of severities and a variety of phenotypes. This has two important consequences. First, it is essential that individuals with asthma are assessed on a case-by-case basis; and second, the best predictor of future performance is provided by consideration of the recent past [2](#).

Given the above, it is clear that the needs of recruits with a history of asthma (current or past) should be considered individually with a focus on the severity, stability and predictability of the disease. Most of the necessary information can be collected through a simple history of current and recent symptoms, recent exacerbations and current treatment use. While the last of these is commonly used as a measure of asthma severity this may not be appropriate and a distinction between treatment 'use' and treatment 'requirement' needs to be made. Spirometry will detect airflow obstruction but is often normal in young adults with well-controlled asthma and in any case is a poor predictor of functional ability. Measurement of residual bronchial hyperreactivity through non-specific provocation testing in a hospital laboratory may be helpful in determining the likely response to respiratory irritants and the probability of a relapse in the future.

Bronchoconstriction after exercise is common in those with inadequately treated asthma; but rarely severe in those whose disease is mild and treated appropriately, and unusual in those with a history of childhood disease that is in remission. Exercise-induced asthma can be identified through a clinical history and confirmed through formal exercise testing although the test is difficult to standardise and may not reflect working conditions well.

Recruits with a clear history of severe or moderate asthma with inadequate symptom control and frequent exacerbations – especially when these are unpredictable – should not be routinely exposed to irritant or volatile vapours or fumes (including smoke) or strenuous exertion. Those whose disease is more mild and requires treatment only during periods of respiratory infection, or is well-controlled by the use of a regular inhaled corticosteroid at low doses with no or rare need for treatment with as-needed β_2 agonist, are likely to have few difficulties with active firefighting. This includes the use of breathing apparatus.

Guidance

There should be no bar to employment based on the diagnosis of asthma alone. Recruits with a history of asthma, past or current, require individual assessment. Assessment should include a careful history that focusses on current symptoms and treatment requirements; triggering factors including exercise and irritant exposures; and the frequency and history of exacerbations.

Recruits with a history of childhood asthma that was never severe and responded well to treatment with a β_2 agonist with or without an inhaled corticosteroid, who have been symptom free in recent years and who have passed their standard fitness tests without difficulty can be employed in all fire-fighting roles. There is no bar to their using breathing apparatus.

Recruits with current asthma that is controlled by the use of a β 2 agonist with or without an inhaled corticosteroid and in whom any symptoms are mild, predictable and provoked by factors unrelated to the work environment, and exacerbations provoked by infection or seasonal allergy are infrequent can be employed in all fire-fighting roles. There is no bar to their using breathing apparatus.

Recruits whose asthma causes symptoms with exercise or exposure to common irritants such as cold air, smoke or fumes (ie triggers that are likely to be encountered at work) irrespective of the treatment they are using, and those with frequent exacerbations provoked by infection or seasonal allergy should not be employed in active fire-fighting roles. They may benefit from a specialist review of their current treatment. Specialist respiratory assessment is required in doubtful cases. Such assessment should include, as appropriate, direct a or indirect b tests of bronchial hyperreactivity.

a usually with inhaled histamine, mannitol or metacholine
b most suitably with exercise

1. Department of Health. [Health Survey for England 2001](#). The Stationery Office, Norwich 2003.

2. Cullinan P. Evidence-based guidance for the assessment of new employees with asthma; a report to the British Occupational Health Research Foundation. Please use this link to [download a copy of the pdf](#).

Disability and Equality Law

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