



The Independent Medical Expert Group (IMEG)

Report and recommendations on medical and scientific
aspects of the Armed Forces Compensation Scheme

December 2017

From: Professor Sir Anthony Newman Taylor



**Ministry
of Defence**

A Non-Departmental Public Body
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Defence

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5 December, 2017

Minister of State for Defence Personnel and Veterans
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Dear Minister,

I have pleasure in submitting the Fourth Independent Medical Expert Group (IMEG) report.

IMEG was set up in 2010 on the recommendation of Lord Boyce's review of the Scheme and became a Non-Departmental Public Body (NDPB) in 2012. It continues to provide you with medical and scientific advice on the AFCS ensuring it reflects contemporary understanding and meets the needs of Service personnel.

Topics for the Fourth report have been suggested by claimants and their supporters and a number of issues were referred for IMEG comment as a result of the 2016 Quinquennial Review (QQR) of the Scheme, published in February 2017. At this date from the end of hostilities in Afghanistan, claims in the scheme increasingly reflect injury and disorder sustained during sport, and adventure training.

Since 2010, IMEG members have made visits to the Defence Medical Rehabilitation Centre (Headley Court), Hasler Company, and most recently to the Personnel Recovery Unit ((PRU) at Colchester). These have provided valuable insights into the priorities and perspectives of Service personnel.

The approach of IMEG to investigation of topics has been to identify and appraise the relevant evidence, reviewing the published peer-reviewed international literature as well as discussing topics with recognised military and civilian experts.

For this report IMEG has considered the medical and scientific aspects of the MOD Radiation Policy Statement. Originally published in 2003, the present revision reflects the significant number of major revised reports published by the World Health Organisation (WHO) and the UN as well as by the Advisory Group on Ionising Radiation of the Health Protection Agency (now Public Health England) on the adverse health effects of ionising radiation. New work since 2003 includes further analyses of the Japanese atomic bomb survivors and a series of international studies on radiation workers. The new Policy Statement includes a list of radiogenic disorders including cancers as well as coronary artery disease, stroke and cataract.

The largest single category of claimed disorders under AFCS are musculoskeletal disorders (MSK) including low back and neck pain. On investigation of these in most cases, there is no serious underlying pathology present but they can be very disabling. Aware of the confusion over the causes of non-specific back pain and how it should be treated, we have taken opportunity to include comment on the epidemiology of low back pain and its best practice clinical management. Other topics include hip pain and MSK disorders in recruits. Because of its size and importance Part 2 will consider pain and pain syndromes as well as diagnoses especially common in military populations such as shin splints, compartment syndrome, stress fracture.

Traumatic brain injury (TBI), particularly mild TBI (mTBI), considered in the US, the signature injury of recent conflicts was referenced in the second (2013) IMEG report when the many gaps in understanding were noted. The then Minister asked us to keep the topic under review and, as appropriate, provide updates. This report includes the first of these.

mTBI is not limited to conflict situations but is relevant to peace time activity including sporting accidents, adventure training, road traffic accidents. The resultant paper is very full and includes sections on audiovestibular and psychiatric effects. Opportunity was also taken to amend Table 6 brain injury descriptors. This was less about an increase in Tariff awards or new descriptors as clarification of existing descriptors. We concluded that although advances were being made in mTBI, there remain many unresolved issues. In particular there is yet no robust method of early identification of cases likely to develop persistent disabling symptoms.

For the first time, this report includes two sections which we hope will be of particular interest to scheme medical advisers and decision-makers. These are the concept of “worsening” and some proposals for a medically sound understandable approach to “spanning” cases, cases where a person has served both before and after 6 April 2005 and eligible to claim under both schemes.

The adoption of a balance of probabilities standard of proof in AFCS was not without controversy. Under the War Pensions Scheme (WPS) any disorder which first presents in service is likely to be accepted unless there is positive evidence that

there is no causal link to service. For epilepsy, and most cancers which sadly can arise in fit young people, that means war pensions entitlement will follow. For the AFCS lack of evidence of a causal link will mean rejection of the claim. This apparent discrepancy was raised with Lord Boyce in the 2010 AFCS Review and in response a category of “recognised diseases” was developed in AFCS. In successive reports we have looked at a range of disorders. In this report we considered ultraviolet light and skin cancers seeking evidence that ultraviolet exposure in AFCS service is consistently associated with an increase in frequency of the disorders and that there are circumstances where the risk is more than doubled. This makes it more likely than not that the case was due to a service cause. In that situation claims can be accepted as presumed due to service, without case specific investigation. The particular focus of the investigation was cutaneous malignant melanoma which is relatively common in working age adults in UK today. The evidence is that none of the established risk factors for skin melanoma is likely to be due to AFCS service. Claims will still be considered on their individual facts but are likely to be for rejection. We noted the publication in June 2017 of a short report from the Medical Research Council (MRC) Lifecourse Epidemiology Unit at Southampton recording an unexpectedly high proportion of deaths from multiple sclerosis among men whose last full-time occupation was in the UK Armed Forces. This was observed over the last three decades. No explanation is presently available but the only published military longitudinal study does not support the finding. We will continue to investigate.

In 2016 a QQR of the scheme took place with report published in February 2017 when a number of issues were referred for IMEG comment. For the most part these were matters of clarification rather than proposals or recommendations for new or expanded approaches. Topics covered included infectious diseases and Zika virus, gender differences in award rates, a series of features of the scheme including permanence, interim awards, worsening and spanning. The team also asked for comment on medical aspects of an Exceptional Supplementary Award (ESA) and reflecting a key current concern for the military and wider communities, there were questions on mental health. In particular there were representations that the highest available award should be level 4, with a corresponding 100% Guaranteed Income Payment (GIP), paid from service termination or if a post service claim, from date of claim, for life. A GIP is a reduced earnings allowance paid to those with more serious disorders likely to have a direct adverse effect on civilian employability.

IMEG looked closely at this issue for the 2013 report concluding then that for mental health disorders likely to be accepted as due to AFCS service, permanent complete incapacity for any kind of civilian work would be very unlikely, and so the highest award in the current scheme is at level 6 with a GIP based on 75% salary at service termination.

There is currently much activity in mental health including in NHS UK enhanced service delivery arrangements, including for veterans, and revision of best practice treatment guidelines and classifications systems for mental health disorders. A new edition of the US classification, DSM V was published in 2014 and ICD 11 is due next year. It is already known that proposed diagnostic criteria for the same disorder are different in both classifications and from earlier editions of the same system. All this is subject to much senior clinician debate. We had the opportunity both to study

the literature and speak with some of the UK's leading clinical experts and academics with an interest in traumatic psychological injury. As a result we propose a new Tariff 4 award. The descriptor is detailed and aims to reflect the rarity of circumstances where a higher award is appropriate. Reflecting the clinical evidence including the opinions of senior clinicians, we do not think level 4 awards, directly due to attributable mental health disorder, will be common.

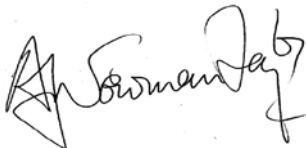
All IMEG members took part in our discussions and agreed the findings and recommendations. I believe these fairly reflect the contemporary evidence and are in line with scheme intentions.

Since publication of the last report several members have left the group. I am sad to report the death of Lt Col Jerome Church OBE, who died suddenly in the US in July 2016. Jerome with his enormous expertise and experience, great humanity, unfailing good humour and sense of fairness made an enormous contribution to the group, as the representative of the charities. I am also indebted to Major Steve McCully RM, AFCS award recipient member who has left the Service and to Brigadier Hugh Williamson, HQ Surgeon General observer, who came to the end of his tour. Hugh has been replaced by Air Cdre Alastair Reid. Appointment of two further new members is well advanced.

I am grateful also to the Secretariat for their commitment and willingness.

The report includes a note on the Stakeholder meeting held at the Royal Society of Medicine on 5 June 2017. As the recent QQR confirmed, ensuring wide visibility of AFCS remains an ongoing challenge. I hope that this, our first meeting made some contribution to effective awareness raising.

Yours sincerely

A handwritten signature in black ink, appearing to read 'A Newman Taylor', with a stylized initial 'A' and a flourish at the end.

**Professor Sir Anthony Newman Taylor, CBE, FRCP, FFOM, FMedSci
Chair
Independent Medical Expert Group (IMEG)**

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Key Points

Topic 1 - Armed Forces Compensation Scheme (AFCS) Quinquennial Review (QQR) Issues

Topic 1 Infectious Diseases and Zika virus

1. Having considered the wide range of infection related disorders, potentially due to AFCS service¹, IMEG concludes that tariff Table 4, Physical disorders is able to accommodate any service acquired infection related disorder, the majority of which will be treatable to cure within a few weeks. As discussed in the report we do not recommend a specific list of infections.
2. If a serving member of UK Armed Forces acquires Zika due to AFCS service, an award might follow dependent on the severity and duration of disabling effects or complications.

Topic 2 Gender differences in AFCS awards

1. Based on data supplied by MOD Defence Statistics, IMEG finds no anomalies between male and female awards in the scheme to date.
2. As the face of the Armed Forces changes over the next few years, IMEG will routinely monitor final award outcomes for AFCS claims by women and keep in touch with emerging research, UK military personnel policy practice and training, and review both the general and military literature, on issues relevant to female musculoskeletal physiology and injury, both short and long term.

Topic 3 Worsening– see separate paper

Topic 4 Spanning– see separate paper

Topic 5 Interim awards

1. IMEG considered the medical aspects of interim awards and finds the logic and utility, sound. We also note and endorse Article 52 (8) (b) i.e. where the person's injury or disorder improves with treatment and a lower final payment is due, no recovery of benefit paid is recoverable.

Topic 6 Permanency

1. Article 5 of the AFCS Order 2011, as presently worded, clearly sets out the meaning of “permanent “. We find the concept medically valid and in line with contemporary best practice clinical management and approaches to disability. No legislative amendment is required from the medical perspective.

¹ For brevity this report will use the phrase AFCS service to imply military service on or after 6 April 2005 when the AFCS applies.

Topic 7 Categories of Award – Mental Health

1. Following evidence review we remain content that contemporary evidence supported the recommendations and conclusions of the 2011 and 2013 IMEG reports, on Table 3 tariff descriptors and award values for mental health disorders, particularly the highest appropriate award.
2. In light of new evidence, clinical insights from the literature and discussion with senior clinical colleagues working in the field of traumatic psychological injury, we conclude that the Table 3 range of descriptors and tariff values for mental ill health should include an award at level 4 attracting a 100% GIP. As stressed by clinical colleagues and the literature, this level of disability will be rare. The descriptor will be tightly defined to address the small number of cases where residual functional impairment, following adequate courses of best practice treatment, including highly specialist tertiary interventions, and directly due to the mental health disorder remains incompatible with paid employment for the foreseeable future.
3. We recommend audit of decisions to make a level 4 award.
4. We would encourage studies of the long-term prognosis of veterans with mental health conditions, particularly related to employment outcomes and outcomes following particular treatments.
5. Diagnosis remains very important and should continue to be made by a psychiatrist or clinical psychologist at consultant level.

Topic 8 High Dependency or Exceptional Supplementary Award (ESA) – medical aspects.

1. IMEG recognises that the intention behind the ESA is laudable but, would urge careful thought. A decision to have such a provision and subsequent criteria for its award should be uncontroversial and robust.
2. We acknowledge no direct relation between a sum of money and the adverse effects of disease or injury on an individual. Individuals and families react very differently to disease and injury with a wide spectrum of views as to what constitutes satisfactory care and support. Because care is given does not imply it is always medically necessary.
3. While by no means yet perfect we note, since the introduction of the AFCS, the enhanced publicly funded holistic healthcare and wider mental disorder support increasingly available to all who require them in the community, including injured veterans. We consider the widespread popular support for the Armed Forces, nationwide development of the Armed Forces Covenant and collaborative working, including with the charities, under successive governments as providing the basis of valid tools, lay and professional, for long term audit of standards and adequacy of provision of health care and social support both in general and locally to individual veterans. Any additional funding for the Scheme might be well invested in developing and implementing sustainable processes for audit and evaluation of care and other services provided under the Armed Forces Covenant.

Topic 2 - Policy Statement on Claims for Ionising Radiation Related Conditions

1. IMEG concludes that the evidence does not support the view that, as a matter of course, those present at UK atmospheric nuclear test detonations, or the Australian Weapons Experimental Programme, and clean-up operations were exposed to harmful levels of ionising radiation as a result of service in these locations.
2. **The National Radiological Protection Board (NRPB) reports.** Based on the first NRPB report, the Secretary of State's normal policy became to award war pension for claims for leukaemia (other than chronic lymphatic leukaemia) and multiple myeloma in those present at test sites. The policy also included awards for primary polycythaemia rubra vera, the red blood cell equivalent of leukaemia. In light of the 1993 report, the Secretary of State's normal policy was revised. Since then, on the basis of presence at atmospheric nuclear test sites new claims for multiple myeloma were rejected but awards continued to be made for leukaemia (other than chronic lymphatic leukaemia) and primary polycythaemia rubra vera (PRV) having clinical onset within 25 years of first presence at the test sites. That position remained after the 2003 third IMEG report.

At this review we found that the approach to polycythaemia rubra vera claims was not medically sound and recommend that policy should change.

The NRPB reports otherwise provided no evidence that presence at the test sites had a detectable effect on expectation of life or risk of developing any other malignancy. We confirm that position.

3. **Radiogenic disorders.** At this date IMEG concludes that reliable evidence raises a reasonable doubt of a causal link between ionising radiation exposure and leukaemia (other than chronic lymphatic leukaemia), female breast, lung, oesophagus, stomach, colon and rectum, primary cancer of the liver, gall bladder, thyroid, urinary bladder, renal pelvis and ureter, central nervous system, salivary gland, and bone. On present overall evidence including military and other studies we find that Chronic lymphatic leukaemia (CLL), Polycythaemia rubra vera (PRV), Hodgkin's disease, (HD), Non Hodgkin's lymphoma (NHL), and Multiple myeloma (MM) are not radiogenic. Risk of circulatory disorders (including stroke, atherosclerotic coronary artery disease and heart failure) is raised at high doses of ionising radiation exposure i.e. 5 Gy acute exposure. (1 Gy equivalent to 1000 mSv). Lens opacification can also be caused by ionising radiation. Cataracts can be induced by 2 Gy of acute radiation and 5 Gy chronic exposure. For visual disablement present evidence is that higher doses, estimated to be about 10 Gy exposure, are required. War Pension entitlement will be considered dependent on the case specific facts.
4. Five categories of presumed "at risk veterans" for ionising radiation exposure have long been identified. Recently it was shown that at some of the Minor Trials, notably Vixen A and B, there was some risk of dispersal of radiation into the environment because of explosions on the ground or on low towers. As a result we recommend that those present at the Minor Trials at Vixen A and B and the clean-up operations are added to the list as the sixth "at risk" group.

Topic 3 - Traumatic Brain Injury (TBI)

1. On investigation we find that TBI remains a leading cause of death in young adults in developed societies. Case series suggest severe head injury accounts for 3% of total: moderate 22% and mild 75%. There is still no agreed definition for mild TBI (mTBI). mTBI is clinically heterogeneous in both presentation and outcome and the diagnosis is made by exclusion, where the features of severe and moderate TBI are not present. Given the imprecise definitions of mTBI, concussion, and post-concussion syndrome, the relationship between these remains uncertain.
2. The evidence confirms that many patients with mTBI recover completely within months to a year post incident with both military and civilian mTBI studies recording overall good return to pre injury function and employability. There remain however a minority of patients in whom symptoms and functional disability persists.
3. While standard CT and MRI scans do not exclude diffuse axonal and vascular structural changes, these can be demonstrated by more advanced, although as yet, not clinically routine, structural imaging techniques notably diffusion tensor imaging.
4. Recent research is focussed on the relevance of non-routine functional and metabolic imaging modalities such as positron emission tomography (PET), single photon emission computed tomography (SPECT), functional magnetic resonance imaging (fMRI) and magnetoencephalography (mEEG) to detect cellular and metabolic change. Work to date has identified no single robust method of identifying those at risk of developing persistent symptoms and disability after mTBI but findings suggest that targeted application of both structural and functional neuroimaging may be useful.
5. Head injury may result in auditory and vestibular symptoms due to isolated labyrinthine pathology, brain injury, or both, but common non-traumatic causes of hearing loss and balance disorders must be excluded. The disabling functional effects of dizziness in relation to TBI have not been well studied, but in general, dizziness is associated with falls and poorer function in everyday and work related tasks, than before the onset of the symptom. Where dizziness persists in mTBI beyond the immediate post injury period, it is appropriate to take an active approach to diagnosis of symptoms and treatment by expert audio-vestibular investigation.
6. Psychiatric disorders have an increased incidence after TBI but may be present before it and some may make TBI more likely e.g. depressive disorder. mTBI is most likely to be disabling in the presence of a co-morbid disorder. Treatment for psychiatric disorder may improve functional prognosis for those with TBI but the evidence base is underdeveloped.
7. As part of this review IMEG considered the wording of the present Table 6 Head Injury descriptors and related awards and recommends a few amendments to support robust defensible decision-making based on verifiable facts.

Topic 4 - Musculoskeletal Disorders (MSK disorders) Part 1

1. The nature of military life makes it unsurprising that MSK disorders are the main reason for military medical downgrading and discharge and the most common reason for AFCS claims and awards. To date over half the awards under the AFCS have been for MSK disorders.
2. MSK disorders in military practice broadly divide into three groups:
 - i) discrete, diagnosable strain, sprain or overuse injury eg knee meniscus or ligament damage;
 - ii) less common physical disorders with clinical onset in service, eg genetic and autoimmune conditions, including rheumatoid arthritis or systemic lupus erythematosus, arthritis associated with inflammatory bowel disease, psoriasis or post infective, ankylosing spondylitis, and;
 - iii) the largest group of low back pain, neck pain anterior knee pain, usually without evidence of specific pathology.
3. Of the three categories, establishing a causal link to AFCS service is easiest in category i) discrete diagnosable strain sprain or overuse injury to tendon or ligament linked to an event. Most disorders in category ii) physical disorders with clinical onset in service eg rheumatoid arthritis will not be due to service, on the balance of probabilities, but rather will be of unknown aetiology. The most difficult determinations in terms of causal link to service are category iii) conditions such as low back pain, often without evidence of specific pathology and of spontaneous onset.
4. There is no evidence in the absence of preceding traumatic injury that work in the Armed Forces generally causes increased risk of degenerative change in the vertebral column. Decisions on these conditions will depend critically on individual case facts, including the type and duration of service. Royal Marine, Parachute regiment, Special Military Units or combat service are likely to produce quite different physical loading stressors compared with peace-time storeman duties in the Logistics Corps.
5. We reviewed the Table 9 Back descriptors and Tariff awards in light of current understanding of causation, progress and associated disabling effects and remain of the opinion that the present approach to back disorders is evidenced and maintains horizontal and vertical equity.
6. Nociceptive and neuropathic pain and Pain syndromes will be considered more fully in Part 2 of the MSK Disorder Review.

Topic 5 - AFCS Worsening

1. We conclude that the present approach to worsening set out in Article 9 of the AFCS Order 2011 is reasonable medically, and supportive of consistent equitable decisions. It reflected Armed Forces personnel and medical policy and practice of attaining and maintaining maximum functional fitness, employability and deployability.

Topic 6 - Spanning

1. As far as possible, given the marked differences between the War Pensions Scheme and AFCS, we recommend approaches based on case facts likely to be documented, in service and medical records, leading to case determinations which are medically robust and defensible, understandable to claimants and administrators.
2. We consider decision-making in spanning cases, potentially challenging and advise that spanning cases should be added to the list of case types where medical advice is mandatory.

Topic 7 - Recognised Diseases: Ultraviolet Light and Skin cancers

1. For a disorder to be a Recognised Disease in the AFCS, we look for evidence that service is consistently associated with an increase in its frequency and whether there are circumstances where the frequency is more than doubled, making it more likely than not in the individual case that the disease was attributable to a cause in service.
2. Skin cancers, the most common cancers in white skinned populations are usually divided into non-melanoma skin cancers (NMSC) and cutaneous malignant melanoma (CMM). The most important types of NMSC are basal cell carcinoma (BCC) and squamous cell carcinoma (SCC).

NMSC Basal cell carcinoma (BCC) is commonly called rodent ulcer. The mortality rate is low and they rarely metastasize but they may invade surrounding tissues including cartilage and bone causing significant destruction. Squamous cell carcinomas (SCC) may arise in scar tissue but the majority arise on sun damaged exposed skin, and most commonly in actinic keratosis (AK).

Cutaneous malignant melanoma. Cutaneous malignant melanoma (CMM) accounts for less than 5% total skin cancers, although the incidence is rising in all parts of the world for which data are available and it leads to 75% of all deaths from skin cancers.

3. By April 2005 public health education on the dangers of sun exposure were well developed including in the UK amongst the military medical services, the chain of command and service personnel. The avoidance of direct UVR exposure and sunburn, use of suitable protective clothing, sunglasses, and sunscreens, were standard practice.
4. While total cumulative lifetime sun exposure is casually associated with AK and SCC, the evidence is that BCCs are more related to short intermittent burning episodes. Sun exposure plays a primary role and supporting role in most cases of CMM with the pattern of exposure in the sub-types varying. The risk for CMM in older people, developing over many years and of generally lower mortality is as for SCC, i.e. chronic long term excess UV exposure. Superficial spreading melanomas, the most common type in working age adults are related to short sharp episodes of burning exposure especially in youth and adolescence.
5. We conclude that in general none of these circumstances is likely to be met at this date due to AFCS service and so most cases of NMSC and CMM claimed under AFCS will be for rejection. However each case should be considered on its facts.

Topic 1 - Armed Forces Compensation Scheme (AFCS) Quinquennial Review (QQR) Issues

Key Points

Topic 1 Infectious Diseases and Zika virus

1. Having considered the wide range of infection related disorders, potentially due to AFCS service, IMEG concludes that tariff Table 4, Physical disorders is able to accommodate any service acquired infection related disorder, the majority of which will be treatable to cure within a few weeks. As discussed in the report we do not recommend a specific list of infections.
2. If a serving member of UK armed forces acquires Zika due to AFCS service, an award might follow dependent on the severity and duration of disabling effects or complications.

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1. Based on data supplied by MOD Defence Statistics, IMEG finds no anomalies between male and female awards in the scheme to date.
2. As the face of the Armed Forces changes over the next few years, IMEG will routinely monitor final award outcomes for AFCS claims by women and keep in touch with emerging research, UK military personnel policy practice and training, and review both the general and military literature, on issues relevant to female musculoskeletal physiology and injury, both short and long term.

Topic 3 Worsening – see separate paper

Topic 4 Spanning – see separate paper

Topic 5 Interim awards

1. IMEG considered the medical aspects of interim awards and finds the logic and utility, sound. We also note and endorse Article 52 (8) (b) i.e. where the person's injury or disorder improves with treatment and a lower final payment is due, no recovery of benefit paid is recoverable.

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1. Article 5 of the AFCS Order 2011, as presently worded, clearly sets out the meaning of "permanent". We find the concept medically valid and in line with contemporary best practice clinical management and approaches to disability. No legislative amendment is required from the medical perspective.

Topic 7 Categories of Award – Mental Health

1. Following evidence review we remain content that contemporary evidence supported the recommendations and conclusions of the 2011 and 2013 IMEG reports, on Table 3 tariff descriptors and award values for mental health disorders, particularly the highest appropriate award.
2. In light of new evidence, clinical insights from the literature and discussion with senior clinical colleagues working in the field of traumatic psychological injury, we conclude that the Table 3 range of descriptors and tariff values for mental ill health should include an award at level 4 attracting a 100% GIP. As stressed by clinical colleagues and the literature, this level of disability will be rare. The descriptor will be tightly defined to address the small number of cases where residual functional impairment, following adequate courses of best practice treatment, including highly specialist tertiary interventions, and directly due to the mental health disorder remains incompatible with paid employment for the foreseeable future.
3. We recommend audit of decisions to make a level 4 award.
4. We would encourage studies of the long-term prognosis of veterans with mental health conditions, particularly related to employment outcomes and outcomes following particular treatments.
5. Diagnosis remains very important and should continue to be made by a psychiatrist or clinical psychologist at consultant level.

Topic 8 High Dependency or Exceptional Supplementary Award (ESA) – medical aspects

1. IMEG recognises that the intention behind the ESA is laudable but, would urge careful thought. A decision to have such a provision and subsequent criteria for its award should be uncontroversial and robust.
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3. While by no means yet perfect we note, since the introduction of the AFCS, the enhanced publicly funded holistic healthcare and wider mental disorder support increasingly available to all who require them in the community, including injured veterans. We consider the widespread popular support for the Armed Forces, nationwide development of the Armed Forces Covenant and collaborative working, including with the charities, under successive governments as providing the basis of valid tools, lay and professional, for long term audit of standards and adequacy of provision of health care and social support both in general and locally to individual veterans. Any additional funding for the Scheme might be well invested in developing and implementing sustainable processes for audit and evaluation of care and other services provided under the Armed Forces Covenant.

Introduction

1. Lord Boyce's 2010 Review of the AFCS was the first review since Scheme introduction, and since neither during scheme development nor at its introduction was the subsequent high level of combat nor of survival from previously fatal traumatic injury anticipated, Government decided that the review should be far-reaching. To support him in the review, Lord Boyce had an independent scrutiny group made up of academics, legal, medical and military colleagues with expertise and an interest in personal injury compensation.
2. Lord Boyce's recommendations were accepted by ministers and his overall conclusion was that the scheme was fit for purpose and a need for future radical review and revision would be most unlikely. Successive UK governments are committed to evidence-based policy and individual decisions including military no-fault personal injury compensation. In line with this, Lord Boyce recommended the setting up of an independent group of medical experts, in specialities relevant to military life, to provide independent transparent evidence-based scientific and medical advice to ministers on AFCS. In 2012 the IMEG was constituted as a Non Departmental Public Body (NDPB) with expert members appointed according to Cabinet Office principles. To date IMEG has produced three reports with the fourth report due in Autumn 2017.
3. The 2016 AFCS QQR was led by a B2 MOD civil servant with no previous links to military compensation. The QQR Team interviewed a range of stakeholders, considered the issues and evidence, and produced a report. Amongst their recommendations they referred a number of topics for comment or further action by IMEG. The report highlighted several overarching themes including the continuing need for effective communications and awareness-raising about the scheme, its provisions and rules, and how and where claimants might get help. Several issues referred to IMEG were the subject of some misunderstanding and required further clarification rather than a need for revision of policy or legislative amendment. Where IMEG identified scientific or medical aspects of such issues it proposed close working with Armed Forces Compensation and Insurance (AFCI) policy, military and Defence Business Services (DBS) colleagues and the AFCS Communications Working Group on appropriate action e.g. review of the Joint Service Publication (JSP) 765.

Topic 1. Infectious diseases and Zika Virus

1. The QQR review team suggested that the AFCS provisions on infectious diseases were not entirely clear and clarification would be helpful e.g. exogenous infection.
 - 1.1 Article 12 of the 2011 AFCS 2011 Order is headed "Injury and death – other exclusions". Article 12 (1) (f) (iii) and (iv) refer to endogenous and exogenous infections. Case law has established that, unless defined in the Scheme, words and terms should be interpreted as having their ordinary English meaning. The AFCS aims to be a generous occupation-related personal injury scheme, recognising the special circumstances of military service and able to address any disorder or injury, predominantly due to or worsened by service on or after 6 April 2005. For infections, it takes the view that infection acquired from within the person's own body, i.e. endogenous infection, should not attract awards, e.g. urinary infection. On the other hand, exogenous infections acquired due to exposures external to a person's body would be accepted if acquired due to deployed service in a non-temperate zone. If the exposure to the infection, e.g. influenza, was in a temperate zone and there was no outbreak in service accommodation or a work-place, no award would follow. This is because the risk to the person over that applicable to the general public is not judged to have been increased by military service. Diseases which are part of an outbreak, taken to mean an acute increase in the expected number of cases of a disease in a particular location, and occurring in service accommodation or work-place in a temperate zone, would potentially be eligible for award. Article 12 (1) (9d) is also relevant providing that infection in any location due to consensual sexual activity and resulting in injury or death is also excluded.

2. The QQR Team asked IMEG to consider providing a list of “eligible” or even “entitled” infectious/infection disorders. IMEG considered this carefully.
- 2.1 Because UK no-fault military compensation schemes can accommodate almost any injury or disorder due to service within the relevant law, the principle of equity and consistency in awards is key. An aim of the AFCS is to maintain vertical equity so that amongst a category of injury or disorder the most disabling disorders receive the highest awards, and horizontal equity which means that across disorder categories the same award level reflects a similar level of disability. The disabling effects of a disorder, e.g. peptic ulcer, can be very different in different people and in the same person at different times. Awards in a full and final scheme like the AFCS aim to reflect the effects averaged over the person’s lifetime when in a treated steady state. They depend less on precise diagnosis than on the functionally disabling consequences following an adequate course of best-practice treatment, the comparator being the functional capacity of a healthy person of the same age and sex who is not injured or suffering a health condition. (Article 5(6)(b) of the AFCS Order 2011 refers). For that reason, descriptors in Table 3 and 4, i.e. mental and physical disorders, are considered generically and not as a list of specific diagnoses. In addition, where lists of discrete diagnoses are published or incorporated in legislation, there is likely to be a need to regularly amend and extend the list. This is a risk with infections because of the numbers of infectious agents, viruses, bacteria and fungi.

Conclusion:

- 1). Having considered the wide range of infection-related disorders, local and systemic, potentially due to service on or after 6 April 2005, IMEG concluded that Table 4, Physical Disorders, is able to accommodate any service-acquired infection-related disorder, the majority of which will be treatable to cure within a few weeks.
 - 2). IMEG is not dismissive of possible uncertainty amongst claimants and their representatives regarding the infection provision in the Order, and will be happy to work with AFC and I policy colleagues at the next revision of the Joint Services Publication 765 to further clarify the medical aspects of the AFCS approach and ensure accessibility.
 - 3). This will include a review of terms used in legislation, e.g. temperate, non-temperate and outbreak and their meaning, and consideration of whether definitions might usefully be included in Part 1 Article 2 of AFCS Order 2011.
3. The Review team specifically asked for an IMEG view on Zika virus in AFCS.
 - 3.1 Zika virus is a mosquito-borne virus that was discovered in 1947 in Uganda but was in the news from late 2015 because of a large outbreak in Central and South America, the Caribbean, South East Asia and the South Pacific. The infection is usually spread via mosquito bites with an incubation period typically of about a week-12 days. It can occasionally be sexually transmitted although precise details remain uncertain. In adults the infection is usually asymptomatic or very mild and self-limiting, lasting up to a week and rather like rubella. It can cause damage to a developing foetus, particularly in the first trimester. Treatment is symptomatic and supportive. There is no specific vaccine or drug to prevent or treat the disorder. Reports of severe illness and complications of Zika in adults and children are rare but it can be followed by Guillain Barre syndrome, an autoimmune disorder in which the immune system attacks peripheral nerves. Guillain Barre is not unique to Zika but may follow any bacterial or viral infection, surgery or vaccine administration and may cause muscle weakness and loss of, or altered sensation in limbs and face. In more severe cases muscles involved in breathing, swallowing and speaking may be affected. While life-threatening cases require supportive care in intensive treatment units, mortality rate at 3-5% is low. Most cases recover fully but a few continue to experience continuing muscle weakness.

- 3.2** In late 2015 reports were received from the Brazilian Ministry of Health of an unusual increase in babies born with microcephaly and other central nervous system malformations. World Health Organisation (WHO) accept the scientific consensus that Zika exposure of the developing foetus may be causally associated with birth defects.
- 3.3** For UK military deployments HQ Surgeon General (HQ SG) and the chain of command follow national (Public Health England (PHE)) and international guidance on Zika prevention, including mosquito bite avoidance and contraceptive advice to prevent sexual transmission.

Conclusion:

- 1). If a serving member of the UK Armed Forces acquires Zika on balance of probabilities predominantly due to deployed service on or after 6 April 2005, an AFCS award may follow dependent on the severity and duration of disabling effects or complications.
- 2). Given military deployment policy and HQ SG policy on prevention of sexual transmission, the likelihood of a child being born to a service member or partner or spouse, affected in utero with Zika, is very small. The military no-fault compensation schemes including the AFCS do not include provision for personal injury in partners or children of serving personnel. As a scientific and medical NDPB this policy is not a matter for IMEG.

Topic 2. Gender differences in AFCS awards including future musculoskeletal awards

1. The QQR raised the issue of gender representation in AFCS awards. Defence Statistics' advice to the review was that from the start of the AFCS to 31 March 2016, of 35601 awards made, 57% were for male claimants with 50% for females. That has been the pattern since the scheme began. A higher percentage of males were awarded GIPs in some injury categories, notably Table 2 Injury wounds and scarring, Table 4 Physical disorders, and Table 6 Neurological disorders. There was no difference between male and female higher awards with Guaranteed Income Payments (GIPs), for Table 3 Mental health disorders, Table 7 Senses, Table 8 Fractures and Dislocations and Table 9 Musculoskeletal disorders.
2. From 2005 until the present, although the proportion of women in the UK regular forces increased from 5.7% in 1990 to 10.2% in 2017, absolute numbers of female personnel in the UK Armed Forces and their roles, compared with men, remained limited. At 1 May 2017 the total strength of the full-time trained and untrained UK Armed Forces was 156,539. Of these there were 15,270 (10.2%) women. The disparity between male and female AFCS awards where present is not great and reflects, firstly, the different proportions of men and women in the total force. In addition principal service occupations, and so exposures, are also different for the genders. The awards made data quoted above are also based on initial claims outcome, and so may not accurately represent the final position, i.e. post reconsideration, review request or appeal. IMEG therefore consider that it is too soon to form a view of whether there is true disparity between the male and female claims success rate.
3. The QQR recommended that in the context of gender, IMEG should consider awards for musculoskeletal (MSK) injuries, risk type and treatment. It is of note that, while accepting the limitations of first award outcomes, Defence Statistics' data suggest that rates and types of MSK disorder awards have been to date no different from those of male colleagues. Given the introduction of the New Employment Model (NEM) and the prospect of women in ground close-combat roles from late 2018 these findings may change in the next few years.

4. The fourth IMEG report includes Part 1 of an overview of MSK disorders and awards in the AFCS. These are the most common causes of military medical downgrading and discharge, as well as the most common claimed and awarded injuries and disorders in the AFCS from the start of the Scheme in the three Services. The Review of MSK disorders looked at tariff descriptors and award levels, including the disabling impact of such disorders on function relevant to civilian employability. Literature scrutiny and discussion with experts confirmed that despite a vast international literature there remain many gaps in our understanding of the causes of disabling MSK disorders and the relative part played by constitutional and genetic factors, beliefs and expectations, compared with external influences such as physical loading, heavy work and sporting activity.
5. Published studies are almost entirely male-based. From overview of the literature and discussion with experts, we concluded that present epidemiological evidence does not make the case that work in the Armed Forces in general or in any service normally increases the risk of MSK disorders or any specific single injury. For the AFCS, claims must be considered on their individual merits.
6. The QQR also raised treatment of MSK disorders and whether the same treatments were appropriate for similar injuries in male and female personnel. Again, published studies are sparse and in general the same therapeutic interventions are applicable. The QQR confirmed that there were few studies evaluating therapeutic interventions and few disorders where the most effective and cost-effective treatment intervention was necessarily known or selected. We found none which compared treatment effectiveness in males compared with females.

Conclusion:

- 1). IMEG will routinely over the next several years monitor final award outcomes for AFCS claims by women, considering injury categories and award levels and comparing with males to detect trends and possible emerging evidence of increased risk of injury type.
- 2). Following the 2015/6 HQ SG Women in Close Ground Combat review, IMEG will keep in touch with emerging research, UK military personnel policy practice and training, e.g. on recruit selection and training, fitness testing, resilience building, etc., and routinely review both the general and military literature on issues relevant to female musculoskeletal physiology and injury, both short-and long-term.
- 3). As indicated by the findings, brief updates on the topic will be included in future IMEG reports.
- 4). Because of the size and complexity of the topic, IMEG plans to include Part 2 of a review of MSK disorders in the AFCS context in the next IMEG report.

Topic 3. Worsening

1. Awards are made under the AFCS where on the balance of probabilities, service on or after 6 April 2005 is the predominant cause of the claimed condition or, where a claimed disorder or injury is not due to service, but service on or after 6 April 2005 is the predominant cause of worsening of the disorder or injury. The current Armed Forces are a volunteer service of selected young fit people, and both personnel and Surgeon General policy focus on preventing disorder and injury, promoting healthy lifestyles, high standards of people management and good Health and Safety practice. There is pre-enlistment and routine interval medical surveillance and clear policies on medical employability and deployability grading. Personnel are downgraded not just because of the functionally limiting or restricting effects of disorders or injury but also as a protective measure to prevent further harm. In considering worsening of injury or disorder in the AFCS context the aim is to make awards reflecting the part played by service in the disabling functional effects of the injury or disorder by taking account of the primary injury and making a comparison between the limitation and restriction of the claimant and the capacity of a healthy person of the same age and sex who is not injured or suffering a health condition. A paper exploring the legislation and medical issues and making recommendations is included in this fourth IMEG report.

Topic 4. Spanning

1. Spanning cases are identified at or beyond service termination and are where a person has served both before and after 5 April 2005 and the introduction of AFCS. Such members may be eligible to claim compensation under both the War Pensions Scheme (WPS) and AFCS. While the circumstance of spanning will eventually be time-expired – we are already more than 12 years from the last day of eligible Service Pensions Order (SPO) service – the last year has seen an increase in spanning claims. Claims processes need to be developed which are lawful, understandable to claimants and their representatives and administratively practical. As a principle of government accounting, they should also avoid double compensation and as far as possible make a single award under one scheme notifying a single appeal right. Certain categories of claim are particularly affected by spanning. These include hearing loss, musculoskeletal and traumatic physical injury and mental health disorders. A paper discussing the medicine and science of these issues and making recommendations re possible approaches to claims determination forms part of this report.

Topic 5. Interim awards

1. The issue of interim awards was raised with the QQR Team by stakeholders concerned that interim awards could lead to financial uncertainty and particularly, in relation to mental health disorders, might cause additional stress, impeding engagement with treatment. The QQR team asked MOD to consider the introduction of an automatic right to review of an interim award when a person is approaching discharge date if more than six months from date of the interim award notification.
2. Article 52 of the AFCS Order² relates to Interim awards:

Article 52.—(1) An interim award may be made where the Secretary of State is satisfied that a person is entitled to injury benefit but—

- (a) the prognosis for the injury in that particular case is uncertain; and
- (b) it is not possible to determine which descriptor is applicable to it.

² Armed Forces Compensation Scheme Legislation.

- 2) The Secretary of State is to select the descriptor considered to be the most appropriate descriptor at the date of the decision.
 - (3) The Secretary of State must specify the period which the interim award has effect in accordance with paragraphs (4) and (5).
 - (4) The period referred to in paragraph (3) is to be a maximum of 2 years starting from the date the award was first made.
 - (5) Where the period specified is less than 2 years, the Secretary of State may extend and further extend the award but, subject to paragraph (6), a final award must be made within the period of 2 years starting with the date on which an interim award was first made.
 - (6) Where paragraph (7) applies—
 - (a) the interim award may be extended and further extended for a period not exceeding 2 years; and
 - (b) a final award must be made within the period of 4 years starting with the date on which an interim award was first made.
 - (7) This paragraph applies where—
 - (a) the prognosis remains uncertain at the end of the initial 2 year period; and
 - (b) the Secretary of State considers the extension just and equitable having regard to all the circumstances of the case.
 - (8) Where the final decision is to award a descriptor at a tariff level which is—
 - (a) at the same level or higher than the tariff level awarded in the interim award, account is to be taken of the amount of benefit paid in accordance with the interim award and only the difference between the amount of benefit paid in accordance with the interim award and the amount of the final decision is payable;
 - (b) lower than the tariff level of the tariff awarded in the interim award, no further amount of benefit will be paid in accordance with the final decision, and no amount of benefit paid in accordance with the interim award is recoverable.
3. A common criticism of civil litigation is the time taken to claim settlement. Like civil awards, the AFCS aims to make a full and final award as early as possible after the claim is made with subsequent limited opportunity for request for outcome review. In contrast to the WPS, AFCS claims can be made in service, and to date about 90% of AFCS claims have been made in service, often very soon after the injury or disorder comes to light.
 4. The intention of full and final awards is to give early financial certainty and to allow the person to move on with his life. Full and final awards can be made when the person is in optimal medical steady state or prognosis is clear. This will follow appropriate clinical management of adequate duration. Particularly in complex or multiple injury cases, assessment and claim determination can take time and interim awards were introduced as a payment on account for cases where an injury or disorder can be accepted as, on balance of probabilities, caused by service on or after 6 April 2005, but where the ongoing functional limiting or restricting effects and their likely duration are not clear. Most commonly, these circumstances arise where a claim is made soon after an injury occurs or disorder presents but before treatment has either begun or an adequate course of best-practice treatment has been delivered. Such cases are not in steady state. Interim awards are reviewed within two years and

a final award with notification of appeal right is made, if possible. Alternatively, and exceptionally, the interim award can be extended for a total of four years after which a final appealable award must be made. To date 3,390 initial interim condition awards have been made in the scheme, most frequently for mental health (1,345), musculoskeletal disorders (1,002) and fractures and dislocations (661).

Conclusion:

- 1). IMEG has considered the medical aspects of interim awards and finds that the logic and utility is sound. We also note and endorse Article 52 (8) (b), i.e. where the person's injury or disorder improves with treatment and a lower final payment is due, no excess benefit paid is recoverable.
- 2). On an automatic right of appeal, for the reasons set out above, we do not consider there would be any value in providing such a right automatically, if an adequate course of best-practice treatment has not been received.
- 3). IMEG notes that a significant proportion of the claims for which an interim award resulted were made soon after the injury or disorder, so that an adequate course of best-practice treatment could not have been delivered. Given the AFCS time limits, IMEG would be happy to input to any briefing or guidance to the charities and welfare staff who advise claimants on practical aspects of making claims including timing.
- 4). We will continue to monitor rates and type of interim awards.

Topic 6. Permanency

1. Related to interim awards is the concept of "permanency" in the Scheme. In the section of the QQR report headed Categories of Award, and under the topic Mental Health, the QQR review team requested IMEG guidance on the concept of "permanent" in the scheme. In contrast to the WPS, where awards are based on the medically-assessed degree of disablement, and the legislation requires assessment to be made for an interim period unless it can be made final, the AFCS aims to make full and final awards as early as possible after claims are made.
2. As the QQR report describes, Article 5 was introduced into the AFCS Order in May 2011. It is headed "Descriptor – further interpretative provisions", and sets out how a descriptor is to be construed and the meaning of terms such as "functional limitation or restriction" and how that should be assessed. It also at Article 5(7) defines "permanent functional limitation or restriction":

"Functional limitation or restriction is permanent where, following appropriate clinical management of adequate duration,

 - (i) an injury has reached steady or stable state at maximum medical improvement and
 - (ii) no further improvement is expected".
3. The WPS allows requests for review of assessment by the Secretary of State or the pensioner "at any time and on any ground". Such a wide gateway can be administratively demanding, expensive in terms of evidence-gathering and inconvenient to pensioners, and by and large does not reflect modern medical practice and the expected course of disorders. It may also dissuade pensioners from full engagement and commitment to treatment as to keep your pension you need to keep sick.

4. While after the Great War the natural course of almost all injuries and disorders was an inevitable worsening over time, that pattern does not reflect modern clinical management of most disorders and injuries, regardless of the age of the person. Today's clinical aim is to investigate and diagnose the patient's complaint and then as quickly as possible to support him or her to access an adequate course of best-practice treatment, reaching a steady state of maximum medical improvement within 18 months to two years on average. For more medically complex situations that time might be extended to a maximum of three to four years.
5. When this steady state is achieved the intention is that the patient can largely manage his disorder and that, unless through accidental injury or event, no further significant improvement or worsening will occur. For full and final compensation awards, it is in this state that the disorder can most fairly be assessed. This state of maximum medical improvement is synonymous with permanency.
6. Because unexpected worsening, although rare, can occur through trips, slips and falls, a further stressful event or experience etc., the AFCS does have some review provisions allowing, under certain conditions, review and revision of awards. This includes, where certain criteria are met, at service termination (Article 55 of the AFCS Order 2011). Article 56, headed "Review – exceptional circumstances within 10 years", provides for review and revision of an initial award within 10 years of the original decision where the worsening of the injury or development of a further injury is unexpected and exceptional, and finally Article 57 – "Final Review" applies more than 10 years after the initial award, with revision of the award where the Secretary of State considers that it would be "manifestly unjust" to maintain the effect of the reviewed decision, because the injury "... has become worse or caused a further injury to develop and the worsening or the development is substantial, unexpected and exceptional ..."
7. Modern thinking on disability and chronic illness, particularly with a pre-injury young, physically and mentally fit population, is as far as possible to treat and rehabilitate people to re-engage maximally with life and living. Making full and final awards as early as possible and when the person is in a steady state of maximum medical improvement is in line with this. Once the award is finalised there will be no review or adjustment even if the person continues to make progress and further improvement. This contrasts with WPS, where, if the assessed level of disablement reduces, awards may be revised downward.

Conclusion:

- 1). IMEG finds that Article 5 of the AFCS Order 2011, as presently worded, clearly sets out the meaning of "permanent" and that the concept is medically valid in terms of contemporary clinical management and approaches to disability. No legislative amendment is required from the medical perspective.
- 2). As appropriate, IMEG would be happy to contribute to any clarification of the JSP or other guidance.

Topic 7. Categories of awards – mental health, musculoskeletal and brain injury

1. The QQR Team noted that stakeholders continued to raise issues on the adequacy of awards and equity across various category of injuries, including mental health, musculoskeletal and brain injury.

Mental health

A. Parity of esteem

1. One issue discussed with stakeholders in the QQR was the desirability (and present perceived lack) of parity of esteem for mental health problems and physical disorders and injuries.
 - 1.1 The term parity of esteem is most frequently used in the context of provision and access to health care and the desirability of similar investment for mental and physical health. On that ground some stakeholders felt that the highest awards payable for physical injuries and disorders and mental disorders should as a matter of course be the same.
 - 1.2 A fundamental principle of the AFCS is that awards reflect the impact of the attributable injury or disorder on function especially for civilian employability. As set out in Article 5 of the legislation (Article 5 AFCS Order 2011), AFCS descriptors and awards aim to reflect the state of maximum medical capacity reached following the provision and engagement in an adequate course of best practice treatment, considered over the person's lifetime. The comparator is "... the capacity of a healthy person of the same age and sex who is not injured or suffering a health condition". Because the scheme aims to accommodate "any" injury or disorder due to AFCS service, important attributes of awards are consistency and equity, both horizontal and vertical. This means that the range and highest award within any of the 9 Tariff categories cannot automatically include the highest available scheme tariff award but reflects the functional capacity, following adequate best practice treatment and when the injury or disorder is in optimum medical state. In other words, because of the very different nature of the disorder categories, the highest tariff available for each of the nine categories of injury or illness is likely to vary across the categories. For example, the functional restriction of the most seriously disabling fracture or dislocation in Table 8 is level 9, with the most serious neurological disorders like high cervical spinal cord injury, with quadriplegia, requiring ventilation being tariff level 1 in Table 6.

B. Mental health disorders due to AFCS service and civilian employability

1. In the current AFCS Order Table 3, the maximum award for a mental health disorder due to AFCS service is at level 6, a lump sum of £ 140,000 and a GIP based on 75% salary at service termination. Another descriptor was also added at level 8. These were recommended in the first IMEG report following the Lord Boyce Review and applied to claims made from the start of the Scheme. The 2013 IMEG report included detailed discussion of the thinking behind the level 6 recommendation.
 - 1.1 A person's employability can be influenced by multiple factors beyond functional impairment due to injury or disorder, including availability of suitable quality work and personal beliefs and expectations. AFCS awards address the functional effects directly due to service accepted injury and disorders. Employment difficulties can arise directly from mental health disorders, particularly the severe and enduring disorders, such as schizophrenia, which are uncommon in the military and veterans' populations. They are also unlikely to be claimed or, on balance of probabilities, accepted as causally related to AFCS service.

2013 IMEG report

- 1.2** For PTSD and other common mental health problems often accepted as caused by service, literature scrutiny and expert discussion for the 2013 report led IMEG to the conclusion that, an adequate course of best practice treatment to optimum steady state should result in improved function and capacity for some type of civilian employment. Given the lack of longitudinal studies on progress and prognosis of these conditions particularly traumatic psychological injury, evidence from clinicians that functional improvement could still take place for individuals at some time in the future, even long after formal treatment, and the evidence, including for mental health disorders, that work is good for self-esteem, sense of purpose, meaningful social interaction, IMEG recommended a 75% GIP as the maximum award. We were also conscious that the implications of a 100% GIP, suggesting that such a person would be unlikely to undertake any employment for the foreseeable future, given the relative youth of the AFCS claimant group, risked unintentional effects such as negative self-image and loss of hope. In the 2013 report, IMEG also confirmed that the suggested upward revision of the two highest mental health awards maintained vertical and horizontal equity across the rest of the Scheme.
- 1.3** During the 2016 QQR some stakeholders suggested to the review team that in some cases, of disorders due to AFCS service, functional improvement in treated optimum steady state was not consistent with any paid civilian work and so the highest mental health award should include a Band A GIP based on 100% military salary. The QQR Team asked IMEG to comment.

IMEG investigation

- 1.4** We considered first whether there was new evidence supporting that proposal; i.e. there are circumstances where a mental health disorder caused by AFCS service could itself directly cause functional impairment incompatible with any civilian employment over a working lifetime. IMEG explored the literature, particularly from 2012, reviewed redacted exemplar mental health cases awarded the highest tariff, and discussed the issues with military and civilian, clinical and academic experts in traumatic psychological injury.
- 1.5** Clinical colleagues confirmed our impression that although the published peer-reviewed research base on psychological disorders, including military traumatic psychological injury, has increased significantly over the last few years, there remain many gaps.
- 1.6** These include a lack of studies on longitudinal course and prognosis of disorders and, important for AFCS, on functional effects and employability (1). Other topics with insufficient evidence or inconsistent findings are evaluation of treatments (2), whether employment outcomes are affected by treatments, form of delivery such as face-to-face versus internet delivered therapies, and what is an adequate or optimum dose and course duration. Where there are dual diagnoses or co-morbidities an issue may be the order of treatment, e.g. the need for stabilisation ahead of addressing trauma or can both be addressed together? Where does support into work fit in? There is accumulating evidence on the effectiveness of vocational rehabilitation even in severely disabling mental health disorders, especially using the supported employment Individual Placement and Support model (IPS)(3) and we note and welcome the increasing frequency of IPS services across the country.
- 1.7** The present NICE guidelines date from 2005 and we are aware that review and revision is expected shortly.
- 1.8** Although AFCS awards are not based on diagnoses, for awards to be made, the Scheme legislation specifies that mental health diagnoses should be included in either ICD or DSM classifications and made by consultant level psychiatrists and clinical psychologists. We note the recent publication of DSM V and that a new edition of ICD, ICD 11 is expected in 2018. The recent and current literature includes much debate on diagnostic criteria for stress and trauma related disorders. PTSD was first

defined in DSM III in 1980 and since then there have been significant revisions and differences in criteria in successive editions of DSM, and between DSM and ICD. These are marked in the new DSM V and ICD 11 is likely to recognise PTSD, where re-experiencing, sense of threat and avoidance symptoms (i.e. trauma related) are dominant and differentiate it from a sub-group diagnosis, complex Post-Traumatic Stress Disorder (PTSD) which has in addition other symptoms (e.g dissociation, affect dysregulation, negative self-concept and difficulties in relationships). These self regulatory problems are shared with disorders included in previous editions of the classifications, Enduring Personality Change After Catastrophic Experience (EPCACE) (ICD10) and Disorder of Extreme Stress not Otherwise Specified (DESNOS) (DSM). In ICD 11 both PTSD and complex PTSD symptoms are likely to have to be present for several weeks and cause significant functional impairment.

- 1.9** There is much discussion in the literature (4) on the new classifications, and the concepts of PTSD and complex PTSD (cPTSD) as sibling disorders. Like EPCACE and DESNOS, complex PTSD is linked to exposure to “sustained or multiple traumas from which escape is difficult or impossible”. Examples include chronic childhood physical or sexual abuse, domestic violence, torture, being a PoW or refugee. Factor analysis studies of the disorders are emerging (5). These support the view that PTSD and cPTSD are distinct categories with a lower prevalence of cPTSD.
- 1.10** Risk factors for the two forms seem to be different with chronic sustained or repeated stressors more frequently leading to cPTSD but on occasion this diagnosis may be associated with a single very severe exposure, e.g. gang rape, or the violent death of one’s child. Equally sometimes severe repeated traumas may lead to PTSD only. Factors such as resilience (itself related to previous traumas), genetics and social support are likely to modify responses. cPTSD is the more disabling diagnosis.
- 1.11** While not necessarily using the cPTSD terminology, clinical colleagues identified the difficult to treat or treatment resistant cases as most commonly having, from the outset at assessment, more severe symptoms of traumatic psychological injury, often complicated by co-morbidity, typically substance misuse and mood disorder. Although the overall risk of suicide in UK veterans is no greater than the general population, the risk seems greater in young veterans (6). PTSD itself may increase the risk of self-harm (7) and suicidal ideas (8), particularly when associated with other psychiatric disorders such as depressive illness.
- 1.12** The expert clinical view was that such cases were likely to need prolonged best practice treatment, involving stabilisation before trauma work, often lasting several years and requiring referral to tertiary trauma services. It was a small number of cases from this group who, in their experience, even following full engagement and commitment, they considered most likely to have such residual steady state functional limitation as to be unable to work longer term.
- 1.13** In light of these new findings, and while recognising the limits of contemporary evidence and the imminent further publications, we are sympathetic to the notion that in a few cases of mental health disorders accepted as due to AFCS service, functional impairment at treated optimum medical state directly due to the mental health disorder(s) may be incompatible with any civilian employment for the foreseeable future.
- 1.14** The type of case to meet this description will likely include i) multiple diagnoses including ii) comorbidities such as substance misuse and mood disorder, and will be iii) caused by a very severe single trauma or chronic multiple traumas from which escape was difficult or impossible and with iv) traumatic and self regulatory symptoms. These will require v) best practice treatment for the co-morbidities i.e. stabilisation, ahead of vi) treatment for the trauma. They are likely to require vii) tertiary/highly specialist complex care. In addition, viii) time from initial specialist assessment to completion of adequate courses of best practice treatments of all disorders, is likely to be several years. Finally, ix) the treating consultant in charge will be of the opinion, based on reasons, that the person is treatment resistant and level of functional impairment is permanent (as defined in the AFCS) and incompatible with any civilian work for the foreseeable future.

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Conclusions and recommendations:

- 1). We do not agree, for reasons discussed, that the highest level of award available for the most severe and seriously disabling mental and physical disorders across the Tariff Table categories should be the same.
- 2). We remain content that contemporary evidence supported the recommendations and conclusions of the 2011 and 2013 IMEG reports, on Tariff values for mental health disorders, Table 3 and particularly the highest appropriate award.
- 3). In the 2013 report IMEG considered decoupling of lump sum awards and GIP based on individual case facts. We reviewed that (2017) and again conclude for the reasons given in 2013 that equitable decisions to support a model of disability which avoids perverse incentives and enables individuals to move on with their lives is best met by a single rule based system equally applicable to all disorders, physical and mental, and injuries in the Scheme.
- 4). In light of the new evidence and clinical insights from the literature and discussion with senior clinical colleagues working in the field of traumatic psychological injury, as discussed above, we conclude that the Table 3 range of descriptors and tariff values for mental ill health should include an award at level 4 attracting a 100% GIP. This would address the small number of cases where residual steady state functional impairment, following engagement and commitment to adequate courses of best practice treatment, including highly specialist tertiary interventions, remains incompatible with paid employment for the foreseeable future.
- 5). We would encourage studies of the long-term prognosis of veterans with mental health conditions, particularly related to employment outcomes and outcomes following particular treatments.

C. Diagnosis

1. The QQR raised mental health diagnoses in the Scheme and who should make them.
 - 1.1 The 2013 mental health report contains a section headed, Robust Accurate Diagnosis going on to discuss an AFCS mandatory diagnostic classification system and specifically who should make the diagnosis. Following discussion of evidence to be collected to inform diagnosis and a possible mandatory classification system, in 2013 IMEG concluded that to support robust accurate diagnoses in the Scheme, diagnosis should be based on an evidence based clinical opinion from a clinical psychologist or psychiatrist at consultant grade.
 - 1.2 These issues were again considered by IMEG for this report including discussion with clinical colleagues. The focus on mental health and expansion in awareness, stigma reduction and support services both in the military and wider UK community is welcome but has unintended consequences including possible increased demand for expert help but at the same time, shortages of trained specialists. This is common throughout the developed world at this date, cannot be solved overnight and there are many gapped posts. Another challenge to quality compensation decision making based on robust clinical evidence, is that new editions of both ICD and DSM classification systems have been published or are imminent. Pre-publication discussion and debate confirms that the many differences between the two in terms of disorders listed and diagnostic criteria including for the same disorder, have increased with a risk of apparently conflicting opinion and case formulation.

Conclusion:

- 1). In the 2013 report IMEG made other recommendations on mental health claims diagnosis and assessment including consideration of establishing a national panel of experts, routine inclusion in clinician reports of detailed information on clinical management and treatment perhaps using a simple AFCS protocol and use of a limited battery of psychometric tests particularly to judge progress over time. As yet these have not been taken forward. We suggest they are worth re-visiting.
- 2). In the meantime, for robustness we conclude that diagnosis of mental disorders in the scheme should continue to be by clinical psychologists or psychiatrists at consultant level.

D. Permanency and Interim Awards

1. The QQR report raised the issues of permanency and interim awards. IMEG comment on these issues is above at Topics 5 Permanency and 6 Interim awards. These comments apply equally to mental health, physical disorders and injuries, including where mental health disorders have delayed presentation or onset and are covered by the AFCS late onset provision (Article 3 AFCS Order 2011).

E. Multiple mental health diagnoses – one award or several?

1. Finally another issue raised with IMEG is how the Scheme approaches multiple mental health diagnoses due to the same incident or experience. Should one or several awards be made from Table 3?
 - 1.1 The medical diagnostic process and classification of disorders attempts to confer some order on symptoms and problems. This first applied to physical conditions or diseases; i.e. objective pathologies. Here diagnosis is the description and name of a disease based on symptoms, signs and perhaps laboratory or radiology findings. If diagnoses are arranged according to similarities and differences we have a classification system grouping together similar conditions for treatment and prognosis and for research. While classification systems for physical diseases and injuries date back hundreds of years,

those for mental health problems are more limited and more recent. There are today two systems: the WHO International Classification of Diseases and Related Health Problems (ICD), now in tenth edition with eleventh due in 2018, and the American Psychiatric Association Diagnostic and Statistical Manual DSM IV, recently replaced by a fifth edition.

- 1.2** There are other differences between physical diseases and injuries and mental health diagnoses and classifications. At this date, understanding of mental health disorders does not extend usually to knowledge of pathophysiology. In psychiatric disorders certain criteria or symptoms may be obligatory – others may be characteristic; e.g. depression or anxiety are symptoms recorded in many different discrete disorders, such as PTSD, anxiety disorder, adjustment reaction and depressive disorder itself. Similarly, some are discriminating symptoms e.g. delusions or hallucinations which may occur where a person has a psychosis, e.g. in schizophrenia. All this means that while criteria for diagnosis are similar in different classifications of injury and physical disorder, for the mental health classifications, ICD and DSM diagnostic criteria may be different and may change from one edition to the next.
- 1.3** As a result, and as is common in AFCS claims, different diagnoses and case formulations may be made in the same case by different clinicians. This becomes particularly complex because of the lack of consensus description of disorders in the ICD and DSM systems and the facts that some disorders are recognised by one classification system but not by another e.g. enduring personality change due to catastrophic experience or psychiatric illness is included in ICD but not in DSM including DSM V.
- 1.4** AFCS awards are based on the severity and duration of functional limitation or restriction for civilian employability. As different case formulation and diagnoses may be identified in the person by different clinicians and over time, AFCS's approach to mental health disorders is to avoid a list of conditions, but to use a generic approach. Where there are several discrete diagnoses, apportionment of disabling effects on the basis of aetiology is not scientific or possible. As a result all functional compromise caused by mental health disorders included in a single claim and due to AFCS service, is accepted and the descriptor chosen, reflects overall functional compromise and its duration. Where there are several diagnoses the AFCS descriptor and award reflects the most functionally disabling disorder for the longest period.

Conclusion:

- 1.** Table 3 of the AFCS Tariff is generic and a single award is appropriate even where there are several diagnoses resulting from the same incident or exposure.

Overall Mental Health Recommendations:

- 1). Present evidence including on disorders potentially attributable to AFCS service, and the need to maintain horizontal and vertical equity in the Scheme means the highest AFCS award for accepted mental health disorders should be revised to be level 4 with 100% GIP.
- 2). We will continue to monitor mental health claims trends.
- 3). We recommend at this time a continued requirement for mental health diagnoses to be made by consultant clinical psychologists or psychiatrists.
- 4). We will further consider the suggestions of the 2013 IMEG report to support quality decision making including the introduction of treatment protocols as part of clinical reports, a national expert panel and the use of psychometric measures to monitor progress.

- 5). We will continue to monitor the literature on mental health disorders and traumatic psychological injury including best practice guidelines and studies evaluating effectiveness of interventions.
- 6). We consider the “permanency” and “interim” concepts to be medically valid in the AFCS context.

Other issues raised in the QQR

Table 9 - Back injury and pain syndromes

1. The QQR requested IMEG to review the clarity of descriptors and award levels for back injury and pain syndromes in Table 9. These issues are discussed in the Part 1 Musculoskeletal Disorders (MSK) paper included in this report. Owing to the wide scope and complexity of MSK, further investigation and a Part 2 report is planned for IMEG’s next report. This will include in depth review of pain and pain syndromes.

Conclusion:

- 1). At present as discussed in Part 1 of our review of MSK we believe the present approach of the scheme to descriptors and awards for back disorders (Table 9 AFCS Order 2011) is fair to claimants and medically valid.
- 2). We will continue investigation of back disorders and pain and provide further comment in Part 2 MSK in the next IMEG report.

Non Freezing Cold Injury (NFCI)

1. The QQR report highlighted the challenge that NFCI presents to AFCS and the many gaps in current understanding. Some stakeholders were of the view that the current descriptors and Tariff levels, whose basis is discussed in the NFCI section of the 2015 IMEG report, did not adequately reflect seasonal variation in symptoms. However, having considered the 2015 IMEG report and aware that the 2015 IMEG recommendations on descriptors were necessarily limited by available evidence, the QQR Team do not agree with this perspective.

Conclusion:

- 1). IMEG agrees that the current NFCI descriptors and awards reflect the limits of contemporary evidence and appropriately consider seasonal and any other seasonal variation in disabling effects.
- 2). We are unaware of longitudinal research being undertaken or planned anywhere in the world and will continue to monitor the literature.
- 3). Since AFCS was introduced almost 2000 awards have been made. It is of note that in 2016/17, award numbers declined.

NFCI AFCS awards based on the outcome of the latest claim

	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Lump sum and GIP	0	1	0	1	0	4	5	4	6	2	2	0
Lump sum	0	3	19	45	65	161	350	281	297	330	216	118

Table 6 - Brain Injury descriptors

- The QQR Team raised the issue of possible confusion between two brain injury descriptors in Table 6. These are, on current Tariff, item 17 at Tariff 4 and item 22 at Tariff 8.

Item 17 level 4

Brain injury where the claimant has moderate physical or sensory problems; one or more of cognitive, personality or behavioural problems and requires regular help from others with activities of everyday living, but not professional nursing care or regular help from other health professionals.

Item 22 level 8

Brain injury from which the claimant has made a substantial recovery and is able to undertake some form of employment and social life, has no major physical or sensory deficits, but one or more of residual cognitive deficit, behavioural change or change in personality. (a)

- The claimant is unable to undertake work appropriate to experience, qualifications and skills at the time of onset of the illness, but able to work regularly in a less demanding job.

- This issue is fully discussed in the Compensation Aspects of the Traumatic Brain Injury update which forms part of this report.

As discussed in the TBI paper, we do not share the QQR view that there is confusion/possible overlap between the two descriptors but have attempted some clarification of the descriptors to put beyond doubt the relative severity of the two injuries.

Recommended revised descriptors - Table 6

Item 17 level 4

Brain injury where the claimant has moderate permanent motor or sensory problems and one or more of permanent substantial cognitive, personality or behavioural problems and requires regular help or full-time supervision from others with activities of everyday living, but not professional nursing care or regular help from other health professionals.

Item 22 level 8

Brain injury from which the claimant has made a substantial recovery and is able to undertake some form of regular employment has no major motor or sensory deficits, but one or more of residual functionally disabling cognitive deficit, behavioural change or change in personality. (a)

- The claimant is unable to undertake work appropriate to experience, qualifications and skills prior to the brain injury, but able to work regularly in a less demanding job.

- We have also reflected that Item 21A and 22 have similarities. In both, those affected have made substantial recovery, but are unable to undertake regular paid work at their previous level. Both can do some regular paid work; the one limited by substantial physical motor deficits and the other cognitive behavioural or personality problems. We propose revised descriptors as below and that both categories should attract a level 7 award.

Item 21A level 7

Brain injury from which the claimant has made a substantial recovery and is able to undertake some form of regular employment, has no major cognitive personality or behavioural problems, but with substantial functionally disabling motor deficit in upper or lower limbs or both (a)

Item 22 level 7

Brain injury from which the claimant has made a substantial recovery and is able to undertake some form of regular employment, has no major motor or sensory deficits, but one or more of residual functionally disabling cognitive deficit, behavioural change or change in personality. (a)

- (a) The claimant is unable to undertake work appropriate to experience, qualifications and skills prior to the brain injury, but able to work regularly in a less demanding job.

Conclusion:

- 1). We recommend the revisions to Table 6 descriptors and awards set out above.

Topic 8. High Dependency or Exceptional Supplementary Award (ESA) - medical aspects

1. The QQR Team recommended the introduction of an ESA for those AFCS recipients most seriously injured or made ill and dependent on 24 hour care to maintain life. They went on to ask IMEG to consider medical aspects of the concept and invited comment on possible criteria for award entitlement, including when the decision might be best made and by whom.
2. Since the QQR report there have been a number of relevant developments which suggest a need to consider carefully the proposed concept. A public consultation on an enhanced compensation scheme for combat injury has been held. The proposal is that, once entitlement is established, awards will be assessed as for civil damages, with the various heads of pecuniary and non-pecuniary damages, based on individual case specific facts and circumstances, including health and social care costs, housing adaptations, loss of earnings as well as general damages, covering pain and suffering and loss of amenity (PSLA). As the majority of the most serious injuries in AFCS to date and for the future, relate to combat, any enhanced scheme would be likely to impact an AFCS ESA.
3. The recent conflicts marked significant advances in acute critical care and casevacating so that previously fatal combat injuries are now survivable although often the person is left in a severely disabled state. At the same time for the wider population, community based NHS led patient centred holistic care packages involving multidisciplinary working across NHS, Local Authorities, social services, and charities have been developed and become increasingly common. NHS Continuing Health Care (CHC) is a package of ongoing care arranged and funded by the NHS where the person has a primary health need. In MOD, work has also continued on the longer term in-service best practice management and rehabilitation of those with severe injuries including on the transition of injured and sick veterans to further medical care and social support in the civilian community. An important aspect of that is the development of a veteran specific NHS funded Integrated Care package (IPC4V) for this group.
4. Within the AFCS the highest (level 1) award for pain and suffering covers a range of injuries and disorders with different disabling effects. The QQR report states the suggested ESA is paid to those exceptionally disabled, for loss of dignity, embarrassment, fear of the future, loss of ability to pursue a normal life, congenial employment and hobbies and pleasures i.e. essentially loss of amenity. It is not for care or home adaptations. The QQR report suggests that payment should be made where

an individual is dependent on others to remain alive - essentially in receipt of a level 1 award or equivalent value award and 24 hour support or care. The suggested level of payment is standard and has a degree of randomness. For entitled recipients, it is set at half the suggested revalorised Tariff 1 award and paid as a one off lump sum. The intention is that it will cover circumstances both at the time of award and for the future.

Medical points on the proposal

5. The Lord Boyce Review discussed in detail possible Scheme funding of private health care for AFCS recipients. A number of factors emerged. Many of the most serious injuries seen in the Scheme at that time were combat related and previously unsurvivable so that their long term health care and other support requirements were (and remain) unknown. Absolute numbers are much smaller than after earlier conflicts so maintaining visibility of this population in the general community over time is an issue. Another factor is the generally increasing long term survival for many serious injuries and disorders. Secure solutions, clinically suitable for the individual were considered imperative by Lord Boyce, despite the very high cost of likely interventions. The 2010 Lord Boyce Review concluded that best practice sustainable treatment reflecting technical advances would be most effectively funded and delivered by the NHS. As with AFCS, funded by MOD, this would form part of the nation's commitment to those who serve and are injured on our behalf and would reflect Sir William Beveridge's proposal in 1942 that treatment and care for injured ex-service personnel should be, as for the rest of the community, the responsibility of the NHS and social services.
6. We appreciate that the idea of the ESA is for pursuit of hobbies or pleasure but advise that for a person with such severe disability, likely to require the support of multiple carers and modified transport etc even £325,000 will be quite limited in funding visits over a lifetime. In addition, a sub group of potentially entitled injured personnel and veterans are those with severe TBI where conscious level and response to the environment means that their appreciation of loss and ability to pursue a normal life or to enjoy hobbies or the pleasures of life cannot be in any way restored to them.
7. Since 2012, IMEG members have much valued opportunity to meet severely injured service personnel and discuss their perspective on a range of issues. On every occasion we have been hugely impressed by their determination, resilience, one body ethos and the part played by mutual support amongst peers in getting back to as full a life as possible. We note that, at service termination, over 95% of injured personnel are independent in activities of daily living (ADL). We have some concerns that measures such as the proposed ESA might be the subject of misunderstanding. This might include being viewed as an inequity or disadvantage to those who have worked very hard for recovery. It might even be a disincentive to full engagement and commitment to treatment.
8. The supplement, may be interpreted as simply a top up award, raising level 1 awards or aggregated capped awards at level 1 value. As the Scheme focuses on impairment for civilian employability, GIP is paid at 100% salary replacement for any of award levels 1-4. Given the suggested value of the ESA, there could be representations re uprating awards at levels 2, 3 and 4 or for abolition of a ceiling for multiple awards at the level 1 tariff level.
9. The QQR Team emphasised the rarity of award of the ESA. From a medical viewpoint we are less sure of that. Advances in casualty recovery from theatre and treatments for severe combat injury are ongoing internationally and many of the interventions will be equally appropriate for severe non battle injury, much of which could be service attributable. Serious neurological injury, the category likely to lead to the most severe levels of disability, occurs commonly in young people including in the Armed Forces and frequently as the result of off duty road traffic accident or other non service related events, some of which will not result in compensation, civil damages or insurance payment.

10. At a time when parity of esteem between physical and mental disorders is an important aim of government and raised by stakeholders in the QQR, consideration needs to be given to, if or how, an ESA might impact that concept. Both the NHS Continuing Health Care and Integrated Care Personal Budgets apply to people with mental health needs.
11. Finally the Review team asked IMEG for some comment on practical aspects of decision-making on ESA. This included advice on a) when should the decision on ESA be made? and b) by whom and on what basis?
12. We found these issues equally challenging. The longitudinal progress of many traumatic physical injuries and disorders is simply unknown. IMEG explored the available evidence on amputation/multiple amputation in the 2015 IMEG report, confirming that while there have been few longitudinal studies of amputees, the literature to date, suggests it would be unwise to consider the position at service termination as necessarily sustained over the rest of the person's lifetime. This lack of good information on prognosis of many conditions raises the dilemma of when a decision re entitlement to ESA should most robustly be made. Would it be fair to make it around service termination, if say five or ten years later the person is running into serious functional difficulties? We need also to take account of future life expectancy and the prospect of more people living longer, even a normal life span, but in an increasingly disabled state eg not necessarily level 1 but eg spinal cord injury or brain injury awarded quite correctly at level 2 at outset but over time disability gradually increases. Should ESA be available to this group, with unquestionably severe disability from a young age, at no matter what time interval after service termination?
13. In terms of who might make a decision on ESA, and on what basis, one option would be to have a defined protocol completed by a multidisciplinary group of treating staff. Judgement would then be an issue and rejected claims would go to appeal. This might be unattractive as in every case very ill or disabled claimants will be involved. An alternative might be to frame the decision mechanistically and on verifiable facts. These might include i) being in receipt of a level 1 award or equivalent ii) receiving 24 hour care and support or supervision with iii) decision to be made at service termination or within normal AFCS time limits i.e. seven years. This way award of ESA might appear automatic but appeals and dissent would still be possible against the gateways i.e. award level or receipt of NHS Continuing Health Care or Integrated Personal Care or the need for 24 hour care.

Conclusion:

- 1). IMEG recognises that the intention behind the ESA is laudable but urges careful thought. A decision to have such a provision and any subsequent criteria for its award should be uncontroversial and robust.
- 2). We acknowledge that there is no direct relation between a sum of money and the adverse effects of disease or injury on an individual. Individuals and families react very differently to disease and injury with a wide spectrum of beliefs and expectations, and opinions as to what constitutes satisfactory care and support. Because care is given does not imply it is always medically necessary.
- 3). While by no means yet perfect we note, since the introduction of the AFCS, the enhanced publicly funded cross government holistic healthcare and other support provisions increasingly available to all who require them in the community, including injured veterans. We consider the widespread popular support for the Armed Forces, nationwide development of the Armed Forces Covenant and collaborative working, including with the charities, under successive governments as providing the basis of valid tools, lay and professional, to audit standards and adequacy of provision of publicly funded continuing health care and support, both in general and locally to individual veterans.
- 4). We suggest that any additional funding for the Scheme might be well invested in developing and implementing sustainable processes for audit and evaluation of care and other services provided under the Armed Forces Covenant.

Topic 2 - Policy Statement on Claims for Ionising Radiation Related Conditions

Key points

1. IMEG concludes that the evidence does not support the view that, as a matter of course, those present at UK atmospheric nuclear test detonations, or the Australian Weapons Experimental Programme, and clean-up operations were exposed to harmful levels of ionising radiation as a result of service in these locations.
2. **The National Radiological Protection Board (NRPB) reports.** Based on the first NRPB report, the Secretary of State's normal policy became to award war pension for claims for leukaemia (other than chronic lymphatic leukaemia) and multiple myeloma in those present at test sites. The policy also included awards for primary polycythaemia rubra vera, the red blood cell equivalent of leukaemia. In light of the 1993 report, the Secretary of State's normal policy was revised. Since then, on the basis of presence at atmospheric nuclear test sites, new claims for multiple myeloma were rejected but awards continued to be made for leukaemia (other than chronic lymphatic leukaemia) and primary polycythaemia rubra vera (PRV) having clinical onset within 25 years of first presence at the test sites. That position remained after the 2003 third report.

At this review we found that the approach to polycythaemia rubra vera claims was not medically sound and recommend that policy should change.

The NRPB reports otherwise provided no evidence that presence at the test sites had a detectable effect on expectation of life or risk of developing any other malignancy. We confirm that position.

3. **Radiogenic disorders.** At this date IMEG concludes that reliable evidence raises a reasonable doubt of a causal link between ionising radiation exposure and leukaemia (other than chronic lymphatic leukaemia), female breast, lung, oesophagus, stomach, colon and rectum, primary cancer of the liver, gall bladder, thyroid, urinary bladder, renal pelvis and ureter, central nervous system, salivary gland, and bone. On present overall evidence including military and other studies we find that Chronic lymphatic leukaemia (CLL), Polycythaemia rubra vera (PRV), Hodgkin's disease, (HD), Non-Hodgkin's lymphoma (NHL), and Multiple myeloma (MM) are not radiogenic. Risk of circulatory disorders (including stroke, atherosclerotic coronary artery disease and heart failure) is raised at high doses of ionising radiation exposure i.e. 5 Gy acute exposure. (1 Gy equivalent to 1000 mSv). Lens opacification can also be caused by ionising radiation. Cataracts can be induced by 2 Gy of acute radiation and 5 Gy chronic exposure. For visual disablement present evidence is that higher doses, estimated to be about 10 Gy exposure, are required. War Pension entitlement will be considered dependent on the case-specific facts.
4. Five categories of presumed "at risk veterans" for ionising radiation exposure have long been identified. Recently it was shown that at some of the Minor Trials, notably Vixen A and B, there was some risk of dispersal of radiation into the environment because of explosions on the ground or on low towers. As a result we recommend that those present at the Minor Trials at Vixen A and B and the clean-up operations are added to the list as the sixth "at risk" group.

Overview

1. This statement sets out the Department's policy on deciding claims for war pensions where service-related ionising radiation exposure is alleged to have caused disablement or death. It also provides the reasoning and evidence on which the policy is based. Situations where claims covered by the policy would be expected to arise include: participation in the UK atmospheric nuclear tests in the Pacific and Experimental Weapons Programme in South Australia, or the subsequent clean-up operations, prisoners of war held near Nagasaki or Hiroshima during the Second World War, accidents on board nuclear submarines, employment as an industrial or medical radiographer.
2. War pension may be claimed for any disablement by anyone who has served in the British Armed Forces before 6 April 2005. Claims may be made at any time from service release. Decisions are medically certified and evidence-based and each case determined on its individual merits. Taking into account the burden and standard of proof applicable to the claim, entitlement may be certified where the service and medical facts and the contemporary medical understanding of the condition claimed show a causal link between service and the claimed condition. For ionising radiation cases, entitlement will be considered where there is reliable evidence of service exposure to ionising radiation and there is a recognised causal link between the claimed condition and such exposure.
3. **Service-related ionising radiation exposure** will be accepted where, as a result of service, there is exposure to a measurable level of ionising radiation as determined by a radiological dosimetry specialist report and derived from direct measurement or estimate.
4. The statement considers general aspects of ionising radiation and the evidence on its adverse health effects including cancer, haematological malignancies, circulatory disorders and cataract. There is a section on military studies from the US, Australia and New Zealand, and because most war pension claims for disorders attributable to ionising radiation relate to the UK atmospheric military tests and Australian Weapons Experiment Programme (Minor Trials), there is detailed discussion of the three NRPB reports. This independent epidemiological study, begun in the mid-1980s, compared rates of mortality and incidence of cancers in a cohort of test participants and a carefully-matched service control group serving around the same time. The mortality rates in test participants were also compared with those of men of the same age born in the same period from the general UK population.
5. It is not accepted as a matter of course that those present at UK atmospheric nuclear test detonations, or the Australian Weapons Experimental Programme, and clean-up operations, were exposed to harmful levels of ionising radiation as a result of service in these locations in the Armed Forces.
6. The present review has led to:
 - a) an investigation of the contemporary evidence on the link between ionising radiation and cancer. This has led to a list of malignancies recognised as radiogenic by the MOD.
 - b) an investigation of the link between radiation exposure and haematological disorders, circulatory disorders and cataract.
 - c) a review of the radiological protection and dosimetry arrangements at the Nuclear Test and Experimental Weapons Programme and identification of circumstances where participating personnel are accepted as being at particular risk of significant radiation exposure.
 - d) a statement of the Departmental policy on war pensions claims for solid cancers, haematological malignancies, circulatory disorders and cataract due to alleged service-related ionising radiation.
 - e) A number of background annexes:

- Annex A on radiation dose, internal radiation, radiological protection, tissue and probabilistic effects of ionising radiation exposure and the concept and calculation of probability of causation.
- Annex B on UK atmospheric nuclear tests.
- Annex C on ionising radiation and circulatory disorders and cataract.
- Glossary.

The Law – How the scheme works

7. For claims made not later than seven years after leaving the Armed Forces, Article 40 of the Service Pensions Order (2006) provides that the onus is on the Secretary of State to show beyond a reasonable doubt that the claimed disablement is not attributable to, or aggravated by, service, or that death was not due to, or hastened by, any such condition. If he cannot show this, entitlement to war disablement pension or war widow/er's pension, as appropriate, may be made.
8. For claims made more than seven years after the end of service, Article 41 of the Service Pensions Order (2006) puts the onus on the claimant to raise, by way of reliable evidence, a reasonable doubt that the claimed condition is attributable to, or aggravated by, a service injury or that death was due to, or substantially hastened by, an attributable injury or the aggravation by service of an injury. If he does so, entitlement to war pension will be certified.
9. About 21,000 UK servicemen participated in the UK nuclear tests and Minor Trials and the largest number of claims relate to presence at these operations. Because the adverse health effects of ionising radiation can take a long time to become apparent, most claims are made more than seven years after service termination, and Article 41 of the Service Pensions Order (2006) applies. This means that the onus is on the claimant to raise a reasonable doubt by reliable evidence that the claimed disablement is attributable to service.

Case Law

10. The High Court has held that the word "reliable", in the context of Article 5 (Article 41 in the 2006 Order), cannot have been intended to mean "convincing", but means "more than fanciful". A High Court Judge held that, with particular reference to "changes of medical opinion" that "there are... in my judgement, three stages: no reasonable doubt, reasonable doubt, and consensus." A war pensions claim under Article 5 would pass the test at the point where the (reliable) evidence raised a reasonable doubt, but: "a mere hypothesis based on a limited study.... would not have created a 'reasonable doubt' within the terms of Article 5(4) (Article 41(5) in the 2006 Order)." The real question, however, the judgement held, "is whether the evidence raises a reasonable doubt in the mind of the Secretary of State (SofS). If he finds the evidence unreliable, it obviously will not raise a reasonable doubt in his mind." (case of Edwards 1992 HCJ no. CO/2281/90).
11. In October 2014, the President of the Upper Tribunal Administrative Chamber clarified the "reasonable doubt" test under Article 41(5). It is for the claimant to establish by reliable evidence, "the possibilities that he asserts found the existence of that doubt". The decision-maker must then identify the claimant's evidence and arguments, go on to do the same for the respondent and consider any additional matters which need to be addressed. He must then carry forward these possibilities and matters upon which he has no reasonable doubt, i.e. effective certainties, and assess them in the round to determine whether or not, combined, they have met the Article 41(5) test. If the combination is too far-fetched the test will not be met.

12. The Courts have also held that a conflict of medical opinion does not, of itself, mean that a reasonable doubt has been established, and that a claim must therefore succeed. This applies irrespective of the eminence or authority of those expressing the opinions. In the case of *Tigg v The Minister of Pensions*, the presiding Judge stated: "Merely because a doctor of eminence, and I have no doubt the doctor in this case was of very great eminence, is expressing a view contrary to the view expressed by the medical witnesses called on behalf of the Ministry, does not mean there is a doubt and the Appellant must therefore be entitled to a pension. It is a question of fact for the Tribunal." (cases of *Tigg* ROSWPA vol.5 p.141 and *Howard* ROSWPA vol.5 p.515).

Evidence-based policy and individual decisions

13. Successive governments have held that in matters of public compensation regard must be paid to contemporary medical and scientific understanding of causation and progress of disorders. In assessing any new approach in science, the evidence must always be considered and weighed relative to the existing body of evidence on a subject, with account taken of the robustness and authority of new studies. Attention must be paid to the design and methods, sample size, case and control selection, statistical validity, repeatability of findings, approach to bias and possible confounding factors. Other important factors include whether the findings have been replicated by other independent researchers and the overall plausibility/consistency relative to contemporary understanding.

Concepts in Ionising Radiation – Background

14. Exposure to ionising radiation in all its forms is part of being alive. "Ionising radiation" is radiation of sufficient energy to displace electrons from atoms and includes cosmic rays, gamma rays, X-rays, alpha and beta particle emissions. Levels of "natural" background radiation vary throughout the world depending mainly on the geology of the underlying earth. In the UK there is a range of values with average natural background radiation of about 2.2 mSv, half due to radon with contributions from cosmic rays, gamma radiation and internal radiation. For the UK, the addition of man-made radiation, predominantly through medical investigation, adds another 0.5 mSv average exposure per annum. Fallout from nuclear weapons testing, use and accidents accounts for 0.3% annual individual radiation dose. By the age of 70 the average UK citizen will have absorbed about 150 mSv of radiation from the natural background (1).
15. Human organs and tissues vary in their sensitivity to ionising radiation and the different types of ionising radiation have different capacities to cause cellular damage and adverse health effects. Other factors include age at exposure, with children and young people having a higher risk of cancer than those exposed at older ages. Direct evidence of damage and adverse health effects, including cancer at doses less than 100 mSv annually, is lacking and it is not known if effects are different when delivered in a single dose or over time. The International Commission on Radiological Protection (ICRP) in its most recent publication maintains that for radiological protection a Linear No Threshold (LNT) model is appropriate to estimate risk at acute or chronic annual dose below 100 mSv. The LNT model assumes no safe level of radiation, risk is proportional to dose and risk for multiple small exposures is equivalent to or less than that for a single acute exposure of the same energy (2). The ICRP confirms uncertainties in the processes involved in radiation tumorigenesis, particularly at low dose and relies mainly on the Japanese atomic bomb survivor high dose studies in calculating risk at low dose. Risk estimates inevitably represent a range. When expressed as a single value, the risk estimate is the most likely value derived from the distribution curve. The 2005 BEIR report predicts that if 100 Americans were exposed to 100 mSv either acutely or over time, one person would develop cancer due to radiation and 42 others would develop a cancer due to other factors (3).

16. The 'atomic' bombs dropped on Hiroshima and Nagasaki in 1945 produced a large and rapid energy release through a chain reaction ('fission') of the heavy nuclei of uranium 235 (Hiroshima) and plutonium 239 (Nagasaki). More powerful 'thermonuclear' devices, detonated in the UK atmospheric nuclear tests in the 1950's, were two-stage weapons. These relied on the fusion of isotopes of hydrogen, occurring at the very high temperatures created within an initial "atomic" nuclear fission reaction.
17. There are three sources of radiation exposure associated with atmospheric nuclear tests and weapons trials.
- the initial burst at the time of detonation – "prompt radiation"
 - the activation products which result when neutrons from the nuclear reaction are mixed with soil in the area around the detonation
 - fallout i.e. radioactive material, including fission and activation products and unused fuel, falling to earth from the fireball
18. External exposure is produced by all three sources while internal exposure derives from inhalation, and to a lesser extent ingestion from hands to mouth. Absorption of radioactive material through broken skin can also arise and result in internal exposure.
19. External radiation is relatively easy to detect, monitor and quantitatively assess and most epidemiological studies on adverse health effects focus on it and report the effects of low Linear Energy Transfer external radiation (LET). All radioactive types and particles can be sources of internal radiation, but for the UK nuclear test and Minor Trials, alpha radiation from unspent uranium and plutonium is particularly important. Alpha particles are heavy and slow-moving, losing energy quickly with a short range (known as high Linear Energy Transfer (LET) radiation) and in contrast to external radiation, are unable to penetrate the outer layers of skin. At Annex A is a note on **radiation dose, internal radiation and alpha radiation, radiological protection and the tissue and probabilistic effects of ionising radiation and the concept and calculation of probability of causation.**

The adverse health effects of ionising radiation

20. Evidence that ionising radiation can cause human cancer and, more recently, other disorders has come from several sources. These include, most importantly, the Japanese atomic bomb survivor studies (4) and other high-dose external radiation studies on patients therapeutically irradiated for malignant conditions, such as cancer of the cervix (5) and non-malignancies like ankylosing spondylitis (6). More recently large cohort studies, notably of radiation workers with protracted low-dose external radiation exposures have been published, including pooled studies with data from several countries combined (7) (8) (9). Other evidence comes from internal exposure studies including low LET exposures to radioactive iodine (10) and high LET studies involving radon (11) and radium (12), and from follow-up of radiation workers with high levels of internal exposure to plutonium at the Mayak PA facility in the Russian Federation (13) and from studies of emergency and clean-up workers following the Chernobyl accident (14).
21. Since 2003 there have also been major reviews of the evidence of the adverse health risks of ionising radiation exposure in the UNSCEAR (2006) (15a) (15b), BEIR (2006) and ICRP (2007) reports, as well as a series of reports by the Advisory Group on Ionising Radiation of the NRPB, subsequently Health Protection Agency (HPA) and now Public Health England (PHE), reviewing the published peer-reviewed evidence on leukaemias and related haematological malignancies (16), solid cancers (17) and circulatory disease (18). UK radiation protection legislation is based on the ICRP recommendations, and in 2009 the HPA published a response to the 2007 ICRP recommendations (19). This acknowledged the potential impact of emerging concepts like genomic instability, bystander signalling and adaptive response, but concluded that understanding of these and their effect on cancer induction and development was not yet well enough advanced to alter existing cancer risk data. Rather, the risk estimates should continue to be based on human epidemiological studies using the LNT model.

- 22.** From 2001-2004 a committee including independent scientific experts, members of NRPB and the nuclear industry as well as anti-nuclear activists was set up to examine the radiation risk of internal emitters (CERRIE) and to consider risk models for health effects. Interpretation of the epidemiological studies on internal emitters is difficult because information is limited, with few studies having individual dose estimates, and findings are inconsistent. However, based on studies of lung cancer in radon-exposed miners, bone cancer in radium-exposed workers, and liver cancer in patients injected with thorostrast, the majority of the committee concluded that risk estimates were consistent with external dosimetry studies and that there was no evidence that risks from internal emitters were significantly underestimated. CERRIE considered that more work was required on internal emitters, but that dose and dose risk estimates from internal and external sources should be combined “using ICRP 2007 methodology for equivalent and effective dose and risk estimates” (Annex A). In response to the report ICRP 103 agreed. The NRPB (now PHE) also endorsed this position, provided risk estimates include an appreciation and explicit statement of the uncertainties involved (20) (21).
- 23.** The Japanese atomic bomb survivor studies are an especially valuable source of information on adverse health effects of ionising radiation. Open studies began in 1947 with the establishment of the Atomic Bomb Casualty Commission (ABCC), and the cohort has now been followed for 65 years. The group received almost exclusively whole-body external radiation. Of the 120,000 original subjects, 54,000 were within 2.5 km of the epicentre of the detonations and 45,000 were located 2.5-10 km away where levels of ionising radiation were low. 26,000 controls were residents of Hiroshima or Nagasaki between 1951 and 1953 but had not been present at the detonations. Individual dose estimates are available for 92% of the population. The study population is of varied ages and exposures, and was not selected by diagnosis or occupation. 40% are still alive, including 80% of those exposed when aged less than 20 years. A sub-population, oversampled for those with high dose exposure, forms the Adult Health Study. This was established in 1958 with biennial health examinations and an on-going high participation rate. The 2004 ICRP publication 99 on low-dose extrapolation of radiation-related cancer risk includes a table of distribution of “estimated radiation dose among the atomic bomb survivor cohort.” Of the over 79,000 total, almost 24,000 were more than 3 km from the epicentres and were estimated to have received no radiation exposure; 10,000 had less than 5 mGy; 30,000, 5-100 mGy and fewer than 500, more than 2 Gy. The mean dose was 200 mGy. These features allow reliable estimates of excess relative risk for cancers and other health effects (22).
- 24.** The main focus of study in the atomic bomb survivors is mortality and cancer incidence, although more recent papers cover non-cancer outcomes, e.g. lens opacities, thyroid and circulatory disease. A detailed overview to 2011 shows that of 17,448 new solid cancers in more than 100,000 subjects (1958-98), 853 are estimated to be due to radiation. About 75% of the cohort were exposed to doses between 5 and 200 mGy. The proportion of total solid cancers, or attributable fraction, in those exposed to more than 5mGy is 11%. This increases with increasing dose and where the dose is above 2 Gy, the attributable fraction is 61% (23). The Japanese koseki system of family registration allows accurate follow-up of mortality data and, as early as 1959, cancer registries were established in Nagasaki and Hiroshima. Results of epidemiological studies and their wider applicability is affected by the underlying general community risk of disorders, e.g. compared with North American or European populations, Japanese populations have since 1950 had low risk of haematological malignancy, breast cancer and circulatory diseases over the period, but generally higher rates of stomach cancer. There are also generational effects. With better nutrition, public health measures and technical advances, incidence and mortality of many cancers has declined although at the same time lifestyle changes, e.g. obesity and alcohol consumption, have reversed the pattern. PHE data show that age-standardised five-year survival in England and Wales over the period 1971-75 to 2004-2008 in males for stomach cancer has gone from 4% to 16.5%, colon cancer 22% to 52.4%, prostate cancer 31% to 80.6% and all leukaemias 12% to 41.7%.

Dosimetry and Probability of Causation (PoC)

- 25.** The Japanese atomic bombs were kiloton devices. For both bombs initial extreme heat and pressure blast was accompanied by gamma radiation and a more limited burst of neutrons. The heat blast set the mainly wooden buildings in the cities on fire and most people within 1.5 km of the epicentre were killed. Although radiation doses were not directly measured, various methods were used to estimate retrospective doses. These included information about location, distance from the epicentre and shielding, both from the person's body and from buildings. Beyond 1.5 km the numbers of survivors much increased, giving a skewed population with many more exposed to low than high dose. The free in-air dose of radiation suitably weighted for the neutron component at 1 km from the epicentre was 7 Gy at Hiroshima and 10 Gy at Nagasaki, while at 2.5km the values were 13 mGy at Hiroshima and 23 mGy at Nagasaki (24).
- 26.** Cancer due to ionising radiation is indistinguishable clinically from cancer due to other causes. Although it is not possible to say with absolute certainty whether a cancer in an individual is due to ionising radiation, in some circumstances, epidemiological data, information about the person and the population to which they belong, as well as radiation dose and exposure circumstances, and recognised risk models can be used to estimate the probability that the cancer was caused by radiation. The Probability of Causation (PoC) is expressed as a percentage and is the risk the disease is due to radiation exposure divided by the overall disease risk in the parent population, i.e. the radiation risk/the base line risk and radiation risk multiplied by 100. For further discussion see Annex A.

The Results of the Japanese atomic bomb studies

- 27.** For cancers:
- dose responses are significant for cancer of the salivary gland, oesophagus, stomach, colon, primary liver, lung, female breast, urinary bladder, gall bladder, central nervous system and thyroid.
 - Rectal cancer, prostate cancer and kidney parenchyma cancer have not been associated with radiation in the Japanese studies.
 - The evidence on pancreas, testis and kidney, pelvis and ureter is unclear.
- 28.** Similarly while leukaemias other than CLL were the first group to be identified as having increased risk, there is no evidence in the latest mortality or incidence analysis of haematological malignancies of raised rates of Hodgkin's, Non-Hodgkin's Lymphoma (NHL) or multiple myeloma (25) (26).

Other sources of evidence on the links between ionising radiation and malignancy

- 29.** There is some inconsistency between the atomic bomb survivor findings, usually considered acute high-dose studies, and conclusions from other study populations, e.g. occupational protracted low-dose exposed groups which themselves show heterogeneity. In considering the epidemiological literature on cancer and other adverse health effects of ionising radiation, attention should be paid to evidence quality, including the study design and power, i.e. case numbers, suitability of controls, age at exposure, age at diagnosis, duration of follow-up, whether the study is high or low-dose, and how the dose was delivered, acute or protracted or episodic and whether looking at disease mortality or incidence and the presence of bias or confounding, as well as case ascertainment. The concept of lag time is also important. Leukaemias have a short lag time, first appearing about two years after

whole-body irradiation and peaking at six or seven years after exposure, while radiation-induced solid cancers, i.e. breast, bone, stomach etc. can occur any time from 10 years onwards. PHE adopts the 2007 ICRP publication, 103 assumptions on cancer risk coefficients, tissue and radiation weighting factors and the use of a dose and dose rate effectiveness factor (DDREF). The 2007 ICRP risk estimates took into account new cancer incidence data from the atomic bomb survivors cohort that was not available at the time of the previous 1990 recommendations (see Annex A).

Military Ionising Radiation Studies

- 30.** About 210,000 military personnel took part in the US nuclear tests between 1945 and 1963 where 99% of those with film badges had a total dose of less than 50 mSv, with the average about 6 mSv. In 1978 the US established a register of service personnel participants. There was some risk of selection bias in assembly of this database, which used a number of methods including self-report. Dates of birth were not always recorded. On it, three studies were based, all using matched service control groups. The first study looked at mortality among 70,000 participants at the Five Test series and 65,000 controls. Standardised Mortality Ratio (SMR) was 71 for all causes of death and 74 for malignancies. Leukaemia mortality in the test veterans was slightly greater than in the controls, but the SMR was 74, indicating that the veterans were at lower risk than the US general population (27).
- 31.** The second study was of 38,000 naval personnel present at Operation Crossroads at Bikini Atoll in 1946 and included a matched group of 35,000 controls (28). In this study the relative risk (RR) for all-cause mortality was slightly raised among participants relative to the controls and the mortality for malignancies including leukaemias was also above 1, although not statistically significantly raised. This means that either the study did not have the power to detect a raised risk or that the raised relative risk was due to chance.
- 32.** Similar findings were recorded in the third study (29) involving 8,500 naval veterans present at Operation Hardtack in 1958 and 14,000 controls, and followed up until 1 September 1991. This group was chosen because of its high proportion of veterans with film badge dosimetry data and median dose 3.88 mSv. Among those who received doses of more than 10 mSv there was an increased mortality from all causes and all cancers. However, for all gastro-intestinal cancers, although overall risk was high, there was no dose/response relationship and the risk of many cancers considered radiogenic was not significantly elevated or occurring in those with highest exposures. These mortality studies were based on death certificate data and did not control for factors such as tobacco and alcohol use, etc. It was concluded from the US atomic veteran evidence in its entirety that the risk of death from certain cancers could not be ruled out.
- 33.** About 500 personnel from the Royal New Zealand Navy (RNZN) took part in the UK tests, and they have been the subject of two follow-up studies. The first covered the period 1957-87 and the second extended follow-up to 1992. Controls were again service personnel of similar age and serving around the same period as the veterans, but who did not participate in the tests (30) (31). The low power of these studies, especially when considering rare disorders, is noted but again relative risk of all causes of mortality and from all cancers was not significantly different from 1. However there were four deaths from leukaemia from a total of eight haematological malignancies by the end of the 1992 study. This was on the border of statistical significance.
- 34.** In the 1980s there was a self-report Australian study (32). Response rates were low and bias an issue so interpretation of results was difficult and a further study was commissioned. Published in 2008, this compared the mortality and cancer incidence in 10,983 UK atmospheric test Australian veterans with the general Australian population, and between groups of veterans with different radiation dose assessments or estimates (33). All-cause mortality was not raised but mortality and incidence was raised for cancers of the head and neck, lung, colon and rectum and prostate and for all cancers

combined. Incidence was raised for oesophageal cancer, melanoma and all leukaemias but mortality was not raised. There was no association between estimated radiation exposure and overall cancer mortality or incidence, nor with any specific cancer or cancer deaths. The estimated average radiation dose was comparable with natural background levels and fewer than 5% received more than 20 mSv. The comparator group from the Australian general population were very different from the veterans with a lower number born in Australia, as well as marked differences in ethnicity. The pattern of cancer in the nuclear test veterans was, however, very similar to that found in Australian Korean war veterans serving around the same time as the UK Minor Trials (34). Here ionising radiation exposure was not an issue and 15% of the veterans had served in both campaigns. The authors related some of the findings to smoking and, in naval personnel, where there was an excess of mesothelioma and lung cancer, to asbestos exposure. They were unable to explain the excess leukaemias, but concluded that the excess cancers and cancer deaths were not attributable to radiation exposure.

The UK Atmospheric nuclear test and weapons experiments

- 35.** The UK atmospheric nuclear tests carried out from 1952-58 involved a series of 21 explosions (12 in Australia (Monte Bello Islands, Maralinga) and 9 in the South Pacific (Malden and Christmas Islands in 9 operations) where natural background radiation is low, e.g. in the Christmas Islands, 0.58 mSv per annum. The Maralinga Experimental Weapons Programme (MEP), also known as the Minor Trials, examined weapons design and safety and did not involve significant nuclear fission, although some of the experiments, notably at Vixens A and B, did generate radioactive contamination with uranium and plutonium dispersal. The Minor Trials lasted until 1963 with clean-up operations until 1967.
- 36.** About 16,000 Australian personnel, military and civilian, also took part in the atmospheric tests and MEP. As with UK personnel, the majority had support functions including transport, construction and catering, with only a minority directly involved with weapons trials or detonations and entering potentially contaminated areas. They have been the subject of a separate epidemiological study looking at mortality and cancer incidence.
- 37.** The atmospheric tests and Minor Trials were carried out to the highest contemporary radiological standards, including the use of high altitude air-bursts and tower-mounted detonations to minimise the production of radioactive fallout. All participants were monitored for radiation exposure in the early tests, but measurable exposures only occurred to those participants who were at high risk because of their duties and locations. For later tests a targeted approach was adopted with only "at risk" personnel being monitored.
- 38.** In Australia (all kiloton-range devices), tests were generally tower-mounted detonations. At Christmas and Malden Islands, all megaton tests were high altitude air-bursts, and the kiloton-range tests were suspended at high elevation from balloons. These measures ensured that participants' exposure to fallout was minimised. Test planning took account of weather conditions so that radioactive debris from the explosion went into the highest levels of the atmosphere and remained there for a significant time, with decay and dilution before descent to the Earth's surface and minimal immediate dispersion of contaminated materials downwind. During the course of the tests and Minor Trials, and afterwards, environmental monitoring programmes (radiation surveys (air, water etc.) flora and fauna analysis, etc.) were performed.
- 39.** In 1967 after the MEP was completed, the UK conducted a clean-up of all the sites to reduce contamination to safe and acceptable levels on the understanding that access to the experimental area would thereafter be restricted. In 1968 the Australian government confirmed that they were content with the decontamination and debris clearance. By the early 1980s, the Australian government

was being lobbied by antinuclear, environmentalist and pro-land rights activists. In 1984 a Royal Commission was set up and recommended that the affected experiment areas should be returned to a state which allowed unrestricted habitation. The resultant Technical Assessment Group (TAG) reported on the residual contamination with options and costings for decontamination. A partial clearance option leaving about 100 square kilometres to which access was prohibited was agreed, and in December 1993 the UK government offered £20 million in a full and final settlement to fund a further clean-up operation. In April 2000 the Australian government announced completion of the clean-up and that it was safe for the indigenous population (35).

The NRPB nuclear test follow-up studies

40. As a result of concern amongst some test participants about the effects that participation could have had on their health, in 1983 the Ministry of Defence commissioned an independent study by the NRPB to investigate whether the health of participants at the UK atmospheric nuclear tests and weapons experimental programme showed any correlation with radiation exposure.
41. This comprehensive cohort study compared the mortality and cancer incidence in over 20,000 test and Minor Trials participants with that of a similar-sized control group of ex-servicemen who were age-matched, had served around the same time and had deployed overseas but had not participated in the test programme.
42. The term ‘test participant’ has a particular definition and includes servicemen present at the due dates, at any of the following test sites and experimental programmes:

Operation	Site	Date
Hurricane	Monte Bello W Australia	April 1952-June 1956
Mosaic	Monte Bello W Australia	May-June 1956
Totem	Emu Field S Australia	Aug 1953-Aug 1957
Buffalo	Maralinga S Australia	April 1955-Aug 1967
Antler	Maralinga S Australia	Sept/Oct 1957
Grapple XYZ	Christmas Island S Pacific	1957-58
Op Brigadoon	Christmas Island	1962
RAAF Pearce RAAF Edinburgh	W Australia S Australia	May-August 1956 Aug 1956-Nov 1960
Minor Trials:		
Kittens	Emu Field	1953-61
Tims	Maralinga	1955-63
Rats	Maralinga	1956-60
Vixen A	Maralinga	1959-61
Vixen B	Maralinga	1960-63
Clean-up ops:		
Ayres	Maralinga	1960-63
Hercules	Maralinga	1964
Brumby	Maralinga	1967

To be identified as a test “participant” there is no requirement to be present at actual detonations.

Op Brigadoon was a series of US tests, part of Op Dominic, which took place off Christmas Island between April and July 1962. At the RAAF sites, the work included cloud sampling and handling contaminated aircraft. RN ships were associated with tests at Monte Bello, Malden and Christmas Island. The Minor Trials did not involve nuclear detonations. They took place at Maralinga (Tims, Rats and Vixen A and B) while Kittens was at Emu Field. Major clean-up operations took place at Christmas Island in 1964 and Maralinga in 1964 and 1967.

43. The main conclusions of the first NRPB Report (36) were that the test participants showed increased risk of multiple myeloma and leukaemia (other than chronic lymphatic leukaemia) compared with service controls. However, the conclusion that this was the result of the participants attending the tests being exposed to ionising radiation from the explosions was not considered appropriate. This was because there was a particularly low rate of the conditions in the controls, meaning that the raised risks were not due to increased disease among the participants but lower rates of disease among the controls. In addition, among the sub-groups, those considered most highly radiation-exposed did not show high rates of the conditions.
44. Otherwise, presence at the sites;
 - did not have a detectable effect on the participants’ expectation of life,
 - did not have a detectable effect on participants’ risk of developing any other malignancy.
45. The study was extended and the second NRPB Report (37)) produced an additional seven years’ data, and:
 - confirmed the overall conclusion of the 1988 Report, that participation in the tests had no detectable effect on the participants’ expectation of life nor on their risk of developing most cancers.
 - concluded that the small hazard of multiple myeloma suggested by the 1988 Report was not supported by the additional data, although the possibility of some small risk of developing leukaemia (other than chronic lymphatic leukaemia) in the first 25 years after participation could not be ruled out.

With regard to other cancers the report concluded that:

 - overall the number of deaths and cancer incidence amongst participants is lower than amongst the control group.
 - as expected, because a large number of diseases were considered, any excesses in participants are due to chance.
46. Following pressure for a further investigation into the alleged effects of exposure, a third analysis of the NRPB study was commissioned. The report of the study which extended the follow-up period to 1998 was published in February 2003 (38).

Key findings:

- Re-affirmed the overall findings of the 1988 and 1993 reports, that participation in the Tests had no detectable effect on the participants’ expectation of life, nor on their risk of developing most cancers.
- Confirmed the conclusion of the 1993 report on the alleged association between participation in the UK test programme and multiple myeloma, that there is no evidence to support a link.

- Suggested, particularly in the 2–25 years after first test participation, a small increase in risk of leukaemia (excluding chronic lymphatic leukaemia) among test participants relative to controls, although the difference in rates between the two groups was narrowing with longer follow-up.

Impact of the NRPB reports on the Department's normal policy on claims for cancers due to service-related ionising radiation

47. Applying the test set out at para 7-9 of this statement, the Secretary of State considered the National Radiological Protection Board Reports, of which a principal author was Sir Richard Doll, to be **reliable evidence**. In particular the following points were noted:

- The study identified the test participants, and followed them up to monitor the occurrence of disease and death in the participant population. It then compared this, over the same time period, with the rates in both a service and civilian control population.
- The study involved 20,000 subjects and an equal number of controls.
- The reports describe in detail the efforts made to ensure sample completeness and to control bias.
- The study limitations are discussed by the authors and conclusions are reasoned and restrained.

The Secretary of State's opinion as to the reliability of the evidence in the reports is in accord with the general opinion of the scientific community, including the US Presidential Advisory Committee on Human Radiation Experiments (32).

48. Based on the first report, the Secretary of State's normal policy became to award war pension for claims for leukaemia (other than chronic lymphatic leukaemia) and multiple myeloma in those present at test sites. The policy also included awards for primary polycythaemia rubra vera, the red blood cell equivalent of leukaemia. In light of the 1993 report, the Secretary of State's normal policy was revised. Since then, on the basis of presence at atmospheric nuclear test sites, new claims for multiple myeloma are rejected but awards continue to be made for leukaemia (other than chronic lymphatic leukaemia) and primary polycythaemia rubra vera having clinical onset within 25 years of first presence at the test sites. On the basis of the findings of the 2003 report, the Secretary of State's current normal policy remained unchanged from that in 1993.
49. The reports did not causally link development of those conditions to ionising radiation exposure and the policy is not an acknowledgement that those present at the tests were exposed to harmful levels of ionising radiation. The accepted Service link is purely presence at the test sites (see Annex B).
50. Having carefully considered the reports, the Secretary of State was and remains of the opinion that they do not provide reliable evidence to raise a reasonable doubt that generally other cancers (e.g. primary liver and urinary bladder) might be attributable to service in the Armed Forces simply because of presence at the nuclear test sites. Consequently it is presently his normal policy that entitlement for solid cancers, causing disablement or death, may not be presumed, i.e. accepted on the basis of presence at atmospheric nuclear test detonations, weapons tests or clean-up operations alone. However, it is also his normal policy that an entitlement to war pension may be certified for cancer or other radiogenic disorders in any case where, on the case-specific facts, there is reliable evidence of service exposure to a sufficient level of ionising radiation and there is a recognised causal link between the claimed condition or cause of death and such accepted exposure.

51. At Annex B details of the design, radiological protection and dosimetry arrangements at the UK tests are set out as well as discussion of those groups of Service personnel considered to be at high risk of exposure to significant doses of ionising radiation.

Children of test participants and MOD civilian employees

52. The sample on which the 1988, 1993 and 2003 NRPB Reports were based did not include the children of test participants, and was solely concerned with a study of the test participants themselves and not with any possible effect their participation might have had on their progeny. Any claim for compensation for a child in respect of disablement or death said to be due to the parent's participation in the UK Tests does not fall within the scope of the Service Pensions Order. Similarly, compensation for civilian MOD employees or their widows who participated in the tests is not covered by the War Pension Civilians Scheme (3 September 1939 and 19 March 1946).

Impact of overall evidence on the Department's normal policy on the radiogenicity of malignant conditions

53. Having carefully considered the overall contemporary medical and scientific published peer-reviewed literature in the context of the war pensions onus and standard of proof, the normal policy in war pensions (at date of statement publication) is that there is reliable evidence to raise a reasonable doubt that there may be a causal link between ionising radiation exposure and the following cancers:-

leukaemia (other than chronic lymphatic leukaemia)

female breast

lung

oesophagus

stomach

colon

primary cancer of the liver

gall bladder

thyroid

urinary bladder

renal pelvis and ureter

central nervous system

salivary gland

bone

rectum

54. In war pension claims for disablement or death due to these conditions **and** where the Secretary of State has accepted **service-related ionising radiation exposure, either from i) expert dosimetry measurement or estimate or ii) where there has been service at the locations listed at Annex B**, war pension entitlement will be considered. Although the Japanese studies do not find a significant dose response for rectal cancer, and because several studies do not differentiate rectal and colon cancer, rectal cancer is also included in the list. The Secretary of State does not accept evidence of participation in nuclear tests as itself equating to proof of service-related ionising radiation exposure. Based on the NRPB studies, entitlement will continue to be presumed for leukaemias other than CLL in those present at the UK atmospheric nuclear tests and weapons experimental programmes. Since the nuclear test studies, more evidence has been published on haematological malignancies and that new evidence and its impact on the Departmental policy is considered below.

Haematological malignancies including Polycythaemia Rubra Vera, Chronic Lymphatic leukaemia, Hodgkin's and Non-Hodgkin's Lymphoma and multiple myeloma

55. The earlier war pensions policy decision to accept Polycythaemia Rubra Vera (PRV) on a presumptive basis as for the analogous leukaemia (other than CLL) diagnosed within 25 years of presence at the tests was based on a single claim and a small US case study suggesting an excess of cases in a population who had taken part in a nuclear test (40). This finding and its interpretation was challenged at the time (41) and has not been replicated in any other population. There are also issues as to the soundness of the histological diagnosis in the cases in the study. As a result, from the date of this policy statement, PRV will not be accepted on the basis of presumption amongst nuclear test and weapons programme participants.
56. Evidence on the radiogenicity of the leukaemias and related haematological disorders is not consistent across studies. An important issue is accuracy of diagnosis: the pathology of haematological malignancy is complex and the disorders relatively uncommon, with small case numbers in many studies. In recent years, new haematological classification systems have been developed, often based on clinical features, genetics and treatment response. This makes pooling of study results or comparison of findings over time very difficult. It is also true that the incidence of some haematological malignancies has increased in recent years. This may relate to higher awareness and more assiduous case ascertainment as well as factors such as HIV infection in communities. Background incidence of haematological malignancies also varies in different populations so that extrapolation of results to other populations may not be valid.
57. The 2003 NRPB Advisory Group on Ionising Radiation (AGIR) review of the literature on the risk of leukaemia and related malignancies concluded that apart from chronic lymphatic leukaemia (CLL), for which there was no evidence of radiogenicity, there was good evidence of a causal link between radiation, and the acute leukaemias and Chronic Myeloid Leukaemia (CML). For Non-Hodgkin's Lymphoma (NHL), considered a group of disorders, not a single diagnosis, they found little evidence of a link to radiation; there was no evidence of a causal link between Hodgkin's disease (HD) and radiation and similarly only weak evidence of a causal link to multiple myeloma (MM) (16).

CLL as a radiogenic disorder

58. CLL is by nature different from other types of leukaemia. It mainly affects older people and is a disorder with a long latent period. It is often asymptomatic with diagnosis made fortuitously. Similarly, there tends to be prolonged morbidity rather than rapid death. These features mean that many of the published studies with short lag and follow-up time as relevant to acute leukaemias may report no link with ionising radiation simply because they have failed to detect cases. Similarly CLL may not be recorded on death certificates as a cause or factor in mortality. Publication bias is also an issue. As in the atomic bomb studies, numbers of cases of CLL may simply be too small for analysis. Finally, as with other haematological malignancies, there may be misclassification and misdiagnosis.
59. In 2011, following advice from the National Institute for Occupational Safety and Health (NIOSH), the US, having previously regarded CLL in the context of its federal occupational and military disability compensation schemes as a disorder with a zero link to ionising radiation, accepted that CLL was radiogenic.

- 60.** A 2005 review article had proposed that, while epidemiological evidence of an association between CLL and radiation was weak, within its limits there was nothing to suggest that CLL was an exception to the general principles of radiation carcinogenesis (42). Meanwhile, follow-up case-control studies of Chernobyl clean-up workers (43) (44) suggesting increased rates of CLL began to appear. There are issues regarding the basis of diagnosis, case numbers are small and history for dose reconstruction often reliant on patient recall or proxy interview. It is also true that the Ukrainian Chernobyl follow-up studies with regular clinical surveillance, including subject review and blood tests, provide higher opportunity for detection of disorders not seen in the equivalent comparator (Ukrainian general male) population. This might go some way to explain the approximately 60% higher rates of CLL in the Chernobyl workers compared with the general population. In the 2013 paper looking at cases of leukaemia diagnosed amongst the 111,645 workers over the period 1986-2006, worker controls were matched to cases by age and residence. Dose reconstruction provided estimated average case radiation exposure as 132.3 +/- 342.6 mGy while for controls it was 81.8 +/- 193.7 mGy. Exposure dose was reconstructed from interviews of subjects or with next of kin regarding work location, the clean-up tasks and time spent. There were 137 leukaemia cases in total including 79 CLL with dose estimation. The study found similar radiation-related risks for CLL and non-CLL except for a sub-set of cases interviewed less than two years from the start of chemotherapy. In that group, radiation risk of CLL was much lower as was their mean bone marrow dose. This group includes personnel within the 30 km zone of the explosion. On the other hand, no such difference was found with worker controls. No explanation was available for this finding. The authors also recognised that their finding of a link between radiation and CLL was not replicated in other high-quality studies, e.g. the third analysis of UK radiation workers (45) or the Techa river contaminated population follow-up (46). They conclude that further study on the relation between the two is required. The 2015 INWORKS chronic low dose study followed up over 300,000 radiation-monitored workers in France, the US and the UK for 8.22 million person years and showed accrual of a mean dose of 1.1 mGy per year. There was strong association between leukaemia mortality and radiation dose (RR 2.96 per Gy (1.17-5.21), mainly due to chronic myeloid leukaemia with an ERR per Gy of 10.45 (Annex A). In this study a negative association was found between CLL and radiation exposure (9).
- 61.** The US decision to accept CLL as radiogenic in its occupational injury schemes was also influenced by their previous decision, despite the lack of direct evidence, to accept Non-Hodgkin's lymphoma (NHL) as radiogenic. Like NHL, CLL is a B cell lymphoma. This makes it biologically plausible that both malignancies should share similar radiogenicity and the US concluded that to continue to assert zero risk for CLL, having accepted NHL as radiogenic, was illogical.

Impact on the Department's normal policy on claims for haematological malignancies due to service-related ionising radiation exposure

- 62.** At this date, based on overall evidence, policy remains to accept entitlement for leukaemias other than CLL simply on the basis of participation at the tests or experimental programmes without case-specific dose determination, when they present clinically within twenty-five years of presence at the tests or weapons experiments. CLL, PRV, HD, NHL and MM are not accepted as radiogenic disorders. The literature will continue to be monitored.

Evidence of radiation induction of non-cancer conditions

63. While reports of increased rates of leukaemia in atomic bomb survivors began to emerge in the 1960s, longer follow-up suggested that ionising radiation exposure may also be associated with non-cancer diseases (47) (48). Associations have been described with uterine fibroids, certain non-cancerous thyroid and para-thyroid tumours and, importantly, with circulatory disorders. Cataract is known to be caused by high doses of ionising radiation. A review of the current evidence on ionising radiation and circulatory diseases and cataract is at Annex C.
64. On present overall evidence, mainly from high-dose radiotherapy studies, it is generally accepted that there is a raised risk of circulatory disorders (including stroke, atherosclerotic coronary artery disease and heart failure) at about 5 Gy acute exposure, and evidence is accumulating for an association at doses between 0.5 Gy and 5 Gy. However, results from the atomic bomb survivor studies and nuclear industry protracted dose studies are heterogeneous and inconsistent, and few studies adequately control for the major established cardiovascular lifestyle risk factors. At present the ICRP does not recommend that calculation of the Probability of Causation (PoC) is appropriate for circulatory disease risk. It states that evidence of excess risk of mortality from circulatory disease is good only at doses of several Gy or more. There are uncertainties about the shape of the dose response curve at low doses, and Japanese data are consistent both with a no-dose threshold or a threshold of 0.5 Sv). ICRP recommends adoption of a linear dose response with threshold at 0.5Sv.
65. Lens opacification can also be caused by ionising radiation. The mechanism of radiation-induced cataract is not understood, nor whether the effect is deterministic or stochastic. Cataracts can be induced by 2 Gy of acute low LET radiation and 5 Gy of chronic low LET. For visual disablement higher doses estimated to be about 10 Gy exposure are required (49).

Impact on Departmental normal policy on the relation between ionising radiation and circulatory disorders and cataract

66. For circulatory disorders – stroke, coronary artery disease and cardiac failure and lens opacity/cataracts, where the Secretary of State accepts service-related ionising radiation exposure, claims will be considered on their individual merits including measured or estimated dose exposure. The literature will continue to be monitored.

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Annex A

Radiation dose

1. The first definition of a unit of radiation dose was made in 1928 by the International Congress of Radiology. The rontgen (R) was defined as that quantity of radiation which produces in 1 cm of air one unit of charge of either sign, thus defining a unit of exposure.
2. Units of **absorbed dose**, rads, the actual energy absorbed in the tissue being irradiated, were later introduced and are now cited in SI (Système Internationale) units – joules per kg of absorbing material. The fundamental unit – 1 joule/kg – is 1 gray (1Gy), equivalent to 100 rads (R).

Different types of radiation differ in the way they interact with living tissues and equal absorbed doses cause different degrees of damage. X-rays, Gamma rays and beta particles transfer a low rate of energy as they pass through tissues, and are referred to as **low Linear Energy Transfer (LET)**, while alpha particles and neutrons are examples of **high Linear Energy Transfer (LET)** radiation. The biological effects of high LET radiation are greater than those of low LET particles. This is taken account of by a **Radiation Weighting Factor** defined by ICRP (2007) as 1 for X-rays, gamma and beta radiation, and 20 for alpha particles.

3. The **absorbed dose** multiplied by the **radiation weighting factor** provides the **equivalent dose** i.e. all doses regardless of radiation type are expressed relative to the effects of X-rays.
4. Not all tissues are equally radiosensitive and this is reflected in **Tissue weighting factors**, so that lung and bone marrow, which are radiosensitive, have a higher value, 0.1, than skin or bone surface at 0.01.

The current SI unit of equivalent dose is the **Sievert (Sv)**. This weighs radiation according to type and the sensitivity of the exposed tissue so that different types of radiation can be added together.

The **effective dose** is derived from **the equivalent dose** multiplied by the **tissue weighting factor** and summed across the body organ and tissues. This can be used for whole-body and local irradiation, and external and internal radiation can be summed together.

For X-rays and gamma rays the equivalent dose in Sieverts and the absorbed radiation dose in Grays are the same. The relationship between the different dose units is:

1 gray (Gy) = 1 joule/kg = 100 rads (R) = 100 rems (r) = 1 sievert (Sv) = 1,000 millisieverts (mSv) = 1,000,000 microsieverts (microSv).

Typical effective doses, i.e. whole body of radiation

Chest X-ray (PA) – 0.014 mSv
Head CT scan – 1.4 mSv
Bone scan – 4 mSv
Chest CT scan – 6.6 mSv
Coronary angiography – 3.9 mSv
Ba swallow – 1.5 mSv

Radiotherapy treatment (radical)

Non-small cell cancer of lung	60 Gy in 30 fractions
Lymphoma	30-40 Gy in 20 fractions

Average annual UK dose from cosmic rays – 0.26 mSv

Average annual UK dose from gamma rays – 0.35 mSv

Average annual UK dose natural background radiation – 2.2 mSv

Most information on cancer risk in populations comes from high-dose studies. It is generally accepted that at low doses and dose rates the risks are lower and a reduction factor, the dose and dose rate effectiveness factor (DDREF) is applied to the risks calculated from high-dose studies and for radiological protection. ICRP 2007 maintained a DDREF of 2. HPA agreed that while the value cannot presently be precisely calculated, the ICRP recommended value of 2 is compatible with other recent estimates.

Internal radiation

5. Radiation from outside the body is relatively easy to detect, monitor and quantitatively assess, and most epidemiological studies on adverse health effects focus on it. Internal radiation results from inhalation, ingestion or absorption through broken skin. All types of radiation can produce internal radiation but for the nuclear test and Experimental Programmes alpha radiation from unspent uranium and plutonium is particularly important. Made up of two protons and two neutrons, alpha particles are heavy and slow-moving, losing energy quickly, with a short range.
6. Internal radiation dose cannot be measured directly but is calculated from estimated radionuclide intake using air, food and water measurements. There are, however, few such measurements in relation to the UK nuclear atmospheric tests. A three-stage model can be used to estimate the ground deposit of fallout, the airborne concentration of radionuclides due to the ground deposit and then using dose conversion factors, dose due to intake of radionuclides. Dose rates over external and internal radiation decline over time as the material decays. After three months or so the internal dose inhaled from the unburnt nuclear fuel becomes dominant while radiation exposure of reducing levels continues while any material remains in the body.
7. When alpha particles enter the body by inhalation, some particles are lodged in the lung while some travel to the thoraco-bronchial lymph nodes and systemic circulation. Dependent on dose and tissue or organ sensitivity there is varying risk of cancer development. Tissues most at risk from particulate radiation include lung, liver and bone. UNSCEAR (2006) and ICRP find that taking into account the higher relative biological effectiveness of alpha particles compared with external radiation, radiation risks from internal and external emitters can be combined. They also conclude that there are no data suggesting that risks from alpha radiation have been substantially underestimated. The evidence of cancers due to alpha radiation at other sites and for the leukaemias is very limited, of low statistical power and quality, and inconsistent.
8. The 2006 study of mortality and cancer in Australian nuclear test veterans reconstructed estimated doses for personnel, concluding that 79% received less than 1 mSv. The mean Australian dose at Maralinga was 15 mSv, while for UK participants it was about 7 mSv (1). The Australian study, like the NRPB studies, found no evidence that Minor Trials participants were different in terms of mortality or cancer incidence from the nuclear test participants overall, nor was there any relation between measured or estimated radiation dose and incidence or mortality of leukaemia or a range of malignancies.

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Radiological protection

9. Radiation dose limits were first recommended for ionising radiation exposure in 1928. The statutory limit on the amount of radiation to which the general public may be exposed in excess of natural background radiation and excluding medical exposure is set from 1 January 2000 at 1 mSv per annum.
10. The most important source of man-made exposure is medical investigation which accounts for 90 per cent of man-made exposure. Average natural background radiation is raised to 2.6 mSv by all man-made exposure. UK estimated experience excluding medical investigation is 0.04 mSv. Other statutory limits include occupational dose limits. From 1 January 2000 these are 20 mSv per annum for classified workers and 6 mSv per annum for unclassified workers. Recent average effective occupational dose is 0.4 mSv with only 1% of recorded doses exceeding 5 mSv and none more than 10 mSv.

Reference:

Watson, S.J. et al (2005) Ionising radiation exposure of the UK population. Chilton HPA-RPD-001

Health effects of ionising radiation

11. Adverse health effects of ionising radiation are independent of the source of radiation and are of 2 types, largely related to exposure dose and occurring early or late.

Deterministic/tissue effects

- These effects arise shortly after exposure, usually within hours or weeks.
- There is a threshold dose, beneath which no effects are seen.
- This threshold is relatively high, exceeding natural background radiation levels in all parts of the planet by several hundred-fold.
- The severity of the effect varies directly with the dose.
- Duration of exposure is also important and for a given total dose, acute exposure is more harmful than a protracted dose.
- The tissues affected are those whose cells have a high turnover rate, i.e. bone marrow/skin/gastro-intestinal tract.

Stochastic/probabilistic effects

- These effects arise years (2-40 or more) after exposure and the probability depends on the level of the dose.
- There appears to be no threshold and the severity of the effects is not dose-dependent.
- This means that there is a finite risk even from low-level natural background radiation. At the same time persons exposed to a high dose may suffer no ill effects.
- The two main late effects are induction of cancer and hereditary disease in subsequent generations.
- All diseases which can be radiation-induced can also occur naturally or in relation to other exposures – cigarette smoke, alcohol, diet (both excesses and deficiencies), occupational exposures – and are not distinguishable on the basis of cause.

- Current best evidence is that radiation of all types gives rise to less than 2% of all cancers worldwide. The most important carcinogenic radiation type is in fact ultraviolet light (UVB), not ionising radiation.
- Not all types of cancer have been shown by evidence to be caused by ionising radiation.
- Hereditary effects have not been demonstrated in humans but there is such evidence in some types of animals.

Effects of total body irradiation

Equivalent dose (Sv)	Effect
Sublethal to man 0.0001 (0.1 mSv)	Around 2 weeks' natural background radiation, no detectable effect.
0.001 (1 mSv)	Around 6 months' natural background radiation, no detectable effect.
0.01 (10 mSv)	No detectable effect.
0.1 (100 mSv)	Minimal decrease in peripheral lymphocyte count, no clinical effect.
1 (1000 mSv)	Mild acute radiation sickness in some individuals (nausea, possible vomiting), no acute deaths, early decrease in peripheral lymphocyte count, decrease in all WBC and platelets at 2-3 weeks, increase in late risk of leukaemia, solid tumours.
Lethal to man 10 (10,000 mSv)	Severe acute radiation sickness, severe vomiting, diarrhoea, death within 30 days of all exposed individuals. Severe depression of blood cell and platelet production, damage to gastrointestinal mucosa.
100 (100,000 mSv)	Immediate severe vomiting, disorientation, coma, death within hours.
1000 (1,000,000 mSv)	Death of some micro-organisms, some insects within hours.
10,000 (10,000,000 mSv)	Death of most bacteria, some viruses.
100,000 (100,000,000 mSv)	Death of all living organisms, denaturation of proteins.

The concept and calculation of probability of causation

1. Cancer due to ionising radiation is indistinguishable clinically from cancer due to other causes. Although it is not possible to say with absolute certainty whether a cancer in an individual is due to ionising radiation, in some circumstances, epidemiological data, information about the person and the population to which he belongs, as well as exposure circumstances and recognised risk models, can be used to estimate the probability that the cancer was caused by radiation. The Probability of Causation (PoC) is expressed as a percentage. It is the risk the disease is due to radiation exposure divided by the overall disease risk in the parent population, i.e. the radiation risk/the base line risk, i.e. the risk in an unexposed population plus the radiation risk, multiplied by 100.
2. The baseline risk of cancers in a society is influenced by many factors but most importantly by age at diagnosis and sex. Taking into account the improved survival experience of cancers and other disorders over time it is important to use baseline information pertinent to the relevant dates. For UK calculations, ONS age standardised baseline risks at different dates for men and women are available.

3. The epidemiological evidence that radiation can cause cancer derives from many sources as discussed above, and where there is evidence that a cancer can be caused by radiation (i.e. it is radiogenic) International organisations, e.g. International Atomic Energy Authority (IAEA) and ICRP have developed risk models for all solid cancers as a group and for various individual cancer sites where the evidence of radiogenicity is strong (1) (2). In the UK, ICRP recommendations inform the worker and public radiological protection regulations, and the 2007 risk models apply to cancer risk estimates. Because calculated risk estimates are only available for radiation doses typically much larger than of interest in the context of occupational injury and compensation, and rarely from the population of interest, in 2004 an ICRP Task group considered the Low-dose extrapolation of radiation-related cancer risk and how one might fairly and reasonably, in terms of scientific certainty, calculate risk at low dose. They looked at the epidemiological evidence including dependence on radiation dose and the existence of a dose response. Based on acute doses in the moderate to high dosage range, the review covered modification of dose response by age and sex, lifestyle factors, population and radiation quality (3).
4. The atomic bomb high-dose survivor data show a radiation dose low LET response relationship that is linear for solid cancer with doses from 2 Gy to 200 mGy, while the evidence below 100 mGy is equivocal, neither confirming nor refuting linearity. For leukaemia, the data support a linear quadratic response relationship, i.e. risk reduces at low dose. ICRP 1991 and UNSCEAR 1993 recommended that, for low and very low doses, dose-specific risk estimates should be divided by a DDREF of 2 with no DDREF applied to leukaemia modelling. ICRP 2007 report maintained that approach, taking the shape of the response models for the 12 site-specific cancers and the general cancer model as LNT. For each site, there are two risk models based on absolute and relative risk. This is because although the risk per unit dose is assumed to be the same at all doses, there is little evidence of excess cancer risk in populations exposed to very low doses, e.g. 10mGy or lower.
5. **Absolute risk** is the probability a given radiogenic cancer will occur at a given radiation dose while the **Relative risk** considers the risk, i.e. numbers of cases in the exposed population relative to the baseline risk. The reason for the different risk models based mainly on the atomic bomb studies is that the baseline risk of cancers is different in different populations and it is not known how to apply such information between the different populations. While **Absolute risk** is not altered by baseline risk, that is not so for **Relative risk**. The convention, in calculating PoC, is to use an average of the two. The **Excess Absolute Risk** is the different rates of occurrence between an exposed and unexposed otherwise comparable population, while the **Relative Risk** (RR) is the occurrence rate in the exposed population compared with that in the non-exposed population. The **(ERR)** is $RR - 1$, i.e. the Excess Absolute Risk. A RR of 1 for a disorder means that radiation is unlikely to be a causal factor. On the other hand, the absolute risk model provides a value between 0 and 1. This is the probability that a given cancer is due to the exposure of interest. If 1, the causal relationship is certain, while as the figure approaches 0 it is increasingly likely that the exposure played no part.

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Annex B

UK atmospheric nuclear tests

1. A nuclear explosion first produces a rapid initial burst of intense light/heat and subsequent air blast. The flash of light can cause 'flash-blindness' at considerable distances and permanent eye injury at shorter ranges. The heat from a nuclear detonation can cause first-degree burns to exposed human skin at ranges up to a few kilometres from a 10 kiloton detonation or approximately 20 kilometres from a 1 megaton detonation). The air blast is unlikely to cause injury to a person more than 3 kilometres from a 10 kiloton burst or 6 kilometres from a 1 megaton burst. At the UK trials, protection to personnel included careful mustering of personnel at distances considered safe, as well as eye protection and anti-flash clothing where indicated. Items were secured, moved or partly dismantled (e.g. tentage) and windows in buildings left open to avoid glass breakage and subsequent injury due to flying shards.
2. The ionising radiation exposure associated with nuclear detonations is of three types:
 - a) Firstly, radiation emitted by the device as it explodes (known as 'prompt' radiation). This is absorbed by the air over distances of a few kilometres, i.e. the general area devastated by the nuclear explosion. To be sufficiently close to receive a significant dose of 'prompt' ionising radiation, a person would also be within the lethal range of the air-blast and heat. This, therefore, does not need to be considered as contributing to a participant's radiation dose.
 - b) However, neutrons from prompt radiation irradiate the surrounding ground producing short-lived 'neutron-activated' activation products, radioactive isotopes in the soil. These are highly radioactive with half-lives measured in hours. They generally emit beta and gamma radiations. At the UK tests, following a detonation, both aerial- and ground-based radiation surveys were undertaken by specialist teams. Controlled areas were then established with checkpoints where required personnel could only enter wearing personal dosimetry and suitable protective clothing. Such teams then worked in the area for specified periods to recover instruments and records. Careful monitoring ensured adherence to the radiological safety instructions issued for participants.
 - c) Radiation is also emitted by the remains of the exploded device and fallout (where ground materials are entrained by the explosion, made radioactive and thus dispersed by the explosion and ensuing winds).
3. UK trial detonations were carried out at altitude to minimise drawing ground materials into the explosion. Planning also took account of weather to disperse debris into the higher atmosphere and carry it away from the detonation site. All UK atmospheric nuclear trials devices produced yields at, or very close to design figures and took place at appropriate altitudes. There is documented evidence that individual trials were postponed to ensure they took place in the correct meteorological conditions. Subsequent monitoring confirmed that detonations were as 'clean' as planned in respect of fallout.
4. Specialist instrumentation was used to measure ionising radiation. Personal dosimeters, in the form of film badges, estimate the dose to an individual from gamma radiation and beta particles. In general usage, these were typically carried for a month. During post-detonation operations, film badges were issued for an individual day/task. The film badge consisted of a piece of photographic film, sealed in a light-tight package bearing a unique number, the whole contained in a cassette adapted for securing to the clothing. Exposure to ionising radiation causes a chemical change within the film. After conventional photographic development, the film is compared with a 'standard' (where the degree of darkening to the film can be related to the amount of incident radiation required to produce such darkening) and a measure of dose to the individual obtained. It is primarily sensitive to photons (gamma rays and X-rays), less so for beta particles and low-energy neutrons and is not sensitive to alpha particles.

5. Although film badges provided an individual's dose, they required processing and could not provide an 'on the spot' dose measurement. For this purpose, quartz fibre electroscopes (QFE) could be issued to measure incident gamma (only) radiation. Once a pre-determined level had been reached, personnel would leave the controlled area, and submit their film badges for assessment. From the original dose records, it can be seen where both film badge and QFE dose data are available for the same individual, then the resulting measured dose values are similar.
6. Doses of ionising radiation can also arise by internal contamination, through breathing air containing contaminated dusts. Although alpha-emitting materials (e.g. uranium and plutonium as part of exploded device components) would be the most hazardous in this respect, such would constitute a very small component (if any at all) of fallout compared with beta and photon-emitting materials generated by a nuclear detonation. The risk of internal dose was minimised at the UK trials by the planning as described above i.e. ensuring that only essential, fully-protected personnel entered areas where internal contamination was possible, and by minimising activation products and fallout.
7. Neither a film badge nor a QFE could measure internal contamination/dose directly. However, to receive a significant internal dose, an individual would have to enter an area where there were high levels of fallout emitting photon and beta radiation. It is highly unlikely that this could happen without at the same time there being a measurable external dose as would subsequently be indicated by his film badge dose measurement. The only exception to this might have been at some of the Minor Trials, particularly Vixens A and B.
8. The Atomic Weapons Establishment, Aldermaston, holds the film badge records of the test participants. Film badges were not issued to all personnel; the Ministry of Defence estimates that approximately 20% of total participants were issued with film badges. At the earlier trials, e.g. operation Hurricane (1953) almost all participants were issued with film badges. The majority detected nil dose and by operation Grapple in 1957, a more targeted approach was in place with badges issued only to those whose duties or location were likely to put them at risk. About 20% overall had personal dosimeters.

"At risk" groups

9. Not all of those monitored showed a measurable dose above the detection threshold of the film badge. In fact, a majority were found to have a measured dose of 'nil'. The records show that less than 1000 of the doses recorded were 1 mSv or above: 81 received 50 mSv or more and 37 more than 100 mSv. From information held, on the location and operation of those with measured doses, certain groups are identified as being more liable to be exposed to significant doses of radiation. These are:-
 - i) RAF aircrews involved in sampling from airburst clouds (205 men). Mosaic. Totem. Buffalo. Antler. Grapple.
 - ii) RAF decontamination flight crews who sluiced the aircraft (129 men).
 - iii) RN personnel on HMS Diana when she sailed through the fallout at Operation Mosaic (282 men).
 - iv) The officers of the Buffalo Indoctrinee Force and Target response group. They assembled to observe at first hand the effects of the detonation (249 men).
 - v) Others – with recorded exposures greater than zero (1123 men).

10. The records also identified those men present at the Minor Trials who were at highest risk of radionuclide ingestion or inhalation. There were 847 in total. In the NRPB study, this group was considered separately. It did not show any increased risk of multiple myeloma, leukaemia or other malignancies relative to the rest of the participant group. When analysed as part of the main study, this group was indistinguishable from other participants. However, it is acknowledged that at some of the Minor Trials, notably Vixen A and B, there was some risk of dispersal of radiation into the environment because of explosions on the ground or on low towers. As a result, the Secretary of State has added to the “at risk” groups where service-related ionising radiation exposure is recognised, regardless of direct dose measure or estimate:

vi) Those present at the Minor Trials at Vixen A and B and the clean-up operations.

Impact on Secretary of State’s policy for radiogenic disorders, cancers, circulatory disorders and cataract where service-related ionising radiation exposure is contended

11. Where claims for radiogenic disorders are made by personnel who took part in any of the activities listed, or otherwise as above, the Department will accept that there is reliable evidence of service exposure to ionising radiation. Certifying entitlement for claimed disablements will depend on the case facts, including the measured or estimated dose exposure and, as required, calculated PoC.

Annex C

Ionising radiation and circulatory disease

1. Until the 1960s the heart and blood vessels were thought to be completely resistant to ionising radiation (1). Since then, many reports have appeared describing inflammation of the heart lining, and conduction disorders, from damage to the electrical system following high-dose (of the order of 40 + Gy) mediastinal irradiation of malignant tumours. Today these effects of high-dose ionising radiation exposure are generally accepted and reflected in treatment programmes.
2. There is a significant literature on the biological mechanisms of radiation-related circulatory disease. Much of this work is animal-based and there remain gaps in understanding. The AGIR report on circulatory diseases reviews the evidence. Some principles are emerging, including that radiation has an effect on the inflammatory response. At high dose it increases the inflammatory response while at low dose the inflammatory response is dampened down. The heart itself is relatively resistant to irradiation, and clinical changes, signs and symptoms can present, particularly vessel occlusion some time after irradiation (2).
3. In 1958 a human case study reported a myocardial infarction following deep X-ray therapy (3) and since then there have been many reports linking death due to coronary disease following radiotherapy for medical conditions including Hodgkin's disease and breast cancer (4) (5). In most of these studies, confounders were present, e.g. they did not control serum cholesterol, blood pressure or cigarette smoking, and the study subjects were already ill and in some cases had chemotherapy.
4. Further information from long-term follow-up studies of heavily irradiated populations (6) has shown excess mortality from circulatory disease, especially myocardial infarction in these populations. There are also case reports of cerebral infarction following radiotherapy to head and neck and of peripheral vascular disease of the lower limbs following pelvic irradiation (7). However, these effects have again only been reported with large dose of ionising radiation (20-60 Sv). Studies involving up to 20 years' follow-up of patients irradiated according to more recent radiotherapy procedures have shown no significant difference in myocardial infarction death rate between irradiated and control populations. A detailed discussion of the evidence was presented in a review paper by Kodama (8).
5. An American 50-year follow-up study of 90,000 radiologic technicians suggested that in those who started practice before 1940 there was increased risk of circulatory disease, mainly cerebrovascular disease, compared with those beginning after 1960 (9). However, a British 60-year follow-up study of 25,000 radiologists did not confirm this effect. For radiologists registered during 1897-1921, mortality from circulatory disease was lower than in other medical practitioners with no trend in date of registration (10). Similarly, follow-up studies of 14,500 patients treated with deep X-ray therapy for ankylosing spondylitis over 30-50 years suggested no increase in coronary deaths (11).
6. Most follow-up studies have focussed on mortality rates, subject to many uncertainties and inaccuracies. A more accurate estimate of the association would come from incidence studies in large populations with lengthy follow-up and controlled classic risk factors.
7. The issue of the association between ionising radiation and stroke or coronary heart disease in non-medical settings has been addressed periodically in the atomic bomb studies. The findings have varied over time and it must be acknowledged that other factors such as baseline risk and generational effect as well as malnutrition, presence of other injuries and burns, may have played a part. Until the report summarising the results for the period 1950-70 (12), there was no suggestion of a relation between atomic bomb radiation exposure and mortality from stroke or coronary disease. That analysis reported

an increased mortality from coronary disease in women exposed to 100 mSv or more. The increase was particularly marked where dose exceeded 500 mSv. The trend was not however confirmed in the subsequent report for the period 1950-1978 (13), although this did show increased mortality from "all diseases other than cancer" where exposure exceeded 2000 mSv. The report on the period 1950-85 (14) used a new method of exposure dose estimate, and showed clearly increased mortality from circulatory disease, including stroke and cardiac disease but again only in heavily exposed survivors.

8. The issue of accuracy of death certificates for the Radiation Exposure Research Foundation studies has been examined (15) and it is apparent that death certification for circulatory disease is less accurate than for malignancies. In addition, in these mortality studies the classic known cardiac risk factors cannot be controlled.
9. A few studies have been published which look at the **incidence** of coronary heart disease and stroke in relation to ionising radiation exposure associated with the atomic bombs, again with varied results. For the period 1958-1964, in an early study, Johnson et al (16) found no association. The later report covering the period 1950-1970 suggested an increase of stroke and coronary disease in females heavily exposed (over 2 Sv) in Hiroshima. The effect was not seen in men or in Nagasaki survivors (12).
10. Kodama's 1994 study (16), now covering the period up to 1990, again confirmed an increase in myocardial infarction incidence in heavily-exposed survivors regardless of age, gender or location, although the excess of myocardial infarction was very small compared with the excess of cancers in the population. The relative risk of myocardial infarction at 1 Sv exposure was 1.17. The associated p value is 0.02 with a confidence interval (95%) of 1.01-1.36. Lifestyle risk factors for coronary disease were not adjusted for.
11. In 2004 generally statistically non-significant excess risks were found for incidence of myocardial infarction and hypertension in a follow-up of the Adult Health Study subgroup of atomic survivors (17). Outcomes of other studies of nuclear workers (18) and Mayak workers (19), while suggesting a positive association, show considerable heterogeneity and in most of these study groups there was again no or only limited adjustment for the major cardiovascular risk factors. The most recent Japanese follow-up mortality study, which updates to 2003, does adjust for the major lifestyle and other factors, and reports significantly elevated circulatory disease risk at doses above 0.5 Sv (20), while a 2001 update confirms the causal link to high-dose radiotherapy with doses of the order of 40 Gy, and most commonly seen in those irradiated as children (21).
12. In conclusion, at this date, it is accepted that circulatory disorders, including stroke, coronary artery disease and heart failure may be caused by ionising radiation exposure in high doses, i.e. 500 mSv or more. Below that dose, while the evidence is suggestive, the studies are heterogeneous and not always statistically significant. Most do not adjust for the major known cardiovascular risk factors.

Impact on Departmental normal policy for claims for circulatory disorder due to service-related ionising radiation exposure

13. Claims for circulatory disorders, stroke, myocardial infarction, and cardiac failure linked to service-related ionising radiation exposure will be considered on their case-specific evidence including measured or estimated exposure dose. The literature will continue to be monitored.

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Radiation and cataract

1. There are several causes of lens opacification and development of sight-limiting cataract. These include ageing, diabetes, treatment with oral corticosteroids, trauma to the eye, family history and radiation of various types, e.g. ultraviolet, infrared and ionising. Studies of lens changes and cataract formation are difficult to interpret because of lack of agreed definitions and end points used in the studies. Typically, they focus on lens opacification rather than disabling cataract. The mechanism and longitudinal course of lens opacification is not yet understood and, in particular, whether lens opacification inevitably produces disabling visual loss. In the context of compensation awards, cataract is a treatable disorder with high rates of return to normal visual acuity following operative treatment. It is also not established whether the radiation effect is deterministic with a threshold exposure dose below which lens opacification does not take place, or whether it is in fact stochastic with no level of ionising radiation exempt from some level of risk. In 2007, the ICRP, assuming the process to be deterministic, set the threshold radiation dose for detectable lens opacity at 5 Sv for chronic exposure and 0.2- 2 Sv for acute exposure, with higher doses estimated at 2-10 Sv single acute exposure required for disabling effects (1). More recently, on further review of the evidence, the ICRP has concluded that the lens is more radiosensitive than formerly assessed, and the threshold for chronic exposure has been revised downward to 0.5 Sv for chronic exposures (2) (3).

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Impact on Departmental normal policy in claims for cataract due to service-related ionising radiation exposure

2. Claims for cataract linked to service-related ionising radiation exposure will be considered on their case-specific evidence including measured or estimated exposure dose and as required, calculated PoC. The literature will continue to be monitored.

Glossary

Absorbed dose see **dose**.

Acute radiation syndrome (ARS) The onset, within hours of high-dose whole-body irradiation, of nausea and vomiting followed by destruction and diminished (or absent) replacement of essential blood cells resulting in vulnerability to serious infection and bleeding; recovery is possible but with increasing doses these effects are more severe and death more likely.

Alpha particle A particle consisting of two protons plus two neutrons, emitted by a radionuclide. Alpha particles are produced following spontaneous decay of certain radioactive atoms, such as radium, plutonium, uranium, and radon. Because of its large mass and positive charge, an alpha particle can usually travel only a short distance – less than 1 mm – in water. A single piece of paper can stop an alpha particle effectively. Therefore, health effects of alpha exposures appear only when alpha-emitting materials are ingested (i.e. internal exposure).

Background radiation ionising radiation from naturally occurring radionuclides both in the environment (from soil, rock and building materials and from space – cosmic radiation) and in the body.

Beta particle An electron emitted by the nucleus of a radionuclide. The electric charge may be positive, in which case the beta particle is called a positron. Beta particles are produced following spontaneous decay of certain radioactive materials, such as tritium (an isotope of hydrogen), carbon-14, phosphorus-32, and strontium-90. Depending on its energy (i.e. speed), a beta particle can traverse different distances in water – less than 1 mm for tritium to nearly 1 cm for phosphorus-32. As with alpha particles, the major concern for health effects is after their ingestion (i.e. internal exposure).

Contamination The suspension in air or deposition of radionuclides upon, or in, the ground, water and other surfaces, and personnel and equipment.

- **External contamination** Of a person – deposition, general or localised, of radionuclides upon all, or any, of clothing, hair, skin and/or equipment.
- **Internal contamination** Of a person – deposition within the body, usually by inspiration, by ingestion or sometimes through penetration of (usually broken) skin by radionuclides which will then irradiate the cells of surrounding body tissues.

Cosmic rays High-energy ionising radiation from outer space.

Decay The process of spontaneous transformation of a radionuclide. The decrease in the activity of a radioactive substance.

Dose The amount of ionising radiation received as deduced from the energy absorbed from an external radiation source.

- **Absorbed dose** Quantity of energy imparted by ionising radiation to unit mass of matter such as tissue. Unit gray, symbol Gy. 1Gy = 1 joule per kilogram.
- **Equivalent dose** The quantity obtained by multiplying the absorbed dose by a factor to allow for the different effectiveness of the various ionising radiations in causing harm to tissue. Unit sievert, symbol Sv.
- **Effective dose** The quantity obtained by multiplying the equivalent dose to various tissues and organs by a weighting factor appropriate to each and summing the products. Unit sievert, symbol Sv.

Dosimeter A small device worn on the person to measure absorbed energy and from which a record of **Absorbed Dose** may be obtained.

Dosimetry The estimating, recording and maintaining of records of **dose**.

Emitter A **radionuclide** decays by emission of certain radioactive particles and/or electromagnetic radiation. A particular **radionuclide** may be described as an **alpha** or **beta** or **beta/gamma** emitter.

Fallout The transfer of radionuclides produced by nuclear weapons from the atmosphere to earth.

Fission products The two, invariably radioactive, fragments remaining after an atom has been split (undergone fission).

Gamma ray A discrete quantity of electromagnetic energy without mass or charge, emitted by a radionuclide. Cf X-ray. A gamma ray is similar to ordinary visible light but differs in energy or wavelength. Sunlight consists of a mixture of electromagnetic rays of various wavelengths, from the longest, infrared, through red, orange, yellow, green, blue, indigo, and violet, to the shortest in wavelength, ultraviolet. A gamma ray's wavelength is far shorter than ultraviolet (i.e. it is far higher in energy). Gamma rays are produced following spontaneous decay of radioactive materials, such as cobalt-60 and caesium-137. A cobalt-60 gamma ray can penetrate deeply into the human body, so it has been widely used for cancer radiotherapy.

Ionising radiation Radiation that produces ionisation in matter. Examples are alpha particles, gamma rays, X-rays and neutrons. When these radiations pass through the tissues of the body, they have sufficient energy to damage DNA.

Ionisation The process by which a neutral atom or molecule acquires or loses an electric charge. The production of ions.

Lag time the period from first radiation exposure of a population or individual to the time when a radiation relation effect could be observed, typically a minimum of two years for leukaemia and a minimum of five years for solid cancers.

Linear No Threshold model (LNT) is a model used in radiation protection to quantify radiation risk. It assumes that the long-term risk is directly proportional to the dose. It defines that radiation is always considered harmful with no safety threshold, and the sum of several very small exposures is considered to have the same effect as one larger exposure (response linearity).

Monitoring The process of searching for the presence of and then measuring, reporting and recording radiation **dose rates** found within a given area or on a person.

Neutron A nuclear particle (similar to a hydrogen atom but without electrical charge), emitted during fission and fusion by only a few **radionuclides**; long range (kilometres) in air and highly penetrating; an external hazard only at detonation; densely **ionising**.

Non-ionising radiation Radiation that does not produce ionisation in matter. Examples are ultraviolet radiation, light, infrared radiation and radiofrequency radiation. When these radiations pass through the tissues of the body they do not have sufficient energy to damage DNA directly.

Radiation weighting factor (RWF) A factor intended to take account of the relative biological effectiveness of different types of radiation according to both their energies and how densely ionising they are.

Radionuclide An unstable nuclide that emits ionising radiation.

Relative Risk the rate of disease (incidence or mortality) in an exposed group divided by the rate in an unexposed group. (Usually standardised to adjust for differences in factors such as age and sex between the two groups).

Excess Relative Risk Excess relative risk is expressed as relative risk (RR) minus one, or that portion of the RR accounted for by the particular risk factor under study – i.e. radiation exposure.

Attributable Risk Attributable risk refers to the fraction of diseases or deaths that is estimated to result from exposure to radiation. It increases with dose.

Standardised Mortality Ratio SMR – Useful for comparing deaths in population of interest with that in a standard population

$$SMR = \frac{\text{observed deaths}}{\text{expected deaths}} \times 100$$

SMR < 100 fewer deaths than expected

SMR > 100 more deaths than expected

X-ray A discrete quantity of electromagnetic energy without mass or charge. Emitted by an X-ray machine. Cf gamma ray. X-rays have the same characteristics as gamma rays, although they are produced differently. When high-speed electrons hit metals, electrons are stopped and release energy in the form of an electromagnetic wave. This was first observed by Wilhelm Roentgen in 1895, who considered it a mysterious ray, and thus called it an X-ray. X-rays consist of a mixture of different wavelengths, whereas gamma ray energy has a fixed value (or two) characteristic to the radioactive material.

Abbreviations

ICRP – International Commission on Radiological Protection

NIOSH - The National Institute for Occupational Safety and Health (US Federal Agency)

NRPB - National Radiological Protection Board

Topic 3 - Traumatic Brain Injury (TBI)

Key points

1. On investigation we find that TBI remains a leading cause of death in young adults in developed societies. Case series suggest severe head injury accounts for 3% of total: moderate 22% and mild 75%. There is still no agreed definition for mild TBI (mTBI). mTBI is clinically heterogeneous in both presentation and outcome and the diagnosis is made by exclusion, where the features of severe and moderate TBI are not present. Given the imprecise definitions of mTBI, concussion, and post-concussion syndrome, the relationship between these remains uncertain.
2. The evidence confirms that many patients with mTBI recover completely within months to a year post-incident with both military and civilian mTBI studies recording overall good return to pre injury function and employability. There remain however a minority of patients in whom symptoms and functional disability persist.
3. While standard CT and MRI scans do not exclude diffuse axonal and vascular structural changes, these can be demonstrated by more advanced, although as yet not clinically routine, structural imaging techniques notably diffusion tensor imaging.
4. Recent research is focussed on the relevance of non-routine functional and metabolic imaging modalities such as positron emission tomography (PET), single photon emission computed tomography (SPECT), functional magnetic resonance imaging (fMRI) and magnetoencephalography (mEEG) to detect cellular and metabolic change. Work to date has identified no single robust method of identifying those at risk of developing persistent symptoms and disability after mTBI but findings suggest that targeted application of both structural and functional neuroimaging may be useful.
5. Head injury may result in auditory and vestibular symptoms due to isolated labyrinthine pathology, brain injury, or both, but common non-traumatic causes of hearing loss and balance disorders must be excluded. The disabling functional effects of dizziness in relation to TBI have not been well studied, but in general, dizziness is associated with falls and poorer function in everyday and work-related tasks than before the onset of the symptom. Where dizziness persists in mTBI beyond the immediate post injury period, it is appropriate to take an active approach to diagnosis of symptoms and treatment by expert audio-vestibular investigation.
6. Psychiatric disorders have an increased incidence after TBI but may be present before it and some may make TBI more likely e.g. depressive disorder. mTBI is most likely to be disabling in the presence of a co-morbid disorder. Treatment for psychiatric disorder may improve functional prognosis for those with TBI but the evidence base is underdeveloped.
7. As part of this review IMEG considered the wording of the present Table 6 Head Injury descriptors and related awards, and recommends a few amendments to support robust defensible decision-making based on verifiable facts.

What's new in TBI since the second IMEG report in 2013

- TBI remains a leading cause of death in young adults in developed societies and at any one time an estimated half a million people (aged 16-74) in the UK have long term disabilities as a result of traumatic brain injury.
- Case series suggest severe head injury accounts for 3% of total: moderate 22% and mild 75%.
- There is still no agreed definition for mild TBI (mTBI). mTBI is clinically heterogeneous in both presentation and outcome and the diagnosis is made by exclusion where the features of severe and moderate TBI are not present.
- Given the imprecise definitions of mTBI, concussion, and post-concussion syndrome, the relationship between these remains uncertain.
- Many patients with mTBI recover completely within months to a year post incident with both military and civilian mTBI studies recording overall good return to pre-injury function and employability.
- There remain a minority of patients in whom symptoms and functional disability persist.
- Similar persistent symptoms may be present in TBI of any severity, following other trauma not involving the head, and even in some apparently healthy individuals.
- A number of mTBI case series show persistent symptoms are associated with a more severe initial injury, older age, being female, previous head injuries, as well as pre-injury psychological problems and social stressors.
- Immediately after mTBI, pathophysiological and neurometabolic changes occur, with most neurones capable of recovery.
- While standard CT and MRI scans do not exclude diffuse axonal and vascular structural changes, these can be demonstrated by more advanced, although as yet not clinically routine, structural imaging techniques notably diffusion tensor imaging.
- Biomarkers of cellular and metabolic changes in mTBI are not yet available.
- Recent research is focussing on the relevance of non-routine functional and metabolic imaging modalities such as positron emission tomography (PET), single photon emission computed tomography (SPECT), functional magnetic resonance imaging (fMRI) and magnetoencephalography (mEEG) to detect cellular and metabolic change.
- There is evidence that early education and specific interventions in mTBI can reduce the numbers of cases developing ongoing symptoms and disability.
- Work to date has identified no single robust method of identifying those at risk of developing persistent symptoms and disability after mTBI but findings suggest that targeted application of both structural and functional neuroimaging may be useful.

Introduction

1. The 2013 IMEG report included a brief overview of mild traumatic brain injury (mTBI) and confirmed many uncertainties and gaps in understanding in clinical, operational capability and compensation terms. Because of the relevance of mTBI to the military population, Minister for Defence Veterans Reservists and Personnel tasked IMEG with ongoing review of the emerging literature and, as appropriate, further reports. This paper, informed by literature scrutiny and discussion with military and civilian experts, considers the evidence on TBI, particularly mTBI, since the end of 2012.

2. Topics explored include a general overview of TBI, going on to a more in-depth consideration of mTBI including definitions for mTBI, concussion, post-concussion symptoms and post-concussion syndrome, and diagnosis, clinical management, rehabilitation and outcome of mTBI. We have considered whether there is now a robust method of predicting prognosis of mTBI soon after injury or diagnosis, and in particular its likely long-term effects on function and civilian employability. There has been a recent increase in further AFCS claims from those with awards for mTBI, for mental health symptoms and disorders, and physical symptoms such as fatigue and dizziness considered to be consequential to mTBI. We have looked at the evidence on these, their relation to mTBI and whether they are part of it, separate conditions caused by it, or unrelated, and how, given overlap of symptoms, they should be compensated. Finally, given the AFCS aim of covering through-life disabling consequences of accepted injuries and disorders, the paper briefly considers the contemporary evidence on long-term effects of TBI of all levels of severity, including repetitive brain trauma in contact sports, and later vulnerability to neurodegenerative change and clinical illness, particularly dementia.

Epidemiology and General Background

3. Head injury, more specifically TBI, remains a leading cause of death for those under 40 years in developed societies. It also causes significant disability with an estimated half a million people (aged 16-74) in the UK having some degree of TBI-related functional limitation, the prevalence being higher in children and adults of working age (1). The literature confirms that, over the last 30 years, there has been some reduction in overall mortality and morbidity from head injury. This is largely due to improved road and vehicle design, legislation on speed, drink-driving, seat belts, windscreens, air bags, motorbike and cycle helmets as well as Health and Safety at Work legislation (2).
4. Head injury of any severity is more common in males and most civilian head injuries are due to blunt trauma. In military populations, penetrating injury due to bullets etc., occurs but head injury in the recent conflicts was predominantly associated with blast, often accompanied by multiple serious injuries. Head injury also occurs, as for civilians, due to road traffic and railway accidents, assault, falls, sporting injury and accidents at work and in the home. Modern clinical management of head injury of any severity is the subject of best-practice guidelines (e.g. NICE) with principles based on the pathophysiology of TBI and its improved early management (3).

TBI severity

5. Injury severity is assessed initially by conscious level using the Glasgow Coma Scale and its derivative the Glasgow Coma Score (GCS). The score provides a single-digit summary of severity. The maximum GCS is 15/15 (eyes open spontaneously, obeys commands, orientated) and the minimum is 3/15 (no eye opening response, no motor response and no verbal response to stimulus). Where GCS is less than 8, TBI is categorised as being severe; 9-12 is moderate and 13-15 is mild (minor) (4).

Table 1: Glasgow Coma Scale and Glasgow Coma Score

Feature	Scale	Score
Eye opening	Spontaneous	4
	To Speech	3
	To pain	2
	None	1
Verbal response	Orientated	5
	Confused	4
	Words (inappropriate)	3
	Sounds (incomprehensible)	2
	None	1
Best motor response	Obeys commands	6
	Localizes pain	5
	Flexion normal	4
	Flexion abnormal	3
	Extends	2
	None	1
Total Coma Score		3-15

- Case series from the US and Europe report severe head injury accounting for 3% of the total, moderate 22%, and mild 75% (5). These figures should be taken as indicative only as mild/minor head injury, called mild traumatic brain injury or mTBI in this paper, often goes unrecognised and unrecorded in the acute phase and so may not be reported. This may be a particular risk in amateur sporting enthusiasts and military personnel.

Pathology and pathophysiology of TBI

- Direct trauma to the brain resulting from head injury can lead to a wide variety of acute and long-term pathological changes. Bleeding into the extradural, subdural or subarachnoid spaces, particularly the first of these, can pose immediate or delayed threat to life. These changes do not occur in mTBI. Head injury may lead to single focal or multifocal large or smaller haemorrhages, visible on CT scanning. Again, these do not occur in mTBI. A more subtle pathological change occurs as a result of the acceleration and deceleration forces that, to some extent, are a feature of all head injuries. These forces cause diffuse axonal injury (DAI), the extent of which correlates in the acute phase with the reduction in conscious level. DAI is produced at the moment of injury and is currently considered to be irreversible. Over hours or days, the full effect of severe DAI becomes evident, due in part to brain swelling (cerebral oedema). As the skull is a rigid structure, this leads to increased intracranial pressure (ICP), which in turn leads to reduced intra-cerebral blood circulation and a vicious cycle of lack of oxygen to the brain (cerebral hypoxia), swelling and further increase in ICP, which may be life-threatening. However, in mTBI this does not occur, and the structural changes indicative of much milder DAI require specialist neuroimaging, such as diffusion tensor magnetic resonance imaging (MRI), and have only relatively recently been recognised to occur in some patients with mTBI. Micro-haemorrhages may also be demonstrated by specialist imaging, not evident using standard techniques of CT or MRI scanning (6).

Cellular and molecular physiology of TBI

8. A large body of evidence, acquired from both animal experiments and human studies, indicates that mTBI can alter normal brain functioning for periods lasting from a few hours to several weeks following the acute event (7). At a molecular level, mTBI produces a number of acute changes including abnormalities in neurotransmission, ionic changes, energy usage and cellular metabolism. Excitatory neurotransmitters, such as glutamate, are released in large amounts, causing abnormal neuronal firing. This in turn leads to ionic changes and excessive metabolic demands in neurones, so-called 'excitotoxicity'. The increased metabolic demand results in greater glucose usage and a state of hyper-metabolism. But over time, for reasons that are not fully understood, cerebral blood flow may decrease, leading to a mis-match between the supply of glucose and the demand for it. This may be sufficient in some patients with mTBI to cause cell death, but in many patients, current evidence is that the metabolic abnormalities are reversible (7). It has been suggested that in the absence of demonstrable structural change on MRI following mTBI, psychological symptoms might be due to subtle, reversible metabolic changes of the type described here (8).

Blast-related Traumatic Brain Injury

9. Blast injury, including to the head, has been common in recent conflicts. Moderate and severe blast-related brain injuries were immediately clinically recognisable and absolute numbers were small. However, there was a larger number of personnel who, often, together with injury to other body parts, reported non-penetrating mTBI. Rates of moderate and severe traumatic brain injury were comparable in US and UK troops, while rates of mTBI, often first diagnosed at an interval after combat and based on self-report, were much higher in US troops (9)(10).
10. Primary blast injuries are due to sudden increase in air pressure following an explosion. If casualties are close to detonations, primary blast injury has high mortality, with severe damage to air-containing organs and structures, i.e. chest, abdomen and middle ear. Secondary blast damage occurs when bomb fragments or debris cause penetrating injury. Tertiary blast damage causes rapid displacement of the person within the blast environment, who is then injured by collision with objects and structures in his path. Quaternary blast injury is due to thermal injury and inhalational effects (11). These mechanisms and effects occur to greater or lesser extent in military blast-related TBI, dependent on factors such as: blast energy, distance from the blast, body position, use of body armour and helmets, whether blast was sustained in a closed environment or an open space, as well as number of exposures. Primary blast injury may cause TBI of any severity level while secondary, tertiary and quaternary blast injury are associated with moderate or severe TBI. Current understanding of blast-related mTBI derives mainly from animal models and is incomplete. In addition to the cellular and molecular changes resulting from brain trauma described in paragraphs 7 and 8 above, blast-specific mechanisms in moderate and severe TBI are thought to include sudden increases in intracranial pressure resulting in brain cavitation and blood surge from the thorax to the brain causing small vessel damage and haemorrhage into the brain. Other possible mechanisms include air embolism with injury, via the eye orbits and nasal sinuses, to the orbitofrontal cerebral cortex (12).

Clinical aspects of TBI

11. Every year in the UK about one million people attend Accident and Emergency (A&E) departments with a head injury (13). Of these, 100,000 are admitted to hospital for observation or treatment, including all those with skull fracture, and about 10,000 are transferred to specialist neurosurgical units either immediately or following complications which develop in hospital. At the scene of the accident and in the A&E department, the focus is on achieving respiratory and haemodynamic stability, maintaining

the airway, avoiding hypotension and immobilising the cervical spine until clinical examination or imaging confirms this is unnecessary. Patients for further investigation or transfer to a specialist centre are then identified and referred in line with the national guidelines (3).

12. The pattern of disability after TBI is diverse, ranging from direct focal brain damage, the effects of intracranial haemorrhage, raised intracranial pressure and diffuse axonal injury (DAI). Despite this, most patients with moderate or mild TBI and even survivors of severe head injury make a reasonable physical recovery. However, many studies record long term problems with physical and mental stamina, balance, coordination, hearing, visual impairment including visual field loss, speech, swallowing or continence, as well as cognitive, emotional and behavioural problems. Difficulties with memory, learning, language, attention and concentration and the ability to plan, organise and carry out tasks (executive function) can be difficult to identify in the short term, in a hospital setting, but can have major effects on employability, running a home and family, and relationships, especially when accompanied by emotional problems, anxiety, low mood, irritability, loss of social skills, personality change, and alcohol/other substance misuse. Other ongoing physical problems or risks include:
- a) **Headache.** Headache is common after head injury, with neither pain level nor duration closely linked to the initial severity of the injury, in both civilian and military populations (14). In terms of effective treatment, it is useful to determine the underlying mechanism for the headache, which may include local trauma, muscular tension, cervicogenic (arising from the neck) and migraine. Migraine may occur for the first time or be a reactivation or worsening of a pre-existing condition. In one series, at one year post-head injury, headache was reported in 50% cases of mTBI (15).
 - b) **Sleep disorders.** Insomnia, hypersomnia and disruption of the sleep-wake cycle may complicate recovery from TBI. It is important to properly assess the sleep problem to diagnose primary sleep disorders, such as sleep apnoea or restless legs syndrome, and other conditions causing secondary sleep difficulties. Initial insomnia can be a sign of an anxiety disorder, and problems maintaining sleep may suggest a depressive disorder. Daytime fatigue and somnolence are common sequelae to a sleep disorder. Management is of the underlying condition, if present, and symptomatic approaches include attention to sleep hygiene. Cognitive behaviour therapy (CBT) can help otherwise intractable insomnia (16).
 - c) **Pituitary Dysfunction.** Variable rates of pituitary dysfunction, ranging from 2 to 68% are reported after TBI (17). The large variation may relate to the use of different tests with different normative values, TBI severity and timing of the diagnostic tests. Hypopituitarism, most commonly manifest by GH, ACTH and gonadotropin deficiencies and hyperprolactinaemia, causes metabolic, physical and psychological symptoms, which may recover over time. A 2013 UK study compared the prevalence of pituitary dysfunction in 19 military patients with blast-related TBI and 39 civilians with non-blast related TBI (18). The two groups were well-matched except for time to endocrine testing, which in the blast group was median 15.8 months post incident, compared with median 5.8 months after the head injury in the civilians. Six of 19 soldiers with blast-related TBI had anterior pituitary dysfunction compared with only one of the 39 civilian patients. No hypothalamic or pituitary abnormalities were seen in the MRI scans of any of the blast injury group, including the six with pituitary dysfunction. Three of the six soldiers had brain contusions on MRI. No metabolic or imaging abnormalities were seen in any subjects with mTBI, civilian or military. The findings were not explained by the use of therapeutic drugs, including opiates. The military patients had more polytrauma and the military TBIs were more severe, with worse cognitive function. The results do not explain the mechanism of pituitary dysfunction and more work is needed, but they do suggest that patients with moderate-severe TBI should have routine endocrine function testing.

- d) **Postural Orthostatic Tachycardia Syndrome (POTS).** Autonomic nervous system dysregulation has been reported frequently following TBI, manifest by tachycardia (rapid heart rate) on standing, in the absence of a fall in blood pressure, the so-called postural orthostatic tachycardia syndrome (POTS). Symptoms include dizziness on standing (orthostatic dizziness), fatigue, heart palpitations and feelings of faintness and mental clouding, often leading to severe restriction of daily activities. The main diagnostic criterion is the demonstration of a heart rate increase of more than 30 beats per minute with prolonged standing. Raised levels of noradrenaline, indicative of sympathetic nervous system activation, and low blood volume have been shown in patients with POTS. Treatment, including postural physiotherapy, rehydration, and sometimes drug medication, is usually helpful (19). POTS may develop at an interval following mTBI (20).
- e) **Post-Traumatic Epilepsy.** Post-traumatic seizures are considered to be early (occurring within one week of injury), or late (more than one week post injury). Late seizures can occur for the first time years after injury. The most important risk factor for post-traumatic epilepsy is severity of brain injury. The overall risk of seizures is 3-5%; with closed (non-penetrating) injuries it is 8-9% and in penetrating injuries, the risk is greater than 50%. While about half of those who develop post-traumatic seizures will be in remission 15 years after injury, long-term seizures persist in 10-15% patients after severe head injury, in 5% after moderate injury; for mild injury the risk compared with the general population is only marginally elevated (21).

13. Functional outcome after TBI may be based on the Glasgow Outcome Scale. This uses five categories, two favourable and three unfavourable. They range from death, level 1 on the scale, vegetative state, level 2, and severe disability (dependent) level 3, to moderate disability (independent) which is level 4, and good recovery, level 5 on the scale. While the scale is useful epidemiologically, its use for prognosis in individual patients is much less certain (22). About 40% of patients presenting in coma with severe TBI die, while a further 20% will survive with major disability. For moderate TBI the risk of death is 20% (23). Most patients who sustain mTBI do well, with neuropsychological ability returning to pre-injury level even without specific therapy, although symptoms become persistent in a proportion of mTBI patients (24).

TBI overview

- Head injury, more specifically TBI, remains the leading cause of death in those under 40 years in developed societies. TBI is more common in males and most civilian head injuries are due to blunt trauma. In military populations penetrating injury is more common, but in the recent conflicts TBI was predominantly caused by blast and often accompanied by multiple serious injuries.
- Injury severity is assessed and categorised initially by the Glasgow Coma Score.
- Case series report severe head injury accounting for 3% of total TBI, moderate 22%, and mild about 75%.
- Clinical management of head injury is the subject of evidence-based national guidelines.
- About 40% of patients presenting in coma with severe brain injury die, while 20% will survive with major disability. For moderate brain injury the risk of death is 20%.
- A majority of mTBI patients suffer cognitive deficit and non-specific symptoms in the acute aftermath with long-term function and neuropsychological measures usually returning to pre-injury level by at most one year.
- However, a minority of mTBI patients have persistent symptoms and disability at a year post incident.

Diagnosis and definition of mTBI

14. Following head injury, mTBI may be suspected when the clinical features of moderate or severe TBI are not present. The first evidence-based definition of mTBI came from the American Congress of Rehabilitation Medicine (ACRM). This held that loss of consciousness (LOC) was not necessary for diagnosis of mTBI. Either post-traumatic amnesia (PTA) or other neurological symptoms are in themselves sufficient to make the diagnosis (25). DSM IV in 1994 proposed criteria for post-concussion symptoms occurring within three months following a concussion, which it unhelpfully went on to define in terms of LOC of 5-30 minutes (26). Some resolution of this contradiction was provided by defining three levels of severity of mTBI, based on the ACRM and DSM IV definitions, in terms of LOC, PTA and other neurological symptoms, with an intermediate third category. Other suggestions for definition of mTBI included the results of neuroimaging, so that those with abnormalities attributable to trauma on CT or MRI were regarded as complicated mTBI, while normal neuroimaging meant that mTBI was uncomplicated. However, partly because the diagnosis may be first suggested long after the traumatic event, neuroimaging in the acute stage is often not performed, so this differentiation may be of limited clinical use.
15. Considerable uncertainty over definition and diagnosis of mTBI has therefore remained. The Mayo Classification System, published in 2007, addressed some of the problems (27). While acknowledging the predictive value of GCS, PTA and LOC, the authors considered that their use was in some cases limited, as each may be influenced by failure of documentation and by factors such as post-injury pharmacological sedation, alcohol intoxication, hypotension, organ failure, fractures, and interval following the injury. The Mayo approach aimed to diagnose TBI of all severity levels, based not only, or mainly, on self-report, but on available documentation in medical records. It also acknowledged that post-concussion symptoms (PCS) are not limited to mTBI, but may occur in relation to any TBI. The Mayo group examined the records of a defined population of about 1,500 patients with at least one confirmed TBI between 1985 and 1999. It was found that the standard measures, including LOC, PTA, GCS and head CT had not been carried out or recorded in a large percentage of the cases. For example, a record of GCS was absent in 74%, assessment of consciousness was absent in 70%, PTA in 58% and no head CT scan findings were recorded in 49%. The Mayo system then went on to attempt classification of cases based on available indicators including death, abnormal neuro-imaging, GCS, PTA, LOC and post-concussion symptoms. From these they derived three categories: A, **definite TBI** i.e. moderate/severe; B, **probable TBI** i.e. mild; and C, **possible TBI** i.e. symptomatic.
16. **Category A definite and moderate to severe** was met if one or more than one of the following applied:
 - Death due to TBI
 - LOC of 30 minutes or more
 - PTA of 24 hours or more
 - Worst GCS in first 24 hours less than 13
 - One or more of intracerebral haematoma; subdural/epidural haematoma; cerebral contusion; haemorrhagic contusion; penetrating TBI; subarachnoid haemorrhage; brain stem injury
17. **If none of category A criteria applied, the injury could be classified as category B, probable mild, if one or more of the following was present:**
 - LOC momentary or less than 30 minutes
 - PTA momentary to less than 24 hours
 - Depressed linear or basilar skull fracture

18. If none of A or B criteria applied, category C, possible symptomatic, is met in the presence of one or more of the following:

- Blurred vision
- Confusion
- Dazed
- Dizziness
- Focal neurological symptoms
- Headache
- Nausea

Applying this system to the medical records, all the cases in the sample were classified. For the **definite Group A**, sensitivity was 89% and specificity 98%. The evidence was that this classified more cases than single indicator systems and with reasonable accuracy. For mTBI the potential for false positives was low but there was a risk of false negatives in the category C, possible symptomatic group.

19. Beyond distinction from moderate or severe TBI, a definitive position on mTBI remained elusive and today there are several, although similar, definitions of mild TBI: e.g. WHO, US military (28)(29) and UK HQ Surgeon General (HQ SG) (see below) based on GCS, loss of consciousness (LOC) and post traumatic amnesia (PTA).

UK military definition of mTBI

20. mTBI due to blast was common in the recent conflicts and may have been accompanied by traumatic injury to other body parts. To make a diagnosis of mTBI, HQ SG uses the following definition. All three of the criteria must be met:

- (i) A history of related head injury or involvement in a blast
- (ii) GCS no lower than 13 at 30 minutes post injury
- (iii) One or more of
 - Alteration of consciousness (AOC)/mental state. This may present as a variety of transient physical, cognitive or emotional symptoms. Commonly this includes confusion, disorientation, feeling or looking dazed and difficulty concentrating.
 - LOC for no more than 30 minutes post injury
 - PTA for no more than 24 hours post injury
 - Transient neurological abnormalities, such as focal signs or seizure

These must relate to physical or blast trauma to the head and not to non-therapeutic drugs, alcohol, medications, other illness or psychological trauma (30).

Concussion

- 21.** In the UK mTBI has traditionally been referred to as concussion, especially in the context of sporting injury. This term may be less daunting to the patient than mild traumatic brain injury. It is also in line with the finding that most cases resolve fully. In a military context, as shown by initial findings from the Defence Medical Rehabilitation Centre (DMRC) mTBI/post-concussion symptoms treatment programme, an optimistic encouraging approach is appropriate (31). mTBI has some of the features of the controversial, often subjective, syndromes and persistent non-specific symptoms, without abnormal clinical signs, seen in relation to previous conflicts, such as shell-shock in the Great War and Gulf War Syndrome in Iraq, 1990/91. In the latter, symptoms were ascribed to particular causes and with a prognosis of poor recovery, but despite exhaustive study no clear consensus has emerged on the basis for these symptoms.
- 22.** The medical study of head injury and the term concussion date back over 3,000 years. Over that time, the word has been used in different ways, and today there remains no agreed definition, nor certainty as to whether concussion and mTBI are synonymous or separate clinical entities (32). For the purposes of this paper, the term mTBI will be used to refer to the acute clinical effects, as defined according to HQ SG above and will cover both concussion and mTBI, and, in addition, the longer term sequelae that occur in some patients. These include physical, neurological, vestibular and cognitive symptoms, together with psychological symptoms. In all case series, military and civilian, numbers of mild TBI are considerably greater than for severe or moderate TBI. The clinical features cover a range of severity and clinical heterogeneity and have variable outcomes. Most patients recover rapidly and completely, while there are some patients with persistent symptoms.

Post-concussion Symptoms and Post-Concussion Syndrome

- 23.** Post-concussion symptoms (PCS), often referred to as post-concussion syndrome (PCSyn), and previously referred to as post-traumatic syndrome, comprise multiple symptoms, with normal standard physical examination in the aftermath of an acute mTBI event. Headache, dizziness and tiredness/fatigue are the most common symptoms reported. These may be accompanied by problems with cognition, concentration or memory as well as irritability, reduced libido, sleep disturbance, anxiety and low mood, mood lability, anger and sensitivity to light and noise. These symptoms may occur in TBI of any severity, as well as in relation to many other diagnoses and in healthy people. Where imbalance/dizziness is prominent, neuroimaging and detailed expert vestibular assessment will be needed to exclude labyrinthine pathology. Although PCSyn is frequently referred to in clinical and basic science studies of brain trauma, there is no agreed definition of the syndrome and its validity and specificity have been challenged by several studies. For example, in a prospective study conducted in Lithuania, a large group of patients with mTBI was compared with a group of acutely injured orthopaedic controls, both groups followed from presentation in the emergency department, with further assessments at three months and one year. At three months, two patients with mTBI and three patients in the orthopaedic control group had six core symptoms of PCSyn, and only one patient in each group at one year. However, when less stringent diagnostic criteria were applied, requiring three or more symptoms, the prevalence of PCSyn was 78% of those with mTBI and 47% of the orthopaedic controls (33). In the absence of any generally agreed definition of PCSyn in the present discussion, the symptoms making up PCS and PCSyn are included within the diagnosis of mTBI.
- 24.** In relation to the cause of PCS, a review of post-traumatic syndrome concluded that while the majority of those with mTBI recover fully within at most a year, this was not universal (34). Published studies varied in the proportion of patients with disabling symptoms at a year or more post event and different impressions might be gained, if the study investigated one or multiple disabling

symptoms. Furthermore, much of the large literature on mTBI was conflicting due to study design, flawed methodology and, importantly, the interval after TBI at which symptoms were studied. PCS and the adverse effects of mTBI needed to be considered as a clinical continuum rather than a single event. It was proposed (34) that following mTBI, adverse physical, emotional, and cognitive effects may combine with pre-injury physical and mental health factors so that symptoms become persistent, leading to failure to recover. A more recent authoritative review of outcome of mTBI (7) integrated the recent and existing literature on mTBI, concluding that the cognitive and neuro-behavioural sequelae were self-limiting and predictable, with immediate physiological changes typically undergoing reversal within weeks of injury. In cases where recovery took longer or was incomplete, psychosocial factors such as pre-existing mental ill-health, social stress, or substance misuse problems were key. In summary, although in most circumstances a good recovery can be anticipated, the outcome of mTBI, like its presentation, is clinically heterogeneous. In the immediate aftermath of injury, pathophysiological and neuro-metabolic changes occur, with cells being damaged but in most cases capable of recovery (see paragraph 8). Longer-term persistent symptoms are currently thought to be more related to pre-injury problems, including psychological symptoms and illness, substance misuse, poor general health, the presence of other injuries, pain, and work, home and, in some cases, litigation issues. While understanding of the cellular and molecular physiology of neurological and psychiatric disorders is incomplete, both neurological and psychological categories are disorders of the nervous system (7). For clarity in the AFCS compensation of mTBI we propose that the terms post-concussion symptoms, post-traumatic syndrome and PCSyn are not used in descriptors.

Investigation and Clinical Management of mTBI

- 25.** A biopsychosocial model emphasises the need to adopt a broad approach to the assessment and management of patients with mTBI and multiple persistent symptoms. Clinical management of mTBI in civilians and in the UK military is based on a multidisciplinary assessment of physical, psychological and social aspects of TBI. Particular factors include neurological deficits, such as cognitive deficits of sustained attention, concentration and memory, as well as personality change as might occur with frontal lobe damage. It is important to address any sleep problems and comorbid psychiatric symptoms and disorders (see below), which can both affect cognitive function. Appropriate medication may sometimes help comorbid neuropsychiatric disorders. Occupational therapy and vocational rehabilitation are mainstays of rehabilitation. Cognitive rehabilitation may be helpful, but the evidence of efficacy is limited (35).
- 26.** Given circumstances where initial medical assessment and accurate documentation in Service medical records may not have been possible or thought necessary, a particular problem in clinical management and compensation terms for combat-related mTBI is retrospective diagnosis based on self-report, often days or much longer after the event. Although screening tools, such as the US Military Acute Concussion Evaluation (MACE) and increasing numbers of computer-assisted assessment tools exist, they have limitations. These include timing of screening: MACE is not useful more than 12 hours post injury. Then there is the need and certainly desirability of a baseline pre-exposure/incident assessment. This is rarely available. Standard CT and MRI scanning are normal in mTBI, and the specialist structural and functional neuroimaging techniques, which may demonstrate subtle abnormalities, are not yet routine in clinical practice. Finally, there are no reliable blood biomarkers of mTBI (36).
- 27.** Although the reported incidence of blast-related mTBI amongst UK troops in Iraq and Afghanistan was much less than in US soldiers, 500 out of 26,000 military casualties or about 2% compared with 14% - 30% in some US series, the number was considered sufficient to lead to the setting up of a multidisciplinary mTBI unit at DMRC Headley Court.

- 28.** In the DMRC mTBI unit, management was multidisciplinary, and initially mainly outpatient-based education about mTBI, explanation of PCS and expected progress. In most cases, symptoms, including cognitive impairment, resolved by three months. However, up to a third of patients reported symptoms beyond six months. Admission for neurorehabilitation was arranged for those with persistent cognitive problems, difficulty with information processing, multi-tasking and/or executive function. Where neuropsychological assessment by a clinical psychologist confirmed cognitive deficits, the approach used was compensation techniques and training with emotional symptoms, especially anger, irritability and low mood treated according to established best mental health practice.

Functional Outcomes in military and civilian TBI cases

- 29.** Clinical experience of outcomes in military cases (Dr E McGilloway, personal communication, 2015) includes results from one DMRC series of about 60 military brain-injured patients, who were contacted via telephone interview, two to three years after discharge from the neuro-rehabilitation group at DMRC. There was about 50% response rate; at the time of the survey about 65% were in some form of employment, military or civilian, with about one third unemployed. No details regarding the precise type or severity of brain injury were available. In another group of exclusively mTBI patients, all highly motivated to stay in military service, many got better; 83% had returned to work following the mTBI programme and two years later, 65% were still at work (Dr E McGilloway personal communication, 2015). It is difficult to be certain of the role of mTBI in this outcome or even if any physical brain injury had actually occurred. In some cases there was no obvious head injury at the moment of the blast, the personnel concerned were able to continue to function at a high level in their military roles in the immediate aftermath, and diagnosis depended mainly on self-report at an interval following the event.
- 30.** A recent prospective study of functional improvement from DMRC, investigated 91 military patients with TBI admitted for neurorehabilitation, with complete data for the admission to discharge periods and at four months post-discharge, when independent living and employment status were assessed (37). 21 had mTBI, 35 moderate, and 35 severe TBI. Before injury all were fully fit and employed. The average age was 27 years and admission length was 63 days. At four months post discharge, 92% were in community-based employment, 8% were unemployed or in sheltered work, 87% were living independently and the remainder had support in their own home. None was in institutional care. The outcome measure used in the study was the Mayo-Portland Adaptability Inventory - fourth edition. This describes global outcome after acquired brain injury and includes several subscales, including: Ability, describing physical and cognitive abilities; Adjustment, describing emotional and interpersonal problems; and Participation, which describes involvement in social, community and productive activities. Scores for all patients improved with the rehabilitation programme, but improvement was most marked in those with moderate and severe TBI. Of the five unemployed at four months after the intervention, three were in the mTBI group and 2 had moderate TBI. None of those with severe injuries was unemployed. This result is perhaps counterintuitive and the study confirmed that the unemployed patients all experienced mental health co-morbidities, such as disabling depression and Post-Traumatic Stress Disorder (PTSD). While acknowledging the short-term nature of the study, the authors concluded that including vocational rehabilitation in neurorehabilitation programmes was beneficial and, given the positive effects of being in employment for the individual, family and society at large, also cost-effective.
- 31.** A 1994 study (38) followed up 366 civilian TBI patients for one year, compared to 96 patients with other trauma. They found low rates of employment in those with either severe or moderate TBI, as measured by the initial GCS (less than 30% employed with GCS less than 9; 55% employed with GCS of 9-12). But 80% of those who had mTBI, diagnosed only on an initial GCS of 13-15, were working, which was similar to the 85% of controls employed by one year. Correlates of unemployment included age, educational level achieved and unstable pre-injury work record. In another study, it was found that premorbid substance misuse multiplied the likelihood of later unemployment by a

factor of eight (39), and anosognosia (unawareness of either limitations or being unwell) was another predictor of unemployment (40). A 2014 systematic review of return to civilian work after mTBI looked at almost 300 studies, noting the very varied patient characteristics, different mTBI definitions and so likely heterogeneity, short follow-up of only two years, and the fact that few of the individual studies considered employment outcomes. As a result the authors cautioned that findings should be considered preliminary. mTBI was found not to predict long term work disability, with most workers returning to work within three to six months of injury (41). The earlier 2004 WHO Collaborating Centre Task Force study on mTBI found that compensation/litigation issues predicted persistent post-concussion symptoms (24) and similarly, insurance claim closure was much faster where there were no payments available for pain and suffering (42).

- 32.** Overall, function and employability outcomes in mTBI follow-up studies vary widely. Many studies with pre-injury baseline show good recovery in cognition at three to six months post injury (43) (44) (45) but a proportion report irritability, forgetfulness and concentration problems at six months, and in some studies up to a third do not resume work or activities at pre-injury level (46) (47). The studies are unable to clarify whether these outcomes relate to traumatic brain damage, psychosocial factors or a mixture of both. Evidence does suggest that patient education and specific intervention, e.g. on headache, can reduce persistent symptoms and disabling effects in those with mTBI (48) and so early identification of mTBI patients at risk for developing chronic disabling symptoms would be useful.

Predicting prognosis in mTBI

- 33.** Some studies have looked at clinical predictors. A 2017 Dutch observational cohort study, called UPFRONT, collected information on pre-injury, social and injury-related factors in 679 mTBI patients of all ages seen at emergency departments (ED) (49). The mTBI group was sub-divided, based on GCS and CT scan abnormality and risk factors were recorded in the ED. Two weeks later data on mood, presence of emotional distress and coping style were also collected. The study outcomes were “complete recovery” or “less than complete recovery” based on the Glasgow Outcome Scale and the data were subject to logistic regression analysis. At six months post incident, 56% were completely recovered based on the Glasgow Outcome Scale with 44% having incomplete recovery. Findings were broadly in line with other studies (50) in that lower education level, female sex, psychological problems pre-injury, lower GCS score, shorter PTA, and intoxication were predictors of incomplete recovery at six months. The authors also identified two new factors, lack of alcohol use on the day of injury and neck pain as predictive of poor recovery. They further refined the model by adding factors present at two weeks post injury. These were depression, anxiety or post-traumatic symptoms and passive coping style. On analysis the ED model was poor at discriminating and liable to identify false positives and negatives, while the extended model taking account of coping style and emotional distress was a better predictor, but application was likely to be more complex in practical terms.
- 34.** To be clinically useful, discriminators must be robust and as simple as possible logistically. In prospective observational studies like the Dutch study, an important potential source of bias is drop-out rate over time, with more severely affected patients more likely to remain in view and so limitation of generalizability. More light was thrown on the issue by a 2017 US study of 421 mTBI sufferers (51). These were again divided into sub-groups dependent on GCS and the presence or absence of CT abnormality at presentation. A control group of 120 trauma patients without head injury was included. The outcomes considered at one month and one year post incident were neuropsychological measures, Glasgow Outcome Scale and post-traumatic symptoms. While at one year post injury no differences were found between any of the mTBI groups or controls on the Glasgow Outcome Scale and only the mTBI group with GCS 13-14 and CT abnormality showed worse performance than any other group or controls on a single measure of episodic memory and learning, post-traumatic symptoms at one year were uniform across the mTBI injury severities and three times the level reported by the trauma controls. These results are similar to some other studies (52) (53) but again

results across the literature are not consistent. Two studies by Meares and colleagues (54) (55) found comparable rates of post-traumatic symptoms in mTBI without CT abnormality and trauma controls, although symptoms in these studies were evaluated at five days and three months post incident.

- 35.** The third potential approach to identifying “at risk” mTBI patients involves functional imaging. The recent literature documents significant advances in high resolution neuro-imaging including functional and metabolic imaging modalities. Techniques include positron emission tomography (PET), single photon emission computed tomography (SPECT), functional magnetic resonance imaging (fMRI) and magneto electroencephalography (MEEG). A 2017 paper reviews the various modalities, their strengths, limitations and costs and discusses how, in the future, combined with structural imaging techniques, they might lead to better understanding of the pathology and metabolic changes of mTBI over time as well as enhancing detection, diagnosis, early identification and treatment of those at risk of persistent symptoms and disability (56). The outcome of mTBI in an individual appears to be multifactorial, dependent on factors additional to the TBI itself, and while post-trauma symptoms are not specific to mTBI, most studies to date have recorded higher levels of symptoms post mTBI than associated with trauma to other body parts. Study design, timing of outcome measure, clarity regarding criteria for diagnosis and a multifaceted approach informed by clinical and objectively verifiable investigation seems most likely to extend our understanding of mTBI and its effects.

Summary:

- Many mTBI patients suffer cognitive deficit and non-specific symptoms in the acute aftermath.
- Across the categories of mTBI, patients report higher rates of persistent post-traumatic symptoms than do trauma controls.
- Several studies suggest that early education and psychological intervention can prevent or reduce development of post-traumatic symptoms. More work on early identification of “at risk” patients is awaited.
- Results from the extensive published literature considering predictors of long term disabling symptoms in mTBI use different definitions of mTBI, outcome measures and time of outcome assessment and have inconsistent findings.
- Recent work combining more rigorous study design and clinical selection of cases with targeted structural and functional neuroimaging seems promising in terms of understanding mTBI.
- We will continue to monitor the literature.

TBI long term outcomes and life expectancy

- 36.** As well as long-term disability, TBI reduces life expectancy in those individuals surviving the acute stages. Most studies considering prognosis and long-term outcome are based on TBI patients admitted or at least seen at hospital. They do not otherwise differentiate the severity of TBI and there are no published civilian or military studies looking at long-term prognosis in mTBI. Although there is some variation owing to methodological issues, in most 20th century studies, findings are that about a third of those who reach hospital after a severe head injury will die during the next few weeks, either from primary brain injury or from intracranial or systemic complications. Those who survive, but are left immobile and with high dependency, survive on average 15 years, while those who recover mobility and at least some independence after a severe head injury, and nearly all those with a moderate or mild head injury, are held to have normal life expectancy (57).

- 37.** More recently, evidence is emerging that even mTBI may be associated with increased mortality (58). This suggests that factors other than the severity of the brain injury itself are involved in determining prognosis. Normal life expectancy in any population is generally influenced by socioeconomic indices and lifestyle factors. Studies in Glasgow and Sweden have thrown some light on the issues.
- 38.** The head-injured patients studied in Glasgow were recruited from those admitted to the five general hospitals in Greater Glasgow over the period February 1995-February 1996. The original cohort included all severe and moderate head-injury cases and a random sample of those with mild or unclassified injuries. All ages were included. This group was compared with two control groups. The first was made up of people admitted to Glasgow hospitals because of "other injury" in the same year as the head-injury cohort and matched for age, gender, social deprivation, date and duration of admission. The second control group comprised community controls matched to study subjects by age, gender and social deprivation. The groups were reported at one year post injury and at five to seven years (59) (60), with the thirteen-year outcome published in 2011, when 40% of the head-injury group had died (61). Their death rate was more than twice that of community controls, 31 per 1,000 per year, compared with 14 per 1,000 per year in the community group. More than a year after injury, death in young adults aged 15-54 years was 17 per 1,000 per year, compared with 2 per 1,000 per year in community controls, more than six times higher. The difference was less amongst older adults at 61 per 1,000 per year compared with 42 per 1,000 per year. When mild head injury in young adults was excluded, the death rate was 15 per 1,000 per year compared with 2 per 1,000 per year in the community controls. Female gender and increased social deprivation were not associated with increased death rates and the causes of death were as in the general population. It should also be noted that deaths were also elevated compared with the general community for those with injury other than head injury, although less than for head injury. The reason for increased mortality after head injury, especially mTBI, is not yet fully explained, although all cases were of sufficient severity to have been admitted to hospital and cases of TBI were not differentiated based on CT scanning, potentially allowing more severe cases to be included in the mTBI group.
- 39.** The relatively small Glasgow follow-up studies are complemented by a more recent 41-year follow-up Swedish population register-based study, looking at all persons born in Sweden in 1954 or later who received an in-patient or out-patient ICD diagnosis of TBI from 1969 until 2009 (62). Mortality rates were compared six months or more after the injury, with those of a general population group matched on age, sex and socio-demographic characteristics, and with another group of unaffected siblings. The study particularly examined traumatic causes of death, including suicide, drowning, road traffic accidents, and assault. Amongst those surviving six months after injury there was a three-fold increase in mortality compared with the general population and an increased odds ratio of 2.6 compared with unaffected siblings. Risks of death from suicide, injuries and assault were elevated. In those with TBI, absolute rates of death were high in those with any life-time psychiatric or substance misuse co-morbidity. Those with substance misuse alone were more likely to die than those without co-morbidity.
- 40.** The power of the Swedish study, comprising 218,300 patients with TBI, compared with the Glasgow cohort of fewer than 800 TBI patients, is particularly important in considering rare outcomes. Although both Swedish and Glasgow studies had similar overall mortality rates, the Swedish study was able to demonstrate higher suicide rates. Premature mortality was increased in TBI patients compared with controls adjusted for socio-demographic factors, in the absence of lifetime mental health disorder, and when those with co-existing multiple injuries were excluded. These findings suggest that TBI itself could be an independent risk factor for premature death. The Swedish register-based study has some limitations, for example, the registers were not validated for TBI, and probably only the more severe depression and substance misuse cases were identified.

TBI prognosis and life expectancy

- The majority of patients with severe TBI are permanently affected, with many disabilities, leading to unemployment.
 - About half of patients with moderately severe TBI return to work.
 - The large majority of patients with mTBI make a good recovery and return to work.
 - In some patients with mTBI, the delayed onset of symptoms emphasises the importance of the psychological impact and consequences of the injury.
 - TBI may increase the risk of developing long-term mental health disorders and the risk of premature death, but the evidence in relation to mTBI is inconclusive in civilian populations.
 - Long-term prognosis studies of mTBI in both military and civilian populations are needed.
- 41.** The next two sections discuss in depth dizziness and balance problems in relation to TBI and similarly associated mental health symptoms and illness.

TBI and Hearing Loss, Vertigo and Dizziness

- 42.** Dizziness, vertigo, unsteadiness, hearing loss and tinnitus are common symptoms following both blunt and open head trauma, with and without temporal bone fracture, and may become persistent, despite the absence of objective labyrinthine or cerebral pathology (63). A prospective study identified 52% of adolescents and young adults demonstrating persistent symptoms more than three months following mTBI (64). A retrospective analysis of case notes on 465 military personnel, who had sustained mTBI, revealed approximately two thirds suffered audiometric threshold shifts and half developed tinnitus (65).
- 43.** Conductive hearing loss may be related to external or middle ear damage and may improve spontaneously or be surgically remediable but will be permanent in a small percentage. Labyrinthine and eighth nerve damage will lead to permanent sensorineural hearing impairment, while brainstem or hemisphere pathology will cause auditory processing dysfunction with a total or partial inability to discriminate degraded speech, speech in background and localise sounds, despite normal peripheral auditory function (66).
- 44.** Balance symptoms are almost universal in mTBI, but usually resolve within three to six months. However, many studies report that patients with dizziness and moderate (47%) or mTBI (20%) remain symptomatic five years post event, giving rise to long-term occupational and social disability (67). Causes of persisting or recurrent dizziness include labyrinthine and non-labyrinthine pathologies such as structural central nervous system injury or interactions between migraine, patients' self-perception, predisposing psychological states, and environmental and stress-related factors.
- 45.** The audio-vestibular effects of head injury depend on the site and type of damage sustained. Peripheral labyrinthine pathology is common in TBI, giving rise to sensorineural hearing loss, benign paroxysmal vertigo and labyrinthine concussion, while cerebral involvement of the auditory and vestibular pathways, non-labyrinthine and non-traumatic causes of dizziness, common in the population, must be excluded.

- 46.** 80% of temporal bone fractures are longitudinal (68), typically resulting from blows to the parietal and temporal regions of the skull, and commonly associated with lacerations of the tympanic membrane and ossicular damage, giving a conductive hearing loss, bleeding from the ear, and a transient facial nerve weakness. Labyrinthine concussion may result in an additional sensorineural hearing loss of variable degree, which may recover to some degree, but frequently there is a residual, high-frequency hearing loss. Patients may also suffer vertigo or imbalance, which usually recovers over a few months as traumatic vestibular end organ pathology resolves or secondary cerebral compensation, which may be spontaneous or follow vestibular rehabilitation physiotherapy, renders patients asymptomatic.
- 47.** Blows to the back of the skull (occiput) may cause a transverse fracture of the temporal bone, crossing the vestibule of the inner ear and transecting the VIII nerve (69). Bleeding from the ear is rare, but there may be blood in the middle ear, and commonly there is labyrinthine failure, with profound, permanent, sensorineural hearing loss, vertigo, nausea and vomiting, together with facial palsy, which is permanent in 50% of cases. The vestibular symptoms generally recover over a few weeks due to cerebral compensation, as above, although there may be permanent or prolonged unsteadiness and a tendency to veer to the side of the affected ear for many months, requiring intensive vestibular rehabilitation physiotherapy.
- 48.** Base of skull fractures may cause bilateral labyrinthine failure, with profound, bilateral hearing loss and bilateral vestibular failure, resulting in severe ataxia and oscillopsia (bouncing vision on head movement). With appropriate rehabilitation there may be some recovery of balance, but unsteadiness, oscillopsia and a tendency to fall persist. Hearing loss does not recover, but if the VIII cranial nerve remains intact, cochlear implantation may aid hearing and communication.
- 49.** Labyrinthine concussion defines a collection of auditory and vestibular symptoms arising from non-specific damage to the delicate labyrinthine structures. The different mechanisms hypothesised include direct or contre-coup head trauma or whiplash injury, associated with membrane rupture, hypoxia, changes in capillary permeability, petechial haemorrhages in the sensory organs or neural structures, or an ischaemic event and with or without TBI. High-frequency hearing loss is most common, and least likely to recover, while approximately one third of cases with associated low-frequency loss show improvement (70). Conversely, vertigo and/or unsteadiness usually recover within a few months, but may last longer depending on the efficacy of cerebral compensation.
- 50.** Benign paroxysmal positional vertigo (BPPV) is the most common vestibular presentation after head injury, with or without fracture, and post-traumatic BPPV (tBPPV) has a poorer prognosis than other aetiologies of this condition. The disorder is caused by otoliths, which it is assumed are dislodged by high accelerations and move under gravity into a semi-circular canal, where they impinge on the function of the semi-circular canal balance receptor organ. Characteristically, clusters (lasting weeks or months) of brief (10-20 sec) positional episodes of vertigo occur over months or years, with long intervals of freedom between clusters of episodes (71). The diagnosis is made clinically by observation of specific characteristics of positional nystagmus, correlated with each semi-circular canal, using the Dix-Hallpike and roll manoeuvres. Treatment relies upon physical particle repositioning procedures, targeted at the affected canal. In many cases of the commonest posterior canal BPPV, only a single manoeuvre will be required (72). Recent studies have identified traumatic BPPV as being more resistant to treatment and, compared to the idiopathic form of the disorder, affecting more than one canal (73).
- 51.** Other much rarer traumatic labyrinthine problems, well described in severe TBI, but not in mTBI, where they remain the subject of debate, include perilymphatic fistulae (74) (75) and post-traumatic Meniere's disease (76). In a significant proportion of cases of dizziness after TBI, no vestibular abnormality is found and this may reflect cerebral pathology, recovered vestibular pathology or, if there is a delay in investigation, psychological or non-vestibular pathology giving rise to vestibular symptoms.

- 52.** The main causes of persistent traumatic hearing and balance symptoms unaccompanied by labyrinthine pathology are:
- TBI of any severity
 - Post traumatic migraine with vertigo
 - Whiplash injury with associated TBI secondary to acceleration/deceleration injury
- 53.** Traumatic brain injury, including mTBI, can lead to diffuse axonal injury, and traction on or contusion of the brainstem or cerebellum, which may disrupt auditory, vestibular and postural reflex pathways with symptoms which may be persistent. There may be no LOC or abnormal neurological signs, and normal computed tomography (CT) scan and magnetic resonance imaging (MRI). Detailed audio-vestibular investigations to differentiate a labyrinthine from neurological vestibular or central auditory pathology are essential.
- 54.** In a retrospective cohort study of military personnel with mTBI versus non-head injury, those with mTBI (n = 334) were more likely than the non-head injury (n = 658) group to report several symptoms, including tinnitus (odds ratio [OR] = 1.63, 95% confidence interval [CI] = 1.10–2.41) and dizziness (OR = 10.60, 95% CI = 3.48–32.27) (77). Furthermore, another study of 176 mTBI patients found that non-specific dizziness and fatigue symptoms were more prevalent in those without abnormalities on cerebral imaging, whereas those with imaging abnormalities were more likely to have auditory or vestibular abnormalities (78).
- 55.** Post-traumatic migraine-like headaches are common after minor trauma to the head and neck (79) and in a recent study of military personnel with mTBI and resulting dizziness, 41% were diagnosed with post-traumatic vestibular migraine (80). Vestibular migraine is now a recognised entity with established diagnostic criteria (81). The vestibular symptoms of migraine vary in severity, character and duration: episodic spinning (lasting seconds to hours), rocking or to-and-fro oscillation sensations, intolerance to head or visual motion, or floating, lasting between 5 minutes and 72 hours. The development of vestibular migraine is predicted by a prior history or family history of migraine. Motion sickness and female gender are also relevant (63). Current diagnosis and management of traumatic vestibular migraine parallels that for idiopathic migraine.
- 56.** The multiple systems and interactions that control balance may be disrupted by medical, neurological, otological and psychiatric disorders such as anaemia, cardiac dysrhythmias, postural hypotension, cerebellar degenerations, neuropathies, vestibular neuritis, labyrinthitis, Meniere disease, channelopathies and anxiety disorders. All require exclusion prior to diagnosing a primary traumatic cause of vestibular symptoms in association with mTBI.

TBI and audiovestibular symptoms

- Head injury may result in auditory and vestibular symptoms due to isolated labyrinthine pathology, brain injury, or both, but common non-traumatic causes of hearing loss and balance disorders must be excluded.
- Central nervous system auditory and vestibular dysfunction carries a poorer prognosis and is less amenable to treatment than labyrinthine causes.
- Labyrinthine injury in TBI may give rise to conductive and/or sensorineural hearing loss, with or without tinnitus. Auditory amplification, tinnitus devices, hearing tactics and counselling are frequently of therapeutic value.
- Failure of recovery from traumatic labyrinthine vestibular injury is commonly associated with psychological and cognitive symptoms.

- Labyrinthine concussion which reflects vestibular sensory organ dysfunction may resolve spontaneously; while cerebral compensation, enhanced by vestibular rehabilitation physiotherapy, commonly leads to symptomatic recovery if unilateral but bilateral pathology carries a poorer prognosis.
- Benign paroxysmal positional vertigo is the commonest traumatic vestibular presentation and is more resistant to the highly effective standard treatment of a particle repositioning procedure than idiopathic BPPV.
- The disabling functional effects of dizziness in relation to TBI have not been well studied, but in general, dizziness is associated with falls and poorer function in all day and work-related tasks, than before the onset of the symptom.
- Overall in mTBI where dizziness persists beyond the immediate post-injury period it is appropriate to take an active approach to diagnosis of symptoms and treatment by expert audio-vestibular investigation.
- Vestibular rehabilitation is highly effective in symptom recovery and functional improvement in labyrinthine vestibular symptoms and to a lesser extent in neurological causes of dizziness.
- Psychological factors should always be considered and investigated if there is failure of improvement in labyrinthine imbalance.

TBI and mental health symptoms and disorders

- 57.** Although the majority of patients who sustain a TBI do not suffer from a discrete mental health disorder afterwards, the prevalence of such conditions is increased after TBI. These psychiatric conditions can be: the cause of the TBI, such as alcohol misuse leading to head injury; caused by the TBI; or independently comorbid. The most common psychiatric disorders found in those with a previous TBI are mood disorders, such as depressive or anxiety disorders, post-traumatic stress disorder, and substance misuse. Additional neuropsychiatric disorders, such as permanent cognitive difficulties and personality change, can complicate recovery from more severe TBI (82).
- 58.** A recent systematic review from the Netherlands looked at the pre- and post-injury prevalence of, and risk factors for, anxiety and depressive disorders following traumatic brain injury (TBI) in civilian adults (83). TBI was defined as an “alteration in brain function or other evidence of brain pathology caused by an external cause.” There was no restriction on the method of diagnosis of TBI nor on its severity. For the psychiatric disorders, only studies using structured interviews for diagnosis were examined. 34 studies were described. Some studies assessed anxiety disorders and some depressive disorders, with a few considering both. Prevalence rates of disorders in the individual studies were variable but pooled prevalence rates before TBI were 19% for anxiety disorder and 13% for depressive disorder, followed by 21% for anxiety disorder and 17% for depressive disorder in the first year after TBI. Follow-up time varied, but in some studies was over 30 years. In this follow-up period the prevalence rates increased further to 36% for anxiety disorders and 43% for depressive disorders. Risks for these disorders included being female, unemployed, and having a psychiatric disorder before TBI. The review has some limitations including that the population had no military personnel and was limited to ages 16- 59 years. There was no differentiation of severity of TBI, and in terms of psychiatric outcomes, the focus was restricted to mood disorders, with no information on substance misuse or PTSD. The review was also silent on cognitive impairment and on PCS, both of which may contribute to or interact with psychiatric disorders after TBI. It also could not comment on whether post TBI psychiatric problems were incident cases or recurrent.

- 59.** A large study of 327,388 US veterans of the Afghanistan and Iraq wars found 7% had suffered a TBI, of whom 89% had a psychiatric disorder, especially PTSD (84). These high rates may be related to the fact that all veterans were seeking care and help from a Veterans Administration healthcare facility. Bailie and colleagues studied 1,341 military personnel who had suffered a combat related mTBI in the previous two years (85). They used a neurobehavioural inventory and PTSD checklist in order to provide symptoms, which they entered into a cluster analysis to find four groups of patients: 22% had PTSD, with prominent dissociation and hyperarousal, 22% had a cognitive pattern of symptoms with headaches and concentration/memory problems/dizziness and fatigue, 19% had a mixture of both patterns with many symptoms, and 38% were well.
- 60.** Traumatic injury of any type occurs in psychologically stressful circumstances which may cause stress reactions. These may be symptomatic and transient or develop into discrete diagnosable disorders. Because traumatic physical injury is common and resultant mental health symptoms and illness are major health care issues, there is a substantial international literature exploring the nature and extent of trauma-related mental health problems, particularly in civilian populations. A range of psychiatric diagnoses can follow traumatic physical injury, but the main focuses of the studies have been PTSD and mood disorders.
- 61.** One Australian series studied over 1,000 patients hospitalized with a mixture of traumatic injuries (86). At 12 months after injury, 31% were found to have a psychiatric disorder diagnosed by standardised psychiatric interview; 22% had a new (incident) psychiatric disorder. New diagnoses were depressive illness (9%), generalised anxiety disorder (9%), PTSD (6%), and agoraphobia (6%) (comorbidity explains the high cumulative number). Unfortunately, the study had no matched control group, but rates of psychiatric disorder were five times that of the general Australian population. The study looked specifically at mTBI and psychiatric diagnoses, finding increased risks for social phobia, panic disorder, agoraphobia and PTSD, when compared to patients with non-brain injuries. Functional impairment was associated more with having a psychiatric disorder rather than the nature of the TBI. The limitations of the study include the fact that all patients had been admitted to hospital, and those who dropped out were on average younger and less severely injured. These limitations suggest that the rates of psychiatric disorders after mTBI may have been overestimated.
- 62.** There is some controversy on the potential link between TBI and PTSD. Some experts have taken the view that impaired consciousness and PTA reduces memory of the circumstances of injury and so the risk for PTSD should be reduced in TBI, whereas others believe that the severity and context of the TBI determine PTSD. There are limits to the design of many studies looking at the links between TBI and psychiatric disorders including diagnosis based on medical records not clinical assessment, mTBI diagnosis dependent on self-report, and the fact that studies are often retrospective in design. Findings from such studies are inconsistent, with some reporting high levels of PTSD and others finding similar rates of PTSD in mTBI and non TBI injury. PTSD was not the most common diagnosis in the Australian study and when it did occur there was high co-morbidity.
- 63.** The issue is further complicated by the different definitions of PTSD used in different studies. The DSM V and future ICD 11 (due out in 2018) definitions of PTSD vary, not least in the definition of the exposure to and nature of the traumatic event thought necessary to trigger the illness. The American DSM V criteria are more liberal, particularly on exposure. So it is unsurprising that studies have shown significantly lower prevalence rates in the same patients using the proposed ICD 11 criteria in comparison to DSM V, and only moderate overlap between the two different sets of criteria (87) (88).
- 64.** A small longitudinal study of 74 previously healthy Finnish adults with mTBI and 40 orthopaedic controls attempted to address some of the methodological limitations of studies looking at the relationship between mTBI and psychiatric disorder (89). Patients were enrolled from an emergency department. The mTBI group first had a CT scan and were screened to meet WHO criteria for mTBI. Both mTBI patients and ankle injury controls were aged 18-60 years and previously healthy. The study

looked at progress at 1, 6 and 12 months after injury and considered cognition, post-concussion symptoms (PCS), depression, traumatic stress, quality of life, satisfaction with life, resilience and return to work. At one month, patients with mTBI reported more PCS and fatigue than the controls, but by six months the groups did not differ on cognition, fatigue or mental health. By 12 months the level of PCS and quality of life was similar in both groups. 96% of the TBI group had returned to work/normal activities by 12 months, although some were still reporting PCS symptoms. A large percentage who had persistent symptoms had a modifiable psychological risk factor at one month (depression, traumatic stress, low resilience) and at six months they reported PCS, fatigue, depression, stress, and poor quality of life.

65. The study showed that previously healthy adults sustaining mTBI have a good prognosis. A number of possible reasons for the robustness of the findings were proposed by the authors, including the highly selected previously healthy study groups, who were given information about the injury and likely progress. There may also have been cultural issues regarding expectations following a traumatic injury and there were few participants involved with litigation. No interventions took place and there was a low drop-out rate. It is generally observed that patients who do not attend follow-up in such studies are younger and have made a reasonable recovery. This particular cohort might then have had a larger proportion of recovering patients than usual, although 20% of the TBI cases had trauma-related findings on brain MRI. While outcome is poorly defined in many mTBI studies, outcomes in this Finnish study were measured across a range of domains. An important finding was that recovery was not uniform across the domains and in particular in relation to function, return to work often preceded symptomatic recovery, with about 30% mTBI patients and 20% controls reporting mild PCS at 12 months. The symptomatic mTBI patients did not have more severe initial injury based on MRI or duration of LOC, nor were there differences in age, education or sex. Both mTBI and control patients with PCS at 12 months were more likely to have a mental health problem. They also had more severe PCS at one month and modifiable psychological problems throughout the first year (e.g. depression, stress, low resilience). This suggests that such patients might well benefit from evidence-based treatment and rehabilitation early in the recovery period.

Treatment of psychiatric disorders associated with TBI

66. Since having a concurrent psychiatric disorder is associated with not returning to employment after TBI (90) treatment of such illnesses is important in determining functional prognosis. Unfortunately, there is a limited evidence base for treatments of neuropsychiatric and psychiatric disorders following TBI (91) (92). Multidisciplinary rehabilitation programmes are particularly recommended, but psychotherapeutic interventions such as CBT may need adaptations taking into account cognitive challenges secondary to the TBI (93). There is some good evidence that CBT can help return such patients to employment (94).

Distinguishing mTBI and Post-Traumatic Stress Disorder (PTSD)

67. Problems of differentiating mTBI and PTSD are not new. 10% of British casualties in the First World War, where close range artillery barrages and mortar attacks made blast injury common, were diagnosed with shell-shock and accounted for a third of medical discharges, if physical injury was excluded (95). In the period after the war there was much debate amongst the medical establishment as to whether shell-shock was physical or psychological. By 1939, the matter was not resolved but most clinicians seemed to favour a psychological explanation and the term shell-shock and associated war pension were not permitted at the start of the Second World War in 1939 (96).

- 68.** The recent US experience in Iraq and Afghanistan confirms high prevalence of PTSD, in some mTBI series affecting, along with depression, a third of cases, and increasingly claims are being made under AFCS, in those with awards for mTBI, for additional stand-alone mental health disorders, most frequently PTSD, often with co-morbid substance misuse and/or depressive illness. A challenge both for compensation and clinical management is separation of the potentially many overlapping symptoms due to TBI from those due to a reaction to stress. In some cases where there is a documented episode of TBI and a preponderance of physical and neurological symptoms, such as visual problems, headache, balance problems, or confirmed cognitive impairment, the balance will favour TBI as the primary disorder. However, if nightmares, hyperarousal and avoidance are primary symptoms, PTSD is likely to be considered the main diagnosis. In reality cases are often difficult to assess, with comorbidity being common.
- 69.** Studies are beginning to explore overlapping symptoms. A US questionnaire-based study of 2,700 Army infantry soldiers, three to four months after return from a one-year deployment to Iraq, enquired about possible TBI and other traumatic injuries during deployment, as well as current general health and symptoms of depression, PTSD or PCS (9). The TBI was usually blast-related with 5% reporting LOC of up to three minutes while 10% reported a TBI without LOC. There were a total of 384 TBI, of which all but four were mTBI. In those reporting mTBI, PCS, which included headache, poor memory and concentration, was common. Of those reporting mTBI and LOC, about half had PTSD while for the group with mTBI but no LOC, that figure was about 30%. Major depressive disorder was present in 23% and 8%, respectively. The high rates of mental health disorder led the researchers to perform a co-variate analysis. This showed that when adjusted for mental health disorder, mTBI was no longer associated with adverse physical health outcomes or functionally disabling symptoms.
- 70.** A subsequent study by the same group, using similar methodology, looked at whether a blast-related mechanism of mTBI correlated with persistent PCS (97). 15% of the sample reported mTBI and of these, more than 70% reported a blast mechanism of injury. 34% reported LOC and the remainder only an alteration of consciousness. Where mTBI and LOC occurred together, blast mechanism was associated with PCS, but not where mTBI occurred only with altered consciousness; i.e. persistent PCS were not associated with most cases of combat-related mTBI.

Psychiatric disorders associated with TBI

- Psychiatric disorders have an increased incidence after TBI, but may also be present before the TBI, some of which make TBI more likely to occur, such as depressive disorder.
- Common psychiatric disorders after TBI include mood disorders and PTSD.
- mTBI is most likely to be disabling in the presence of a comorbid psychiatric disorder.
- Treatments for comorbid psychiatric disorders may improve functional prognosis for those who suffer from TBI, but the evidence base is underdeveloped.

Long term effects of TBI

- 71.** The cognitive gains during the acute and post-acute period after TBI of any severity are generally maintained or may increase over time, but over the last 20 years evidence has emerged that in some people there is gradual decline in cognitive function within the first 5-10 years post injury (98). This seems to relate to age at injury with older patients being more at risk (99) and there was also an association with intensity or amount of therapy at six months post injury, regardless of severity of TBI and neuropsychological impairment. The long term effects of TBI are thought to resemble accelerated normal ageing. A recent neuro-imaging study applied an established model of normal brain ageing to

99 TBI patients and 113 healthy controls (100). The mean estimated brain age of Grey Matter (GM) in TBI patients was 4.66 (+/-10.8) years older than chronological age, and for White Matter (WM) was mean of 5.97 (+/-11.22) years older. This correlated with time since injury, indicating an on-going process through the post-injury phase rather than a one-off effect at the time of the injury. The effect was seen only in moderate – severe injuries, not in mTBI. This outcome was not dependent on mechanism of injury and predicted cognitive impairment.

- 72.** Although there is an increasing body of evidence exploring the relationship between single moderate – severe TBI and later life dementia and other neurodegenerative disorders such as Parkinson's disease, motor neurone disease and dementia, results are conflicting. This is largely due to study limitations including size, presence and choice of controls, diagnostic criteria, and reliance on self-report or reports from relatives, in terms of the TBI. To date, a relationship has been documented between moderate – severe TBI, in the presence of certain genotypes, and increased risk of neurodegenerative disorders, such as APOE-epsilon 4 and Alzheimer's disease (101) and Alpha- synuclein Rep 1 and Parkinson's disease (102).
- 73.** A 2016 investigation involved three prospective cohort studies of 7,130 participants in total with TBI and LOC in one group of less than, and in the other, more than, one hour. Subjects were free from dementia at the outset. They were followed for 45,190 person years. No association was found between TBI and LOC of any duration with dementia or Alzheimer's disease, but an association was found with incidence and progression of Parkinson's disease and development of Lewy bodies, but not with neuritic plaques or neurofibrillary tangles (103). IMEG will continue to monitor the literature.

Repetitive Brain Injury (RBI) and Chronic Traumatic Encephalopathy (CTE)

- 74.** Since the 1920s and the first description of the punch-drunk syndrome (104), there have been small studies, case series and case-based reports suggesting that sports and other injuries leading to repeated brain injury may be associated with long-term risk of neurodegenerative disorders including dementia, Parkinson's disease, and motor neurone disease. Sports other than boxing have now been implicated, including American football and baseball. In soccer where frank concussion is rare, sub-concussive blows from heading the ball are part of the game (105). A recent study of former soccer players, playing for an average of 26 years, all skilled headers of the ball and dying in their seventies, having suffered progressive cognitive impairment with average duration of 10 years, included six cases of identifiable concussion. Six had post-mortem brain examination, which showed abnormality in the connection between the cerebral hemispheres (cavum septum pellucidum). This finding is recognised as associated with previous head trauma. Four brains showed CTE (see paragraph 75) but other pathologies were also mentioned including Alzheimer's disease in six cases, cerebral amyloid, hippocampal sclerosis and Lewy body dementia. The authors concluded further work was needed (106).
- 75.** At present the definitive pathological diagnosis of CTE can only be made post-mortem, and is characterised by the accumulation, increasing over time, of hyperphosphorylated tau protein in specific patterns and areas of the brain (107). These changes have been reported in the brains of sportsmen who have sustained repetitive brain injury, including mTBI, concussion and even sub-concussive blows. CTE has also been described in disabled people with head-banging behaviour and in victims of physical assault. It is currently proposed that CTE can result in symptoms of executive dysfunction, memory impairment, depression, suicidality, apathy, poor impulse control and finally dementia with symptoms usually beginning eight to ten years after the repetitive brain injury (108). However not all sports studies confirm this daunting prospect (109) (110) and few consider other possible risk factors or influences such as substance misuse, performance-enhancing drugs and supplements and mental disorders. A 2015 review of all reported cases of CTE in contact sports showed limitations in case reporting and overlap of CTE with many other neurodegenerative disorders

(111). This sequence of events is reminiscent of the development of our understanding of mTBI in general. While accepting the study was limited to civilian mTBI cases, the 2004 WHO task force report concluded that although short-term symptoms were common in mTBI, there were persuasive and consistent findings in studies using different designs and considering different mechanisms of injury and populations, that cognitive deficits had largely resolved a few months post injury (24). That view was more recently reinforced by the 2014 update which despite a substantial increase in published studies, still found a lack of evidence of increased risk of dementia after mTBI (112).

- 76.** Research in CTE is still in its infancy. Recent focus has been on epidemiology and exploring required risk factors for its development additional to brain trauma; e.g. age at exposure and genetic predisposition. Work is also urgently needed on the specificity of the diagnosis, and its pathogenesis.

Compensation aspects

- 77.** Available data to date shows almost 1,000 awards for TBI have been made. These include 323 awards at levels 1-8 covering severe and moderate TBI and, for mTBI, 563 are at levels 11-13.
- 78.** Because of the seven-year time limit for claims under AFCS, the fact that claims may be made while serving, the recent kinetic activity and the high frequency of TBI in multiple injury cases, useful comment on the annual award rates and possible future pattern of brain injury and their causes would be speculative. As discussed, the awards made to date in the Scheme reflect combat and other causes such as road traffic accidents (RTA), adventure training and sporting injury.
- 79.** The AFCS is no fault and aims to focus on those most disabled due to service. To provide certainty and financial security full and final awards are made as early as possible after claim. The scheme is tariff-based with descriptors and associated awards set out in nine tables, each a category of injury or disorder, likely to be seen in military populations. These are Burns, Injury wounds and scarring, Mental health disorders, Physical disorders, Amputations, Neurological disorders, Senses, Fractures and dislocations and Musculoskeletal disorders. A lump sum is paid for pain and suffering and claims are ideally assessed when the injury or disorder is in steady state medically, following best practice treatment, or where prognosis and long-term outlook can be determined. All descriptors take into account psychological symptoms but where there is a discrete diagnosable disorder, a stand-alone award can be made. For the more functionally disabling disorders, as well as the lump sum, an additional Guaranteed Income Payment (GIP) is paid from service termination for life. This recognises that the accepted condition is likely to adversely impact the person's ability to do suitable civilian work. The GIP takes into account age, service length and rank and a factor for expectable promotion. Payment of GIP does not preclude taking a job. The GIP is based on four rates or bands corresponding to tariff levels. For the highest awards i.e. in levels 1-4, a Band A GIP based on 100% salary at service termination applies. Then for lump sum awards at levels 5 and 6, a Band B, 75% GIP is paid. Level 7 and 8 awards attract a 50 %, Band C, GIP and levels 9, 10 and 11, a Band D, 30 % GIP. Like its predecessor, the War Pensions Scheme, the AFCS is unusual amongst public schemes in that it is able to address almost any claimed injury or disorder, not just a defined list. As a result an important principle of decision-making is maintenance of both vertical and horizontal equity. Vertical equity means that the more serious injuries in any Table attract higher awards than the less serious, while horizontal equity means that across the Tables, the disabling effects of injuries or disorders at the same tariff level should have similar functionally disabling effects. In claims determination, when a causal link to service has been accepted, the next step is to select the appropriate tariff descriptor and award level. It is recommended that the decision-maker first looks at the case facts and establishes the disabling functional effects of the accepted injury or disorder, their severity and impact on suitable civilian employment. "Suitable" relates to skills, training and aptitude. On that basis, a decision on GIP and its level will be made, in turn allowing selection of a suitable Tariff descriptor and award. In line with Departmental policy where higher tariff level awards are envisaged, cases will have medical advice. The current TBI brain descriptors and tariff levels are:

Table 6 (May 2013)

- Item 5 level 1 Brain injury resulting in major loss or limitation of responsiveness to the environment, including absence or severe impairment of communication and language function, and a requirement for regular professional nursing care.*
- Item 11 level 2 Brain injury where the claimant has some limitation of response to the environment; substantial physical and sensory problems; and one or more of cognitive, personality or behavioural problems, requiring some professional nursing care and likely to require considerable regular support from other health professionals.*
- Item 17 level 4 Brain injury where the claimant has moderate physical or sensory problems; one or more of cognitive, personality or behavioural problems and requires regular help from others with activities of everyday living, but not professional nursing care or regular help from other health professionals.*
- Item 21A level 7 Brain injury with substantial recovery of sensory and cognitive function, some useful recovery of upper and/or lower limb motor and sensory function, but with some residual motor deficit in upper or lower limbs or both.
- Item 22 level 8 Brain injury from which the claimant has made a substantial recovery and is able to undertake some form of employment and social life, has no major physical or sensory deficits, but one or more of residual cognitive deficit, behavioural change or change in personality. (a)
- Item 26 level 11 Minor traumatic brain injury which has caused or is expected to cause functionally limiting or restricting post-traumatic syndrome for more than 52 weeks.
- Item 27 level 11 Brain or traumatic head injury with persistent balance symptoms and other functionally limiting neurological damage including permanent sensorineural hearing loss of less than 50dB averaged over 1, 2 and 3 kHz.
- Item 34 level 13 Minor traumatic brain injury which has caused or is expected to cause functionally limiting or restricting impaired balance or post-traumatic syndrome for more than six weeks, with substantial recovery beyond that date.

(a) The claimant is unable to undertake work appropriate to experience, qualifications and skills at the time of onset of the illness, but able to work regularly in a less demanding job covering severe and moderate TBI and, for mTBI, 563 are at levels 11-13.

* An award for brain injury in levels 1, 2 or 4 includes compensation for associated sexual dysfunction, incontinence of the bowel and bladder, and epilepsy.

Items 1, 2 and 4 attract an additional Band A GIP, items 21A and 22, Band C GIP and items 26 and 27, Band D GIP.

- 80.** As part of this review IMEG has considered the wording of the present tariff descriptors and related awards in light of equity and consistency and their clarity, and current understanding of the injuries. There has been particular regard to the less severe mTBI injuries at items 26, 27 and 34 above. The 2016 Quinquennial Review also raised the issue of the need to better differentiate items 17 and 22 at Tariff levels 4 and 8. That too is addressed in the amended descriptors.

Findings and recommendations:

81. Given the new findings discussed in this paper we recommend:

- i) The use of the term mTBI in Table 6 items 26 and 34.
- ii) For the more serious brain injuries the present descriptors make reference to nervous system (including neurological and psychological) audiovestibular, and associated functionally disabling symptoms and deficits.
- iii) A similar approach should apply to the mTBI descriptors with awards at Levels 11 and below, replacing term post-traumatic syndrome in the present descriptors and we should not introduce the terms PCS or PCSyn.
- iv) A single amended descriptor will replace present items 26 and 27.
- v) For items 26 and 34 we recommend addition of a footnote to ensure that discrete labyrinthine pathologies, diagnosed following detailed assessment by a specialist audiovestibular physician, have been excluded.
- vi) For the descriptors at items 17 and 21, having applied the principles discussed above, we do not share the QQR view that there is confusion/possible overlap between the two descriptors but have attempted some clarification of the descriptors to put beyond doubt the relative severity of the two injuries.
- vii) Item 21A and 22 have similarities. In both, those affected have made substantial recovery, but are unable to undertake regular paid work at their previous level. Both can do some regular paid work; the one limited by substantial physical motor deficits and the other by cognitive behavioural or personality problems. We propose revised descriptors and that both categories should attract a level 7 award.

Recommended revised descriptors - Table 6

- | | |
|------------------|--|
| Item 5 level 1 | Brain injury resulting in major and permanent loss or limitation of responsiveness to the environment, including absence or severe impairment of communication and language function, and a requirement for regular professional nursing care. |
| Item 11 level 2 | Brain injury where the claimant has some permanent limitation of response to the environment; substantial motor and sensory problems; and one or more of substantial cognitive, personality or behavioural problems, requiring some professional nursing care and likely to require considerable regular support from other health professionals. |
| Item 17 level 4 | Brain injury where the claimant has moderate and permanent motor or sensory problems and one or more of permanent substantial cognitive, personality or behavioural problems and requires regular help or full-time supervision from others with activities of everyday living, but not professional nursing care or regular help from other health professionals. |
| Item 21A level 7 | Brain injury from which the claimant has made a substantial recovery and is able to undertake some form of regular employment, has no major cognitive personality or behavioural problems, but with substantial functionally disabling motor deficit in upper or lower limbs or both. (a) |

Item 22 level 7 Brain injury from which the claimant has made a substantial recovery and is able to undertake some form of regular employment, has no major motor or sensory deficits, but one or more of residual functionally disabling cognitive deficit, behavioural change or change in personality. (a)

(a) The claimant is unable to undertake work appropriate to experience, qualifications and skills prior to the brain injury, but able to work regularly in a less demanding job.

Item 26 level 11 Mild traumatic brain injury which has caused or is expected to cause functionally limiting or restricting central nervous system and/or audio-vestibular symptoms of peripheral labyrinthine origin** for more than 52 weeks including permanent sensorineural hearing loss of less than 50 dB averaged over 1,2 and 3 kHz.

Item 34 level 13 Mild traumatic brain injury or head injury which has caused or is expected to cause functionally limiting or restricting central nervous system and/or audiovestibular symptoms of peripheral labyrinthine origin** for more than six weeks, with substantial recovery beyond that date.

**Labyrinthine causes of audiovestibular symptoms must be excluded by detailed specialist audiovestibular assessment.

Conclusion:

82. While data for TBI awards under the scheme are incomplete, dating only from 2012, the numbers of TBI awards attracting a GIP are small and have reduced considerably following the end of the recent conflicts. As a result IMEG concluded that any TBI due to AFCS service, on balance of probabilities, but for which there is no provision in the Tariff at date of claim or application for review, should be the subject of a temporary award at the appropriate Tariff level (Article 26 AFCS Order 2011). As provided at Article 26 para (6) (a) the Secretary of State will within one year of notification amend the Order with a new descriptor at the Tariff level paid as a temporary award and notify the claimant of a permanent award and right of appeal. Even if, exceptionally, a decision is made not to incorporate a new descriptor and make the award and GIP permanent, no amount of benefit paid to that date is recoverable.

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Topic 4 - Musculoskeletal Disorders (MSK disorders) Part 1

Key points

1. The nature of military life makes it unsurprising that MSK disorders are the main reason for military medical downgrading and discharge and the most common reason for AFCS claims and awards. To date over half the awards under the AFCS have been for MSK disorders.
2. MSK disorders in military practice broadly divide into three groups:
 - i) discrete, diagnosable strain, sprain or overuse injury eg knee meniscus or ligament damage;
 - ii) less common physical disorders with clinical onset in service, eg genetic and autoimmune conditions, including rheumatoid arthritis or systemic lupus erythematosus, arthritis associated with inflammatory bowel disease, psoriasis or post infective, ankylosing spondylitis, and;
 - iii) the largest group of low back pain, neck pain, anterior knee pain usually without evidence of specific pathology.
3. Of the three categories, establishing a causal link to AFCS service is easiest in category i) discrete diagnosable strain sprain or overuse injury to tendon or ligament linked to an event. Most disorders in category ii) physical disorders with clinical onset in service eg rheumatoid arthritis will not be due to Service, on the balance of probabilities, but rather will be of unknown aetiology. The most difficult determinations in terms of causal link to service are category iii) conditions such as low back pain, often without evidence of specific pathology and of spontaneous onset.
4. There is no evidence in the absence of preceding traumatic injury that work in the Armed Forces generally causes increased risk of degenerative change in the vertebral column. Decisions on these conditions will depend critically on individual case facts, including the type and duration of service. Royal Marine, Parachute regiment, Special Military Units or combat service are likely to produce quite different physical loading stressors compared with peace-time storeman duties in the Logistics Corps.
5. We reviewed the Table 9 Back descriptors and Tariff awards in light of current understanding of causation, progress and associated disabling effects and remain of the opinion that the present approach to back disorders is evidenced and maintains horizontal and vertical equity.
6. Nociceptive and neuropathic pain and pain syndromes will be considered more fully in Part 2 of the MSK Disorder Review.

Introduction and Background

1. The nature of military life with its focus on physical and sporting activity in a young, fit, predominantly male population makes it unsurprising that MSK disorders are the main reason for military medical downgrading and discharge, and the most common reason for AFCS claims and awards. To date over half the awards under the AFCS have been for MSK disorders. Since the beginning of the scheme, awards have been made as follows:

All years	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
All 26,313	50	385	899	1,597	2,256	2,271	2,900	3,028	3,279	3,486	3,290	2,322
Inc. GIP 535	5	16	34	57	69	101	88	61	52	37	13	2

These data are based on latest available outcomes and should be considered as minimum numbers of awards. In considering MSK disorders in the AFCS, in addition to literature scrutiny, IMEG has taken advice from senior military and civilian academic experts in the epidemiology and clinical management of these disorders, including physical treatment and rehabilitation and orthopaedic surgery. The term musculoskeletal disorders (MSK) relates to a group of symptoms and conditions ranging from common short-lived aches and pains with no established pathology or identifiable precipitant to objectively verifiable effects of specific accidental injuries. MSK disorders are widespread in the general community, occurring at all ages, including amongst adolescents and young adults as well as those of working age. Because of the size of the issue this paper is Part 1 of the IMEG review of MSK disorders.

2. In the military community, about 20,000 cases per year of MSK symptoms and disorders are dealt with in Defence Primary Health Care or at Defence Rehabilitation Centres. MSK disorders in military practice broadly divide into three groups:
 - i) discrete, diagnosable strain, sprain or overuse injury, e.g. knee meniscus or ligament damage;
 - ii) less common physical disorders with clinical onset in service, e.g. genetic and autoimmune conditions, including rheumatoid arthritis or systemic lupus erythematosus, arthritis associated with inflammatory bowel disease, psoriasis or post-infective, ankylosing spondylitis; and
 - iii) the largest group of low back pain, neck pain or anterior knee pain, usually without evidence of specific pathology.

Symptom onset may be acute or gradual, apparently spontaneous or with a clear temporal relationship to an incident or event. The context may be sport, adventure or other training, or claimants may cite factors such as heavy lifting in their principal service occupation or trade. Symptoms often settle quickly through natural healing and without medical advice, but they may become recurrent or chronic. Following clinical assessment, diagnosis and exclusion of serious pathologies, first-line treatment for MSK disorders is usually physiotherapy, which is successful in most cases. Surgical interventions are much rarer than previously but may be considered where there is failure to progress using physical therapies alone.

3. A key aim of the Defence Health and Well-Being strategy is to maximise operational capability. Owned jointly by the Chief of Defence Personnel and Surgeon General, the strategy applies through life, from joining to service termination and beyond. It is for all Defence personnel, building resilience, physical and mental fitness, promoting healthy lifestyle choices and prevention of injury and disorder. Despite the high rates of physical activity and repetitive exposure to mechanical stressors associated with military life, including adventure training and sport, the rates of medical downgrading and discharge for military personnel due to MSK disorders is similar, at about 20% of personnel not fully deployable, to most quality rugby teams' fitness for selection rates. Defence Medical Services provide excellent multidisciplinary physical and rehabilitative treatment and occupational health services. These are focussed on regaining and maintaining function particularly in the work context. A decision to medically discharge may be more for protection than a reflection of the severity or functional limitation of the disorder itself, and does not necessarily imply the person is unfit for suitable civilian work. Military service by its very nature demands higher standards of physical and mental fitness than is required for most civilian jobs.

4. A significant proportion of those who leave service for medical reasons annually are so-called “early service leavers”, meaning those discharged compulsorily, or who leave at their own request, having completed less than four years’ service. Recruit training is designed to improve aerobic fitness, muscle endurance and strength through running, loaded marches and battle training. In recent times as military training across the world increasingly requires recruits to address much greater physical loads than many have ever done previously, MSK symptoms and disorder incidence in recruit studies have ranged from 20-59%. The highest number of problems occur early in training and a recent prospective follow-up UK study of recruits on the Combat Infantryman’s Course at the Infantry Training Centre, Catterick, looked at MSK injuries in 6,608 recruits during a 26-week initial training programme, recording injury and rehabilitation times for specific injuries (1). The overall incidence of injury was 48.6%, similar to other military studies and civilian runners, and (2) the most common complaints were leg pain, low back pain, ankle sprains, upper body, head and neck pain and stress fractures. Similar rates and type of injury are seen in other series internationally.

5. In the British Army, soft tissue injuries to recruits typically get better quickly while ankle sprains , low back pain and stress fractures take on average much longer to settle and in some cases lead to medical discharge. Results of trials of general interventions to prevent MSK injury are unproven and disappointing, but evidence is now emerging in support of a more effective role for injury-specific intervention (3) (4). Possible strategies to counter these effects might be simply to recruit only those who are ready at entry to cope with the physical demands. That seems likely to have poor yield, however, and it might be appropriate to move to another basis for recruit selection as in some dance schools and athletic programmes, e.g. gait analysis or quality of movement. Alternatively, it might be possible to re-design training programmes, building up the physical load gently. At present the highest risk of recruit injury occurs early in the programme when the load is highest, there has been little time to acclimatise and the environment itself is unfamiliar. Early downgrading may be especially dispiriting to young recruits, risking reduced motivation and a desire by the young person to leave. These issues are relevant to women as the New Employment Model and women in front- line deployment move closer. The literature as a whole on MSK issues, particularly occupational studies, is primarily male-based. Much more is becoming known about female physiology from recent studies on women athletes, and HQ Surgeon General and the chain of command are undertaking an extensive research programme including the 2015/16 Women in Ground Close Combat Review. As the Armed Forces more fully reflect the diversity of people in the UK today, we need to consider also MSK risk factors and disorders which may be more common in certain ethnic groups. We will continue to monitor the literature.

Specific Injuries

Knee injury

6. Overall, **knee meniscus injury** is relatively uncommon in young men and women and when it occurs in a military context is due mainly to acute sporting trauma, especially while playing football, where there is torsion of the knee in partial flexion. Meniscal damage is increasingly common with age and may be asymptomatic (5). Beyond this the epidemiology of meniscal injury, its predisposing factors and why it occurs in some people without significant trauma remains largely unknown, and studies to explore effects such as the roles of pre-existing joint laxity or whether background occupational kneeling, squatting or ladder-climbing increase risk of acute traumatic damage are difficult to design robustly. Meniscal damage is associated with osteoarthritis with risk further increased by surgical treatment, whether open surgery or through arthroscopy. Obesity, joint laxity and repetitive occupational kneeling and squatting are individual risk factors for degenerative meniscus lesions, and obesity enhances the risks of heavy physical work (6). Surgical treatment of meniscal injury is common but there remains controversy about its timing, extent, risks and benefits and whether the whole meniscus should be removed, etc.

7. Other problems affect the **knee in military personnel including chondromalacia patellae** (literally softening of the cartilage), **anterior knee pain** and, more recently, **patello-femoral pain syndrome**. These terms are poorly defined and cover anatomical or developmental abnormalities, e.g. patellar mal-tracking or Hoffer's syndrome affecting the infra-patellar fat pad as well as repetitive traumatic and overuse causes and cases where aetiology is simply unknown. There is disparity in the literature over causation and the best practice in the investigation and controversy concerning management of such disorders. Most MSK disorders presenting in the military context are mild to moderate in severity, assessed clinically to exclude serious pathology and treated conservatively with further investigation, e.g. imaging or arthroscopy and possible surgery only considered where that fails.
8. **Knee ligament injury** is common as a result of sport, including skiing and especially football. Most injuries settle with physiotherapy but further damage is common on return to sport or other physical activity, and surgery may eventually be indicated. Anterior cruciate ligament rupture predisposes to knee osteoarthritis (7). Numerous studies suggest that operative single anterior cruciate ligament reconstruction produces good surgical and functional results (80-90% normal knee function) but a lower return to any level of sports activity (80%), pre-injury level sports activity (60%) and 44% to competitive sport. Fear of further injury was the most common reason cited for failure to return to pre-injury sports level (8). Further research is needed on indications for, and optimal timing of, surgery and whether this should be open or arthroscopic, as well as on return to sport protocols and injury prevention programmes. Present RN policy is to exclude from enlistment recruits with a past history of anterior cruciate ligament rupture. This is owing to the risks associated with frequent ladder-climbing and the relatively long service of RN personnel compared with the Army and RAF, 12 years on average. Neither the Army nor RAF currently operates the same policy.
9. While damage to a single unilateral knee ligament is common in military practice, the recent conflicts were associated with **high energy multiligamentous knee injuries** often accompanied by additional ipsi-lateral limb injuries, most commonly intrarticular fracture of the knee. Most of these ligament injuries were treated surgically with delayed single-stage operative treatment usually several weeks after the index incident. A recent US series confirms that surgical treatment of these complex injuries produces better outcomes than physiotherapy alone. Especially if accompanied by other limb injury and regardless of management, given the severity of these injuries, return to duty rates are low (9). By contrast a French systematic review looked at outcomes in combined anterior or posterior cruciate ligament and posterolateral corner injuries in civilians, due to sports or motor vehicle accidents, and suggested good functional outcomes especially for anterior ligament tear, although less good than for single reconstructed cruciate ligament tears. Data on posterior cruciate ligament outcomes was scarce (10).
10. **Osteoarthritis (OA) Knee** is primarily a disorder which is symptomatic in older age and as the population ages, is an increasing public health problem. Early joint changes are usually only diagnosed on MRI imaging in the military population and, owing to the limited correlation of symptoms with MRI changes, such a finding may not be clinically significant at diagnosis or later. Despite the extensive international literature going back over many decades there remain many gaps in our understanding of the causes and progress of OA knee. Risk factors include obesity, female sex and previous knee joint injury including surgical procedures. Open surgery carries higher risk of subsequent osteoarthritis than arthroscopy where, in experienced hands, microscopic techniques and small instruments result in more limited damage.
11. There is a substantial literature on the relation between sport and occupational loading and osteoarthritis of the knee. Where knee injury, significant enough to be documented, occurs, osteoarthritis is likely to develop. Similarly, elite sports activity or participation in high-impact or loading sports, but not hobby or fitness level running, can cause osteoarthritis of the knee. The evidence on typical military-level sport including moderate level running is not convincing of a causal effect (11). Occupational studies are of varied quality with the strongest evidence of a causal link for squatting and kneeling, lifting and heavy physical workload. Evidence is weaker for stair and ladder

climbing and against a significant effect for walking or standing on the development of osteoarthritis of the knee (12). In general occupational studies, assume exposure dose based on carrying out the various activities at similar intensity, on most days for most of the working day and week and over at least five to ten years. Where osteoarthritis is established, continued mechanical stress at a similar or greater intensity may worsen the disorder. Obesity and ligament laxity are established risk factors for OA worsening (13).

12. Most studies on working-age adults are restricted to males. In the light of the changing face of the working civilian and military populations, both in the proportion of female workers, as well as the range and intensity of activities including sporting, more work on female risk of osteoarthritis of knee and MSK disorders in general, including duration of exposures, is required. A recent review of studies on physical tasks and knee osteoarthritis did discuss the issue of home making recognising kneeling and lifting as key homemaking activities which can generate a heavy physical work load (14). A 2012 Danish study (15) following up the whole population and based on occupation and job register data showed that generally, jobs with a heavy physical workload are associated with a risk of knee osteoarthritis, and that risk increases directly with cumulative years in occupation. There is a dose response relationship so that workers with 6-10 or more than 10 years' cumulative work have increasing risks of OA knee. This contrasts with OA knee after severe extremity injury due to blast or gunshot wound. Here radiologically detectable and symptomatic OA is often well established within two to three years post-index incident (16).
13. **Ankle sprains and instability** Ankle sprains account for 20-40% of all sports-related injury in some series (17) and are common in the UK military context. Sprains usually involve tears of the lateral ligaments and while the majority heal uneventfully, about a third will suffer a second sprain. In addition attenuation of affected ligaments may lead to ankle instability. This is of two types: mechanical, where range of joint motion is greater than normal, and functional, where movement is physiological but is not under voluntary control. In some cases the picture is mixed. Management of each type may be different, with mechanical instability more likely to need surgical intervention. A trial of at least three months' physical therapy is indicated as the first-line treatment for ankle sprains. If recovery does not occur then surgery should be considered. Over the last sixty years multiple procedures have been developed, including recent less invasive interventions thought likely to have shorter recovery times. However, there is little robust evidence that surgical intervention is required or that modern techniques are more successful than long-established techniques. As with other MSK disorders, evaluation of the various techniques including cost-effectiveness, best practice and timing is required (18).
14. **Shoulder dislocations, primary and recurrent, and shoulder instability** are as important in military populations as in athletic populations and the associated chronic or recurrent injury and high rate of OA can be very disabling. As yet our understanding of modifiable risk factors is not well developed, and more research is needed on issues such as whether or not recruits with a history of pre-service shoulder subluxation are at greater risk of further dislocation and instability. Two recent US studies showed that a prior history of gleno-humeral joint instability led to an approximately five-fold higher risk of a further dislocation within a four-year follow-up period (19). The other study (20) looked at the ten-year incidence of shoulder dislocation and the percentage with recurrent instability, and the risk factors. Risk was highest in younger individuals and more in males than in females. There was a 30% recurrence rate more likely at younger ages and where there was axillary nerve injury concurrent with the first dislocation. Although the initial dislocation rate was lower in women, women were at more risk of recurrent or chronic lesions; overall, about a quarter had recurrent or chronic injury.

Hip pain

- 15. Femoracetabular impingement (FAI)** and associated labral tears are common in young active populations, e.g. sporting and military, and are thought to have a 10-15% incidence (21). FAI gives rise to hip pain and early osteoarthritis. Diagnosis is made clinically and confirmed on X-ray, where cam and pincer deformities of the femoral head and innominate bone acetabulum will be identified. MRI or MR arthrogram can subsequently identify any consequential labral tears or detachment. In a recent Defence Medical Rehabilitation Centre-based trial (22), once FAI diagnosis was confirmed, patients were first treated conservatively by a multidisciplinary team of health professionals for up to three months. If no improvement occurred patients were referred for arthroscopic surgery. A single experienced surgeon was involved and patients were reviewed by the surgeon six weeks post-operatively and then at two, six and twelve months by the military rehabilitation team. As clinically indicated, at the two months' post-surgery review further residential multidisciplinary rehabilitation was undertaken. Both males and females were eligible. 76% of males showed significant improvement over time in symptoms, functional and occupational measures. In both sexes this maximised at six months post-surgery. Another systematic review reported satisfactory return to sport in symptomatic athletes with FAI, particularly professionals, following either open-hip surgery or arthroscopy (23), both procedures having similar outcomes. Results are influenced by time after operation, level of sport competition, and the presence of even minor osteoarthritic change carries less good prognosis. The concept and best-practice management of FAI remains controversial and a UK randomised control study comparing arthroscopic surgical treatment and a non-operative physiotherapy-led intervention called personalised hip therapy is currently being undertaken (24).

Low back and neck pain

- 16.** The most common reasons for overall AFCS claims and awards to date are back disorders, including simple low back pain, and neck pain. It is also a common reason for consultation in Defence Primary Care. This contrasts with the situation in the general community where, although low back pain is a very common symptom, it is estimated that only about a quarter or a third of those affected see their GP. Less severe pain of short duration usually resolves spontaneously. The decision in the civilian community to seek medical help is not directly related to duration or severity of pain but influenced by multiple factors including the person's previous experience, work, attitudes and beliefs (25). **In non-specific low back pain**, frequently with spontaneous onset or onset-related only to minor trauma, symptoms are mainly local to the lower back although they may affect buttocks and thighs. True sciatic pain due to a prolapsed intervertebral disc compressing the lumbo-sacral roots is rare (less than 5%). Neck pain is the second most common site. In both conditions, neurological examination is usually normal. Where pain becomes chronic and disabling, serious spinal pathology or nerve root problems should be excluded or referred for specialist advice.
- 17.** In simple low back pain MRI changes and anomalies are very common, inconsistently reported and with generally poor correlation to pain. Degenerative disc prolapse in both lumbar and cervical areas is common even among young people and not necessarily symptomatic or related to significant trauma. These limitations have made surgical intervention relatively uncommon in UK practice and only undertaken after very careful assessment and selection of cases. There is no universally-agreed treatment for simple low back pain but increasingly it is considered best explained by an interaction of physical, psychological and social influences. As a result, programmes delivered by multidisciplinary health care teams have emerged. This is the approach in the UK military. A recent Cochrane systematic review and meta-analysis of multidisciplinary rehabilitative treatment for low back pain lasting over three months (26) considered 41 trials with over 6,500 participants, with pain on average for more than a year, and previous failed treatments. This provided moderate quality evidence that treatments with physical, psychological, social or work-targeted components were more effective than usual care, taken to mean GP community-based care using analgesic and anti-inflammatory medication, and in

some cases referral to physiotherapy. The review also found low-quality evidence for the effectiveness of physiotherapy in decreasing pain and disability. For work outcomes, multidisciplinary rehabilitation was more effective than physiotherapy but not more effective than usual care. Two trials compared multidisciplinary treatment with surgery. Although outcomes were similar for the two, risk of adverse events was greater after surgery. The authors concluded that for all types of management, the positive therapeutic effects were of modest size and more intensive intervention made no difference to the effects or their size. The review was unable to explore any impact of symptom intensity at presentation. These results suggest that the positive but limited effects need to be carefully considered against the considerable resources required.

- 18.** For many painful disabling cases of low back or neck pain, no underlying pathology can be demonstrated objectively and any imaging abnormalities may not correlate with pain. There is often no clear relation between the severity of the initial symptom or injury and the disabling effects or their duration. Studies of back disorders focus on reported symptoms or consider objective findings such as X-ray and MRI appearances (27). An extensive literature on causation, or more commonly association, between MSK disorders and symptoms and the physical demands of mainly civilian work or sport over a period and different conditions is of variable quality with inconsistent results. There is generally no evidence, in the absence of significant preceding traumatic injury, that work in the military, police, fire service, healthcare or most other occupations causes increased risk of degenerative change in the vertebral column (28). A 2011 systematic review (29) examined eight systematic reviews including 99 studies looking at evidence of a causal relationship between bending, twisting, awkward postures, lifting, manual handling and low back pain. Overall evidence quality was limited and none of the reviews found strong evidence of a causal relation between any occupational physical activity considered and low back pain. Conflicting evidence of an association between low back pain and bending, twisting, lifting, pushing or pulling was found and there was strong evidence against a causal relationship with manual handling, assisting patients, awkward postures, carrying, sitting, standing or walking. These are of course population findings and in compensation terms individual cases must be looked at on their merits.
- 19.** Driving is a common element of many jobs and there seems to be a link between professional driving involving more than half working time and low back pain (30). For many vehicles, vibration is mainly at 4-6 kHz, which is the resonating frequency of the spine (31). Although the evidence is inconsistent and studies addressing issues such as the dose/response relationship are rare, it is generally agreed that whole-body vibration exposure should be as low as possible (32). Advances in vehicle design including HGV and plant-moving equipment are reducing vibration problems and there is some evidence that posture is an important interacting factor. For pilots, an association is often contended between G-force, helmets and self-reported neck pain. However, a meta-analysis found no difference in neck pain, cervical or lumbar spondylosis in fighter pilots, helicopter and cargo pilots, despite the very different G-forces experienced (33).
- 20.** The evidence on sporting activity and low back pain is that chronic elite-level sport is associated with imaging changes but not necessarily symptoms, while the evidence on moderate or occasional activity as a cause of symptomatic MSK disorders is not compelling. In athletic and military populations there is evidence, particularly in the past, of people being tempted to play on at the same level, despite injury or symptoms, for fear of loss of promotion or team selection, etc. To do this at high competitive sport activity level risks worsening disorders. However, moderate activity is to be encouraged. For low back pain in the military, an important predictor is held to be cigarette-smoking, especially amongst younger personnel (34). Risk is greater with numbers of cigarettes smoked (35). The precise mechanism is unclear. Smoking may simply reflect lifestyle or fitness while there is some evidence of a direct effect on disc cell metabolism (36) and increased rates of low back pain and intervertebral disc degeneration recorded in people with lumbar atherosclerosis suggests an ischaemic effect (37). There is some evidence in the wider literature that this is relevant in other MSK disorders in the general community, but overall evidence suggest this is quite a weak risk factor (34).

21. Until about the mid-1980s, as with many diseases and disorders, standard management of low back pain included bed rest, often well beyond the acute period. Around this time as the deconditioning, psychological and social effects of bed rest became recognised, studies into duration of bed rest began to suggest that across a range of conditions, including low back pain, short periods of rest were better than longer periods. In the mid-1990s work from Scandinavia went further and showed that maintenance of normal activity actually led to more rapid recovery, fewer recurrent problems and less chronic disability (38)(39). This was confirmed by a 1997 systematic review of randomised control trials of bed rest for acute back pain of up to three months (40). Evidence is more limited where there is nerve root irritation or prolapsed disc or sciatica, but what evidence there is, similarly, questions the role of rest (41). Evidence on remaining in work or returning to work as early as possible is also limited but generally positive (42).
22. MSK disorders including low back pain may make work or certain occupation-related tasks difficult or uncomfortable. Present evidence on prevention of low back pain is disappointing. Manual material handling advice and training do not prevent back pain or back pain-associated disability, and a 2010 systematic review of ergonomic interventions which examined ten RCTs provided little evidence that they were more effective than no intervention for short term or chronic long term back pain (43). Most people with episodes of MSK symptoms remain at work and may not even seek medical help, but a proportion of civilian and military cases of low back pain, neck pain, knee pain and sometimes people with initial more specific diagnosis, e.g. ankle sprain or prolapsed degenerative lumbar vertebral disc, go on to chronic pain and disability and long-term work incapacity.
23. In the period between the mid-1950s and the mid-1970s, DWP data show that rates of UK civilian sickness absence for low back pain were fairly steady with about 10 million days lost per annum. There was then acceleration, so that by the mid-1990s some 85 million days were being lost annually for back conditions. This was despite a marked reduction in the prevalence of heavy work and occupational lifting. The relation between particular jobs and tasks and specific MSK diagnoses is not strong and modification of work ergonomics, with reduction of exposures, has done little to reduce MSK complaints or sickness absence (44).
24. A link has been found between low back pain and low mood and somatising tendency, in neither case not necessarily serious enough to meet a discrete psychiatric diagnosis. Studies also relate disabling MSK symptoms to factors such as low work control, poor support at work, perceived organisational injustice and low job satisfaction (45). The rates of common MSK problems between those in similar occupations differ in different countries and in the same country over time. Incapacity for work due to MSK disorders in Europe is estimated to have a direct cost of 0.5% - 2% of Gross Domestic Product (GDP) (46). The Cultural and Psychosocial Influences on Disability (CUPID) study, an international multi-centre epidemiological study, was established to look at cultural risk factors in common MSK disorders, notably low back and wrist and hand pain amongst workers carrying out similar physical activities in different cultural environments. A 2013 study in this series compared the prevalence of disabling low back pain and wrist/hand pain among workers in 47 civilian occupational groups in 18 countries. The one-month prevalence of disabling low back pain ranged from 9.6% - 42.6% in nurses, and of disabling wrist/hand pain in office workers from 2.2% - 31.6%. After allowing for known influences including health beliefs, group awareness of people outside work with similar symptoms and availability of compensation and disability benefits, an up to eight-fold difference in prevalence still remained. An adequate explanation for these considerable differences remains to be found (47). It seems likely that local cultural beliefs and expectations play a part.
25. The medical model of ill-health assumes a linear relationship between injury, impairment, disability and handicap/participation. An **injury or disorder** causes **impairment**, i.e. anatomical and functional consequences, and **disability**, i.e. limitations and restrictions which are a **handicap** for social and occupational participation. This model is well suited to clinical management of serious and specific MSK pathologies. Virtually all people with disabling painful but minor or non-specific disorders have

a primary strain or sprain or overuse injury and the emergence of chronic symptoms and disability is strongly influenced by superimposed psychosocial issues including attitudes and beliefs. Effective management addresses all of these. The medical model is innately doctor-centred: the patient presents symptoms and it is then for the doctor or other health professional to provide curative treatment. In contrast, a biopsychosocial approach addressing the personal, psychological and social issues requires a patient centred approach, educating and supporting the patient in taking responsibility for managing the symptoms rather than passively awaiting curative medical interventions.

- 26.** Evidence of the effectiveness of physiotherapy (massage, manipulation and mobilisation), chiropractic, exercise therapy and medication is limited (48). There are also markedly differing rates for operative interventions for MSK disorders, especially low back pain, across Europe, and again the evidence base on their indication and evaluation of effectiveness is small. It is important that clinicians take an optimistic approach to low back pain and MSK disorders, stressing from the outset the high likelihood of recovery and, for those of working age, that maintaining activity and remaining in or returning to work in most jobs as early as possible will not worsen or exacerbate the problems. For working age adults and the military population the emphasis should be on simultaneous, not sequential, work-focussed healthcare and rehabilitation. In relation to work, a key aim is early intervention and, wherever possible and safe for the patient and colleagues, return to his/her own work or temporary modification of work activity and environment with a graduated return to work programme. Successful management of MSK disorders requires effective communication and coordination between the individual, clinicians and workplace management.
- 27.** This approach is that of DMS and the military chain of command. From the outset the clinical management is work-focussed. Physical rehabilitation and cognitive behaviour therapy aim to give the patient insight and mastery of his pain rather than permitting it to dictate functional limitation and restriction. At the same time individual specific occupational modifications and return to work programmes are developed. Cases where, following an initial fairly minor injury, intractable chronic pain develops can occur in the military population with risk of a prolonged clinical course and ultimate adoption of a highly disabled state. In their evidence, military clinicians indicated to IMEG that many military personnel are more comfortable with a purely physical basis for their symptoms, e.g. retaining MRI images on their mobile phones.
- 28.** Although rates of return to military service and own role vary, for chronic low back pain without identified major pathology, only about 25-33% are generally able to return to some form of deployable service. The costs of chronic MSK disorders include reduced operational capability, loss of military expertise and, most importantly, adverse impact on the well-being of the person and his family. Against that background, any approaches which reduce risk of that sequence are welcome. The current practice, for MSK disorders, of use of primary care-based general manual conservative therapies first is long established, but the selection of cases, timing of their specialist referral and best-practice assessment and treatment interventions including surgery would benefit from further study. There is increasing suggestion and expert observation that earlier referral for expert opinion may lead to better prognosis.

Compensation aspects

- 29.** Table 9 of the AFCS tariff is headed "Musculoskeletal disorders and descriptors" and aims to address the soft tissue diagnoses and low-energy injuries commonly seen in military practice, often in relation to sport and training: strain, sprain and overuse. Fractures and dislocations are in Table 8 and high-energy traumatic physical injury, e.g. Improvised Explosive Device (IED) injury in combat or Road Traffic Accidents (RTAs) are listed in Table 2, "Injury wounds and scarring". All awards from Table 9 include an element for psychological symptoms short of a discrete diagnosable disorder, and also include any expected consequential osteoarthritis.

- 30.** AFCS is an individual jurisdiction and decisions are based on the case facts as well as the relevant law and contemporary medical understanding of causation and prognosis. As discussed above, the evidence base on MSK disorders, notably osteoarthritis and low back problems and causal link to occupation, is large but inconsistent. Overall it provides no general clear association with military service, as perhaps expected, given the very different roles and activities, duration and era of service. Decisions regarding AFCS awards need careful individual evaluation on causation, disorder severity and prognosis.
- 31.** Of the three categories of injury at paragraph 2 above, establishing a causal link to service on balance of probabilities is easiest in category i), discrete diagnosable strain, sprain or overuse injury to tendon or ligament linked to an event. Where several structures covered by separate Table 9 descriptors are damaged in a single incident, e.g. sporting injury to joint with several damaged ligaments, the overall amount of lump sum awarded is determined by special rules set out at Articles 21 and 22 of the AFCS Order.

Most disorders in category ii), physical disorders with clinical onset in service, e.g. rheumatoid arthritis, will not be due to service on the balance of probabilities, but rather will be of unknown aetiology. An exception might be some post-infective arthritides and in some cases worsening by AFCS service will be considered.

The most difficult determinations in terms of causal link to service are category iii), conditions such as low back pain, which are usually without evidence of specific pathology and often of spontaneous onset. As discussed above, there is no evidence, in the absence of preceding traumatic injury, that work in the Armed Forces causes increased risk of degenerative change in the vertebral column (28). Decisions on these conditions will depend critically on individual case facts, including the type and duration of service. Royal Marine, Parachute Regiment, Special Military Units or combat service are likely to produce quite different physical loading stressors compared with peace-time storeman duties in the Logistic Corps.

- 32.** The QQR raised the issue of the adequacy of AFCS awards for disorders causing low back pain. Table 9 includes a range of descriptors and awards for back disorders where “back” is intended to include cervical, thoracic, lumbar and sacral vertebral segments and the coccyx. Pathologies covered include non-specific back pain, often arising spontaneously, as well as pain following sprain, strain or significant injury, the latter likely to be documented contemporaneously. Other differentiating descriptor features include the presence of neurological signs, imaging abnormality and consideration of surgery. Under some circumstances an additional award from Table 4, “Physical disorder for a pain syndrome” may be appropriate. Nociceptive and neuropathic pain and pain syndromes will be considered more fully in Part 2 of the MSK Disorder Review.

Conclusion and recommendation:

- 33.** We have carefully reviewed the back descriptors and awards in light of stakeholder concerns and current understanding of causation, progress and associated disabling effects, and remain of the opinion that the present approach is evidenced and maintains horizontal and vertical equity.

Part 2 of the IMEG Review of MSK disorders in the AFCS context will consider overuse, lower limb injuries including Achilles tendinopathy, shin splints, compartment syndrome, medial tibial stress syndrome and stress fractures, pain syndromes and fibromyalgia syndromes.

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Topic 5 - AFCS Worsening

Key points

- We concluded that the present approach to worsening set out in Article 9 of the AFCS Order 2011 is reasonable medically, and supportive of consistent equitable decisions. It reflects Armed Forces personnel and medical policy and practice of attaining and maintaining maximum functional fitness, employability and deployability.

Introduction

1. IMEG consideration of this topic was first raised during the Lord Boyce Review at a time when few exemplar cases had been seen, largely because worsening can only be considered at Service termination or beyond. More recently the Quinquennial Review (QQR) report (1) identified it as an issue for IMEG comment. Some stakeholders had suggested to the QQR Team that the legislation was too tightly drawn and so some claimants might be unfairly denied compensation. There was particular concern about claims for musculoskeletal and mental health disorders. This short paper discusses medical aspects of the present AFCS approach to worsening of disorders. The QQR suggested that IMEG findings might inform any policy or legislative amendment of the provision. The note will also be of interest to claims' decision-makers and medical advisers and to claimant representatives.

Background

2. Many of the Scheme's attributes, including the "worsening" provision (Article 9 AFCS Order 2011) derive from and aim to reflect the modern Armed Forces, and the ethos and aim of optimising and maintaining function and fitness for work. Wherever a claim is made and, on balance of probabilities, a causal link to service on or after 6 April 2005 is recognised, an AFCS award will normally be made. This may be "due to service" or "worsened" by service with benefits paid at the same level for both categories. For brevity this paper will use the phrase AFCS service to imply military service on or after 6 April 2005 when the AFCS applies.
3. Compared with civil personal injury and compensation schemes such as the Criminal Injuries Scheme, the AFCS has a relatively narrow selected client group of fit young people. High standards of physical and mental function and fitness for work are delivered through effective people management, training, health and fitness promotion, protection and prevention from injury and disease and dedicated occupational health services. For serving personnel, healthcare is also the responsibility of Defence and where injury or disease, mental or physical, is detected, prompt referral for best practice treatment and rehabilitation is provided.
4. Regular health surveillance monitors these measures and medical examination to assess function, medical employability and deployability takes place pre-enlistment and at regular intervals throughout Service to Service termination. Defence practice is to adhere to Health and Safety legislation and the Equality Act 2010 as far as reasonably practical. The primary focus of medical assessment of function is military employability but since typically people leave service long before active working life is complete, longer term effects are also relevant to post-service civilian employability.

Medical employability, deployability and the PULHHEEMS System

5. Some understanding of the above concepts is important in AFCS worsening. Full details can be found in the MOD Joint Service Manual of Medical Fitness (1). This includes information on disorders whose presence at recruitment or a pre-service history may preclude service entry or require further specialist examination and opinion. The employability standard is awarded based on findings of the medical examination and the PULHHEEMS classification system which assesses and records function and the capacity to perform certain tasks involved in a given service role. The letters in the acronym refer to physical and mental function qualities as below:-
 - P physical capacity overall
 - U upper limbs
 - L locomotion
 - HH hearing acuity (right and left)
 - EE visual acuity (right and left)
 - M mental capacity
 - S stability (emotional)
6. The overall assessment of the qualities is the PULHHEEMS profile. The medical employment standard (MES) is derived from that. Medical employment standards are service specific and their award ensure that Service personnel are not employed on duties for which they are unfit. Each quality can theoretically be awarded a grade of 1-8 but in practice only the EE, visual acuity uses all 8. The grades are defined so that:
 - 0 implies medically unfit for duty and under medical care
 - 2 is medically fit for unrestricted Service worldwide
 - 4 is medically fit with minor limitations
 - 4 is fit within the limitations of pregnancy
 - 7 implies major employment limitations and
 - 8 means medically unfit for Service.
7. Standards for hearing and visual acuity equate to specific measured levels of performance at audiometric testing (hearing threshold levels) and testing of visual acuity. For the other qualities findings on examination and medical judgement are key.
8. The PULHHEEMS profile at entry is designated, P (permanent). Subsequently re-grading may take place following a medical board. If a condition is treatable it may be designated R (remediable) and grading's may be temporary, and held for a maximum of 18 months. If a person does not require in-patient care and is able to remain on duty he or she will be classified according to function down to 7.
9. From 2015, to support consistency across the single Services, the Joint Medical Employability Standard (JMES) was introduced. Awarded by medical staff, this informs the Commanders, who take the decisions, of the medical fitness for deployability and employability of Service personnel. It is important that Service personnel are employed or deployed within their functional capacity i.e. JMES. Only in exceptional circumstances can someone be employed out with their JMES and then following a risk assessment including advice from a consultant occupational physician. In

general terms exceptional circumstances are met where life is at stake, or there is no other choice and the repercussions of not carrying out the task would be substantial and serious. The JMES is an alphanumeric code reflecting fitness in Air (A), Land (L), Maritime (M) environments and including category E, which is environment and medical support considerations. There are 6 grade levels for each environment, where 1 is fully fit, unrestricted duty in the specific environment and 6 is unfit any duties in the environment or reflecting environment and medical support consideration.

10. Deployability has three categories, medically fully deployable (MFD), medically limited deployability (MLD) and medically not deployable (MND). Finally to ensure the chain of command has precise understanding of how a person may be employed there are Medical Limitations. These are defined across the domains e.g. miscellaneous land air etc. with identified sub-domains e.g. flying or working conditions or food handling and descriptors of the limitation e.g. unfit solo or specific aircraft type. Medical limitations are documented with various codes, as published in the Joint Service Manual (2).
11. The present AFCS approach to “worsening” – is set out in the legislative extract below:

Extract from The Armed Forces and Reserve Forces Compensation Scheme Order 2011

Injury made worse by service

- (1) Subject to articles 11 and 12, benefit is payable to or in respect of a former member of the forces by reason of an injury made worse by service if the injury:
 - (a) was sustained before the member entered service and was recorded in the report of the medical examination when the member entered service,
 - (b) was sustained before the member entered service but without the member’s knowledge and the injury was not found at that examination, or
 - (c) arose during service but was not caused by service, and in each case service on or after 6th April 2005 was the predominant cause of the worsening of the injury.
- (2) Benefit is only payable under paragraph (1) if the injury has been worsened by service and remains worsened by service on—
 - (i) the day on which the member’s service ends; or
 - (ii) the date of claim if that date is later.
- (3) Subject to paragraph (4), in the case of paragraph (1)(a) and (b), benefit is only payable if—
 - (a) the member or former member was downgraded within the period of 5 years starting on the day on which the member entered service;
 - (b) the downgrading lasted for a period of at least 6 months (except where the member was discharged on medical grounds within that period);
 - (c) the member or former member remains continually downgraded until service ends; and
 - (d) the worsening was the predominant cause of the downgrading.

- (4) In the case of paragraph (1)(a) or (1)(b), benefit is not payable if the injury is worsened—
 - (a) within 6 months of the day service commenced; or
 - (b) 5 years or more after that day.
 - (5) In the case of paragraph (1)(c), benefit is only payable if the member—
 - (a) was downgraded within the period of 5 years starting on the day on which the member sustained the injury and remains continually downgraded until service ends; and
 - (b) the worsening was the predominant cause of the downgrading.
11. When a claim is made for AFCS worsening it can be considered at Service termination or beyond that date. It cannot be considered during Service (Article 9 (2) AFCS Order 2011). Worsening is recognised wherever any PULHHEEMS quality MES or DS is recorded as having a reduced grade compared with that at Service entry or, in the case of an injury which arose during Service, but was not caused by it, after the injury first occurred or disorder presented. Downgraded is also recognised where, as in Article 2 AFCS Order 2011, for medical reasons, a person undertakes a reduced range of duties but retains rank and pay. For many disorders and diseases worsening may occur over time simply as the natural course of the disorder. For an award to be made the evidence must support Service on or after 6 April 2005 as, on balance of probabilities, the predominant cause of the worsening.
12. Another issue which may be relevant to the “worsening” provision is the need in AFCS compensation determination to differentiate predisposition from the presence of a medically diagnosed disorder, especially with regard to the pre-Service period. If a person is “predisposed”, a discrete medically diagnosable disorder is not necessarily present, although he may have symptoms and is at risk of developing a medically diagnosable disorder. From a legal perspective, in the AFCS it is not appropriate to automatically reject Service attribution where a discrete diagnosed disorder presents and is formally diagnosed for the first time in Service, even if symptoms have arisen earlier, pre-Service. Acceptance of a causal link, due to Service, may still be appropriate. Predisposition may be familial or a similar approach is appropriate where, as a result of overall pre-Service experience and non-Service related events, a person is “at risk” of developing a discrete diagnosable disorder. In some cases, for example, a stressor related psychological disorder, there is a dose threshold for discrete diagnosis which may build up through multiple traumas over time. In the meantime symptoms may be accumulating and increasingly functionally disabling.
13. A principle of the AFCS endorsed by Lord Boyce at his 2010 review was that the Scheme should focus on those most disabled due to service. The time limits in Article 9 (4) and (5) were introduced, to reflect that principle. Given the nature of recruit early phase training it is reasonable to consider that breakdown or worsening of a pre-existing disorder in that early period cannot be considered predominantly due to service. Similarly if a person has been functional at average or above, breakdown at five years plus from service entry is not predominantly due to service worsening of a pre-service problem, although it may be a new problem or episode, which may itself be due to service and attract an award .
14. The next section sets out a few case examples of common situations including asthma, musculoskeletal and mental health disorders where worsening may be an issue. **Please note these are all fictitious and designed to address particular issues referenced in the paper rather than to accurately reflect Departmental practice. They should be considered at face value and within their limitations.**

Example 1

JS aged 18 years joined the RAF in May 2005 with a view to being a pilot. At enlistment medical he declared no past history of note and was made P2. He had not been especially sporty at school but did some hill-walking (30-50 mile hikes) for his Duke of Edinburgh's award with no reported ill effects. Four weeks into initial training he noticed some breathlessness after running and towards the end of rugby/soccer matches. 12 weeks later he reluctantly presented to the Medical Officer (MO) and finally was diagnosed with asthma. At home for some leave his mother recalled "wheezy bronchitis" after whooping cough when he was in Primary 1. His younger brother had eczema as a child which remitted aged 12. He was managed in service in primary care and with occasional use of inhalers he kept well passing all BFTs etc. He was not downgraded. In winter 2009 he had a period of adventure training in Scotland and developed a "heavy chest cold". Despite antibiotics and oral steroids this was slow to resolve and he was left with significant wheeze, breathlessness etc. and medically downgraded P3. Within 6 months he was again P2. The next winter he again had a chest infection and post acute phase, in steady state he had rather poorer respiratory function and was made P3 permanent. Now clear about career limitations he was eventually medically discharged in April 2013.

Would you accept Service worsening here?

Example 2

AB joined the Army aged 19 in 2009. At recruitment medical he said that he had mild asthma as a pre-school child and up to age 8. As a child he was diagnosed at a respiratory unit and thereafter treated by the GP but never used an inhaler regularly and was not routinely followed up either in primary care or at a respiratory clinic. He had never used a nebuliser nor been admitted to hospital and did not recall use of steroids at any time. He admitted to smoking ten cigarettes a day but said he was trying to stop. He denied previous skin trouble but said he had a brother who had problems with itch, weeping and cracked skin etc. The Civilian Medical Practitioner undertook further investigation, wrote to the GP and asked AB to keep a peak flow diary for a month. On review AB was accepted as fit for entry, P2. He enlisted and passed initial training (2010) and began electrical engineering training in early 2012. He much enjoyed this and was considered to be making excellent progress. As his training advanced he was required to use soldering material containing colophony and scrupulously followed the standard best practice exposure control requirements. However after a few months he was soldering more regularly and became aware that in the evenings he was short of breath on exertion and gave up playing football or going to the gym. Symptoms disappeared on holiday and at weekends. He had still not succeeded in stopping cigarettes. In the next few months he did less soldering, did not seek help and remained P2. In 2013 he went on winter adventure training and developed a lower respiratory chest infection. This was difficult to treat - there was associated bronchospasm. He was not admitted to hospital but regular inhaler use was added and by the end of the year he was made P3. He was seen by a consultant respiratory physician. Pulmonary Function tests confirmed marked and sustained deterioration in his function and he was diagnosed as having chronic irritant asthma. He initially required regular follow-up and maintenance according to British Thoracic Society Management guidelines level 3. He was still at work but with restricted duties including no soldering and was further downgraded to P7. He was recommended to change trade but declined to do so and was eventually medically discharged, P8.

Would you accept Service worsening here?

Example 3

RR was an infantryman who joined aged 24. He was tall with a long back and as a teenager although a keen footballer he frequently complained of low back pain. This usually resolved in a few days with rest and he rarely saw his GP and was not investigated. After he left school he worked for himself as a painter and decorator and continued to play amateur football at weekends. The bouts of low back pain continued – sometimes following clear strain or twist, or awkward lifting but sometimes apparently spontaneously. Episodes were not becoming more frequent so he rested and used over the counter medication. He joined up in 2009. He successfully negotiated initial training and passed into the field Army. About two years later on a promotion course route march /run with loaded bergan he had sudden onset of severe back pain. He struggled on but eventually had to seek help as he was finding it difficult to get out of bed in the morning because of the back pain. There was no referred pain or other bowel or bladder symptoms. Investigation was negative and specialist opinion diagnosed mechanical low back pain. He was treated with intensive physio but not downgraded. Over the next few months the episodes became more frequent and commanding and apparently spontaneous in onset or triggered by very minor strains e.g. lifting equipment /the baby and he was downgraded P3 and then P7 in 2012 and remained so until service release. He was attending his Personnel Recovery Unit and claimed in service in 2014 ahead of his final medical board. He had been ineffective in role for 18 months and was unable to do more than minimal physical activity. He could not attempt loaded runs, fitness tests etc. Imaging and neurological testing remained negative.

Would you accept Service worsening here? If the story were similar but...

Example 4

RR was a Royal Marine (RM) who joined aged 24. He was tall with a long back and as a teenager although a keen footballer he frequently complained of low back pain. This usually resolved in a few days with rest and he rarely saw his GP and was not investigated. After he left school he worked for himself as a painter and decorator and continued to cycle, run and play amateur football in evenings and weekends. He had always admired Special Military Units and increasingly had ambition to join up so he worked very hard at physical fitness. The bouts of low back pain continued– sometimes following clear strain or twist or awkward lifting but sometimes apparently spontaneously. Episodes were less frequent and again he rested and used over the counter medication. He joined up in 2009 and did not mention back pain. He successfully negotiated initial training. Following an active deployment to Afghanistan in 2011 but no specific injuries, about a year later on a promotion course route march/run with loaded bergan he slipped and fell awkwardly with sudden onset of severe back pain. He struggled on with all RM training and other activities but eventually, some months later had to seek medical help as the pain, which did not radiate and there were no bowel or bladder symptoms, was becoming more frequent and commanding. Investigation including imaging, and specialist opinion, diagnosed mechanical low back pain and no specific vertebral lesion. He was treated with intensive physiotherapy and initially not downgraded. Keen to be promoted he continued to carry out as much physical activity as he could. Over the next year the painful disabling episodes became more frequent and commanding. He was downgraded P3 and then P7 in 2012 and remained so until medical discharge P8 in 2013.

Would you accept “worsening” here? In general does continued physical activity worsen low back pain, lumbar spondylosis or osteoarthritis of lower limb in general? Please see Musculoskeletal Disorders Part 1 paper in this 4th IMEG Report

Example 5

AB, an infanteer joined up in 2007, aged 18 after a spell of unemployment and no regular job since leaving school. Two older brothers were at college and he had always looked upon himself as a bit different and much less clever and successful. At Service entry he was enthusiastic for an Army career, physically fit and daring, and made P2. He did well in initial training and passed out into the field Army. He was deployed to Afghanistan in 2009. He looked forward to it but the tour was busy and three men were lost. He was not present but was close to one of them. He himself narrowly missed being involved in an Improvised Explosive Device (IED) explosion in which colleagues lost limbs. On return to UK he was noted by friends to be drinking more than previously, was much quieter and unwilling to socialise. He denied any problem. Just as he completed post tour leave he developed severe skin scaling and joint problems affecting scalp, trunk and limbs and swelling and arthralgia of knees and elbows. He was eventually six months later diagnosed with psoriasis. This failed to settle with standard treatment and he had PUVA and methotrexate was considered. He was downgraded first to P3 and finally as the disorder was not settling made P7. Although he volunteered no pre-service history at entry he now said that there was a family history of skin trouble and he remembered a scaly rash on arms and legs a few times as he was growing up e.g. when he was sitting the 11 plus. On these occasions the rash abated by the time he was seen by his GP and no diagnosis was made. His skin improved but his joints remained problematic and after developing low mood and diagnosed with adjustment reaction and being sick at home for a year he was made P8 and medically discharged.

What would you do about the claimed psoriasis? Was that due to or worsened by Service?

Example 6

In 2007 JR joined the Army from school aged 17. He had a difficult childhood. His parents split up when he was 4 and his mother had a history of depressive illness and alcohol misuse. He and his two brothers were several times taken into care and eventually he went to live with his grand-parents. His life improved in all respects and he was especially close to his grandfather who had been a regular soldier for 22 years. It was largely this example which led to his joining up. As hoped he loved the Army and did well in recruit training. A year after enlistment his grandfather died suddenly. He was distraught and despite good support from the chain of command, the unit MO and his peers seemed to take a very long time to get over this. He was not downgraded and declined to be referred to the Community Mental Health Team. He also defaulted on MO follow-up. In 2010 he requested transfer to be nearer his grandmother. As an Army wife she reassured him that she was managing and that she would be happy to see him as leave etc. permitted. Transfer was not granted. Over the next 6 months he became socially isolated and several times had to be talked out of going Absence Without Leave (AWOL) by his peers. Previously adamant that alcohol was not for him he began to drink heavily and alone and eventually was persuaded to seek help. He was made P3 in 2011 and initially supported re an alcohol problem but it then came to light that he was also gambling heavily and was in considerable debt. Seen by a consultant psychiatrist, major depression was diagnosed and he was hospitalized as a potential suicide risk and made P0. He made slow progress and after a year, ineffective, when he declined further treatment in a military setting. He was made P7 and medically discharged for follow-up as a civilian. A month before Service termination he claimed mental health disorder under the AFCS which he contended was due to chain of command failure to agree his transfer.

Would you accept Service worsening here? Was his illness due to or, worsened by service?

Example 7

RR, born 1986 did engineering at university and joined the Army in November 2007. He did well at RMA and quickly passed out into REME. He was sociable collegiate and observed by his commanding officers (CO) to have leadership qualities. In 2009 on his way to a course driving his own car and spending an overnight with an aunt near the course venue, he was in a motorway pile up. Ten vehicles in front of him were involved. He had only minor physical injuries but several cars were significantly damaged and the next day he discovered that a child and mother in the second row of the collision had lost their lives. He did not see their car or the impact. At first he recovered well physically and mentally but, he had a 6 year old niece (daughter of his sister) of whom he was very fond; he was also increasingly thinking about modern warfare and the implications of collateral damage and for the first time having some doubts about his career choice. Six weeks after the incident he admitted to friends he was having difficulty sleeping and occasional nightmares about the Road Traffic Accident (RTA). He was able to work and concentration, mood etc. were "normal". Following discussion with his peers he sought help from the MO and, over a few weeks and several visits the symptoms abated and by four months post incident he appeared well and functioning normally. No formal mental health referral or diagnosis was made and he was not downgraded remaining P2S2. He continued to work in his mainly administrative technical role. He shared with the MO that when he was about five, his mother was admitted in the night to hospital for several weeks. He woke up to find she had disappeared and was not allowed to visit. Following this he had always tended to be a worrier. In January 2011 he deployed to Afghanistan. He had a good tour exercising his skills as an engineer and received commendation from his CO. Three weeks before he was due to return to UK he, with six of his men was involved in an ambush. No one was killed but two men sustained multiple gun shot wounds. He was unharmed. His conduct of the incident in its immediate aftermath was exemplary but on return to UK after decompression in Cyprus on his post deployment leave, he gradually became low in spirits, irritable with poor concentration. He developed nightmares of the event and of the RTA and avoided news bulletins re the conflict or any trauma. He referred himself to medical attention on his return to duty in October 2011 and was eventually diagnosed with PTSD and downgraded P3. He was made P0 and treated with 12 sessions of cognitive behavioural therapy, with initially some improvement in function but that soon plateaued and an attempt at a GRoW programme in an undemanding job was only partially successful. He awaits a Medical Board to review his medical employability grading. He is still serving...

He claimed for PTSD under the AFCS. This was rejected as not due to Service. **Do you agree with that?**

Assuming he remains P3 or P7 or even P8 after the Medical Board and is eventually medically discharged or decides that as promotion may be compromised he wishes to leave, **would you accept worsening by Service on or after 6 April 2005 if considered at Service termination?**

Conclusion and recommendation:

1. We have carefully considered the AFCS concept of worsening including the background Defence policy to medical employability and deployability grading. We have also considered some fictitious exemplar cases including musculoskeletal and mental health diagnoses.
2. We conclude that the present approach, set out in Article 9 of the AFCS Order 2011 is reasonable medically and supportive of consistent equitable decisions. We find no evidence that it is likely to lead to unjust decisions. It reflects Armed Forces personnel and medical policy and practice of attaining and maintaining maximum functional fitness, employability and deployability. We also support the fact that AFCS claims determination is informed by factual documented employability grading evidence, rather than purely medical judgement.

3. Where Armed Forces personnel and medical policy and practice as set out in JSP 950, leaflet 6-7-7 are adhered to, cases where worsening by service on or after 6 April 2005 is the basis of the award should be uncommon.
4. We agree with the policy that where an award is made, the amount of benefit paid for injury or disorder due to AFCS service and that for injury or disorder worsened by service, should be the same.
5. We recommend that claims for worsening would benefit from mandatory medical advice as with the other categories identified following the recommendation by Lord Boyce in the 2010 Review (3).
6. IMEG should routinely monitor from 2019-20, final outcome annual rates and types of claims where AFCS worsening is claimed, accepted and rejected.

References:

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- (2) Joint Services Publication 950 Medical Policy Part 1 vol 6 Occupational Medicine/Health Chapter 7 Medical Employment Standards Policy Leaflet 6-7-7 Joint Service Manual of Medical Fitness.
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Topic 6 - Spanning

Key points

1. As far as possible, given the marked differences between the War Pensions Scheme (WPS) and AFCS, we recommend approaches based on case facts likely to be documented, in service and medical records, leading to case determinations which are medically robust and defensible, understandable to claimants and administrators.
2. We consider decision-making in spanning cases, potentially challenging and advise that spanning cases should be added to the list of case types where medical advice is mandatory.

Introduction

1. This is the second of two papers, the other being on “worsening”, which consider the medical aspects of the present approach to determination of two specific types of AFCS claim. As with “worsening”, spanning was first drawn to attention in the Boyce Review and more recently by the QQR team. “Spanning” cases are identified at or beyond service termination and are where the person has served both before and after 6 April 2005. As a consequence they might have entitlement under both the WPS and the AFCS. Where an injury or disorder has been caused before 6 April 2005 entitlement and award under the WPS may be appropriate, while for causation on or after 6 April 2005 the AFCS is the relevant scheme. Although spanning cases should be a temporary phenomenon, at present, more than twelve years post-introduction of AFCS, ex-Service personnel with spanning service are increasingly claiming compensation. The purpose of this paper is to explore and recommend medically sound approaches to such claims. The findings will be of interest to policy colleagues, in particular, in relation to the legislation and also to scheme decision-makers, medical advisers and claimant representatives. For brevity this paper will use the phrase AFCS service to imply military service on or after 6 April 2005 when the AFCS applies.
2. Decisions in spanning cases should as always, be evidence-based, consistent and equitable, reflecting the case service and medical facts, contemporary medical understanding of causation and progress of injury or disorder and the relevant law. They need also to be administratively practical and understandable to claimants. As far as possible two awards and two appeal rights for the same disorder under both the WPS and AFCS should be avoided. Claims categories especially impacted by spanning Service include hearing loss, musculoskeletal/orthopaedic disorders involving both chronic attrition or overuse and acute trauma to joints/structures, and mental health problems.
3. The aim in spanning cases, where possible, should be to make a single award under one scheme, notifying one appeal right. While awards under both schemes are based on a causal link to service and both schemes are individual jurisdictions, with decisions based on evidence, there are innate differences between the two which are set out in the legislation, i.e. Service Pensions Order (SPO) 2006 for war pensions and the AFCS Order 2011:
 - War pensions claims can only be made at or after service termination, while it is possible to claim under AFCS while still serving.
 - War pension claims have no time limits, while AFCS has normal time limits of seven years along with late-onset provisions.

- War pensions assessment (and hence award) for accepted injury at earliest is from date of service termination. AFCS lump sums may be paid in service with any income stream, the Guaranteed Income Payment (GIP) paid from service termination for life.
- Assessment and award for war pensions is normally for a defined time period with wide gateways for both the pensioner and Secretary of State to request review. For AFCS a key principle is to make full and final awards as early as possible.
- War pensions are medically certified while AFCS is medically advised.
- War pensions standard of proof is “reasonable doubt” while AFCS is “balance of probabilities”.

A Double compensation

4. When the AFCS legislation came in, in 2005, it was assumed that a person might first claim under the AFCS, i.e. while still in service, but could only claim war pension at and beyond service termination, i.e. second. To address that situation, a provision was introduced into the WPS to prevent double compensation for the same injury or disorder, i.e. the amendment said that if there was an award under AFCS there could not be one for the same disorder under the WPS.
5. In addition, although the AFCS includes a “worsening” provision, claims can only be made for AFCS worsening after the end of all service. It was thought that if an injury was accepted as attributable under the WPS, any subsequent later increase in disablement would also be accepted under that scheme, and so it was not necessary to introduce a similar exclusion in AFCS for disablement accepted under war pensions.
6. However an Upper Tier Tribunal (UTT) (equivalent of High Court and so binding) judgement (CAF/842/2011) established that these provisions were not robust in avoiding double compensation because causation was established in the two schemes using different standards of proof. The judge found that because war pensions have a lower standard of proof, AFCS worsening would still need to be considered. To address this, AFCS legislation was amended on 7 April 2014 to prevent payment for the same injury or disorder under both schemes.

B Suggested practical approaches to decision-making

7. The remainder of this paper suggests some principles and general observations to support medically sound decisions in spanning cases. This is followed by a few worked examples. In all cases it will be appropriate first to determine some case facts:
 - i) The service dates for all period of service from initial entry until final discharge.
 - ii) The duration of service periods, pre- and post- 6 April 2005.
 - iii) What is claimed? What is the contended service link, i.e. event, exposure, behaviour? Is it pre- or post- 6 April 2005?
 - iv) If a physical or mental disorder as opposed to an incident-related injury is claimed, is there evidence of when the disorder came into existence, its date of clinical onset or when the person first sought medical advice?
 - v) What are the claimant’s medical employability gradings and dates over the total service period?

C Some general observations to bear in mind

- 8.** 6 April 2005 is a wholly artificial date in operational and clinical terms. There may be no factual or medical information at or around it in a specific case. However, where a person sustains an injury or develops a disorder due to service before 6 April 2005, and serves on, is not being investigated or treated and is not medically downgraded on that date, it is reasonable to assume that any extant injury or disorder present on that date has a Nil or very low level of disablement or functional restriction or limitation. We suggest the principle of “taken as found” should then apply to any AFCS consideration. If we take someone into service or allow him or her to continue, we are accepting any vulnerability or susceptibility to develop a disorder.
- 9.** Amongst the most common spanning claims are hearing loss. Since 1987 Service personnel have been able to take civil action against MOD with awards made for lapse of duty of care. From at least the introduction of AFCS, in line with wider UK legislation and best practice, we can assume the use of hearing protection in Defence industrial workshops, range training etc., as the norm. That means that unless there is positive evidence to the contrary we should not accept chronic industrial type noise exposure during AFCS service.
- 10.** It is important in all claims, including spanning claims, to differentiate “predisposition” from “predestination”. If a person is “predisposed”, a discrete diagnosable disorder is not necessarily present, although he is at risk of developing one. From a legal perspective, it is not appropriate to automatically reject service attribution where formal medical diagnosis of a discrete disorder is first made in service even if the person had symptoms and/or previously sought medical help. Acceptance of a causal link to service may still be appropriate. If, on the other hand, something is predestined, it is inevitable and arises from constitutional factors regardless of external influences and so no entitlement or acceptance of attribution is due even with a low standard of proof as in war pensions, e.g. Huntington’s chorea.
- 11.** War pensions entitlement and assessment are determined at or beyond Service termination, regardless of when that occurs relative to 6 April 2005. The WPS legislation is the Naval, Military and Air Forces etc. (Disablement and Death) Service Pensions Order 2006, usually abbreviated to the Service Pensions Order (SPO) 2006. If someone leaves service on 31 October 2017, the “beyond reasonable doubt” Article 40 of the SPO standard of proof applies to war pension claims, from date of service termination for seven years, i.e. until 31 October 2024. To reject entitlement under Article 40 there must be positive evidence that there is no causal link to pre-6 April 2005 Service. It is not enough to have “no evidence of effect”. There must be “evidence of no effect”.
- 12.** References in the legislation of both schemes to “Service” entry etc., means entry to “any” Service and similarly discharge date means discharge from “all” Service.
- 13.** Finally, the assessment of disablement/disability under war pensions or AFCS, or for medical rehabilitation, is not an exact science. Overall assessment is determined and can rarely, if ever, be apportioned on the basis of aetiology, particularly with chronic exposures lacking dose measurements.

D Spanning Case Examples

Please note these are all fictitious and designed to address particular issues referenced in the paper rather than accurately reflect Defence practice. They should be considered at face value and within their limitations.

Hearing Loss Cases

14. Pure tone audiometry became widely available in the 1970s and the current military system of assessing hearing acuity was introduced in 1981. Reflecting the different operational requirements, principles are shared but slightly different standards apply to the three Services. The military approach to hearing and medical employability, including retention in service, does not depend on any particular level of hearing threshold but on the individual case facts and specialist otolaryngological and occupational health opinions. The military approach involves routine surveillance of overall hearing acuity, detection of the presence and progress of noise damage and the provision of hearing protection suitable for the individual and their circumstances. Allocation to a PULHHEEMS hearing standard is based only on hearing acuity. Pure tone audiometry is carried out at time intervals and, as required, clinically. Hearing acuity tested by pure tone audiometry at 250 Hz to 8 kHz is used to determine the PULHHEEMS category in each ear using the sum of the thresholds (dB) at low frequencies, i.e. 500 Hz, 1 and 2 kHz and high frequencies 3, 4 and 6 kHz.

The standards are as follows:-

Low frequencies	High frequencies
H1 not more than 45	not more than 45
H2 not more than 84	not more than 123
H3 not more than 150	not more than 210
H4 more than 150	more than 210

Example 1

An infanteer served 1988-2007. In training in 1989 a colleague accidentally discharged his weapon causing acute acoustic trauma to his left ear. Hearing loss and tinnitus settled over time. He had an uneventful tour of Iraq in 2004/2005. He had a normal discharge and claimed in 2012.

- The legislation provides that his claim is deemed to be made to either scheme.
- It is for the Secretary of State to determine which scheme applies.
- In this case the facts as claimed are confirmed in the Service medical record and the case worker considers the claim to have been made under the War Pensions Scheme.
- At service termination in 2007 he was H1H1 i.e. good hearing in both ears.
- Article 40 SPO applies and on the facts of the case, at service termination the medical adviser certified entitlement to acute acoustic trauma assessed at 1-5% for ongoing tinnitus (mild) with no assessable hearing loss. A gratuity was paid.
- Appeal rights under the SPO were notified.
- There was no AFCS award.

Example 2

An infanteer served 1988-2007. Service to 6 April 2005 was uneventful. He had a busy Iraq tour and in June 2005 suffered a blast injury to his right ear. He was medically discharged in 2012 for a musculoskeletal (MSK) condition. He claimed compensation for hearing loss while still serving in 2010. He made his in-service claim under the AFCS and Service medical records confirmed his history and medical support and follow-up.

- His in-service claim was made under the AFCS.
- The facts of the case as claimed were documented.
- Pure tone audiometry dated December 2005 was unremarkable in pattern.
- At claim he was H2H2 with evidence of asymmetrical high frequency sensorineural hearing loss.
- He was awarded blast injury to ear from AFCS Table 7 with appeal rights.
- No entitlement under the WPS and no appeal rights.

Example 3

A gunner, WO1 born 1960 served 1976-2011. He had several deployed tours to Iraq (2003, 2004, March 2005) and Afghanistan 2006 but did not experience any identifiable acoustic trauma or blast incidents from the 2006 tour. He complained of hearing loss which he related to early weapons training and general weapons noise in Iraq. At service entry he was H1H1 (forced whisper test). He was downgraded H2H3 after 2001 but allowed to deploy with restrictions, e.g. base areas and use of double hearing protection. He said he did not use hearing protection in early years but was meticulous about it after 2001. He was not medically discharged. At service termination in 2011, he was again H2H3. He claimed hearing loss in 2009. The audiometric pattern was suggestive of bilateral noise-induced sensorineural hearing loss. The left ear deficit was slightly greater than right ear.

- He claimed expressly under AFCS.
- His long pre-2005 service was recognised as well as his claims history.
- The SofS accepted chronic noise exposure in the first service period but not in the second, i.e. post 6 April 2005.
- There was sparse audiometry in WPS service until 2001 and then a few audiograms which showed gradually accruing sensorineural hearing loss with no particular pattern.
- At service termination he had hearing threshold 33 dB averaged over 1, 2 and 3 kHz right and 42 dB averaged for the left ear.
- He served 27 years before AFCS and was notified in a letter that his claim would be considered at service termination under WPS.
- The history, audiometric pattern and rate of increase of hearing loss led eventually at service termination to certification under SPO of bilateral noise-induced sensorineural hearing loss assessed at Nil final.
- He was given War Pension appeal rights and no notification/appeal rights under AFCS.

Example 4

Cpl B was an RAF mechanic. He served 1976-2011 when he was discharged with hearing loss. He was first noted to have hearing problems allegedly due to hangar noise in 2003 and was downgraded H3H3 so he was not fully deployable and only deployable in any role/location with double hearing protection. He twice after 2005 deployed to Iraq and Afghanistan and for, at least one period during the Afghanistan tour, he was servicing planes by day and his accommodation was next to noisy generators. He did not however receive regular post-tour surveillance. One audiogram in 2007 showed H3H3. He was not screened after Afghanistan but picked up in 2009 at his age 50 medical. He was H3H4 with average threshold of 50dB averaged over 1, 2 and 3 kHz (right) and 52dB left. This was shown at audiogram dated 12 December 2010. He was medically discharged in 2011.

- The SofS accepts noise exposure before and after 6 April 2005.
- No evidence of acute acoustic trauma.
- Service where the War Pensions Scheme applies was 1980- April 2005.
- There were several audiograms confirming the pattern of developing bilateral noise-induced hearing loss.
- He remained H1H1 or H2H2 until 2003 when he was H3H3.
- Audio in 2007 showed some slight further deterioration in hearing thresholds but he was again within H3H3 grading.
- The final audio, in 2011 said to be reproducible and repeatable was H4H4.
- The thinking here is that this man was noise-exposed across his service and so needs to be considered under both schemes.
- In the absence of information on noise dose across the service period it is too simplistic to simply identify the “predominant cause” by service length. By his own account post-2003 service was noisier.
- WPS assessment must apply from service termination where, because noise injury stops when the person is removed from the noise, the assessment in this case will apply from actual service termination but based on the audiometric hearing threshold at or around 5 April 2005.
- No acoustic trauma so the compensation threshold applies.
- Bilateral noise-induced hearing loss was certified as attributable to WPS service and assessed at Nil final. Appeal rights were given.
- All sensorineural hearing loss was then accepted under AFCS.
- Apportionment of loss between the two schemes would result in no award under either scheme and would be manifestly unfair.
- The reasons for decision need to explain this reasoning/approach very clearly.
- With two accepted injuries under two schemes, exceptionally, he will have appeal rights under both schemes.

E Musculoskeletal Disorder/Traumatic Injury

Example 1

A Royal Marine SSgt, born 1965, served from 1982 – 2012 when he was medically discharged with a principal invaliding disorder of low back pain. The medical records make reference to short-lived episodes of low back pain regularly from 1990. There was no identifiable discrete incident, but he had several episodes of deployed service in the Gulf 1990/91, the Balkans in 1996/7 as well as Iraq 2003. Usually, symptoms became troublesome on return from deployment or following a training exercise/"yomping", etc. with loaded bergens. He was not downgraded in WPS service and was treated with physiotherapy and simple analgesia, and later he carried out his own exercises without medical intervention. In 2007 in Afghanistan he was on the edge of an IED blast and fell, injuring his lower back. It did not come to immediate medical attention but on return home until service termination he complained of more frequent and more severe episodes of low back pain. The pain did not radiate and neurological examination was normal. He was investigated with X-rays negative, but MRI showed mild generalised signs of degeneration throughout the lumbar spine. He was treated by intensive physiotherapy and facet injection and engaged fully, but he failed to improve significantly and was progressively downgraded from 2008. First he was made P3 then P7 and on restricted duties. At service termination, having been advised against surgery, he was awaiting an appointment at a pain clinic.

- This man had 30 years physically demanding service of which 23 years was covered by the WPS.
- While symptomatic during pre-2005 service no formal diagnosis was made, clinical examination was normal and he was not downgraded.
- Similarly, while there was an event-related injury in 2007 in Afghanistan, the evidence is that this was primarily soft tissue.
- Clinical examination in 2008 was normal and neuroimaging by MRI showed no focal bony damage as might be expected secondary to trauma, but rather generalised lumbar degenerative change likely to signify more cumulative load damage.
- His case was considered at service termination and on the history, and under Article 40 SPO, the medical adviser certified lumbar degenerative change attributable to service.
- An appeal right was given.
- There was no entitlement under AFCS.

What if the 2009 incident had resulted in prolapsed intervertebral discs with neurological signs and extending over several levels of vertebrae which required surgery in 2010 and again led to invaliding?

- On these case facts it would have been reasonable to take his back symptoms pre the 2007 incident as predisposing features.
- We could then go on to accept all back disablement under AFCS using a descriptor from Table 2. This would take account of the spine pathology, clinical neurological signs and surgery and attract a GIP.
- An element of the AFCS award would take account of lumbar OA present and subsequent to the traumatic injury.
- An appeal right would be given under AFCS.
- No entitlement or award under SPO.
- An alternative, in view of his long Service, might be to give lumbar spondylosis attributable under the Service Pensions Order assessed at Nil Final with all disabling functional effects accepted under AFCS as above.

Example 2

AB is in the RN and a submariner engineer. Born 1980, he served from 2000 and is still serving. Pre-service, he was a keen amateur athlete and suffered recurrent right knee pain. Radiologically and clinically no discrete pathology was identified and by age 17 he was asymptomatic, and similarly at service entry aged 20 years. He therefore did not report the pre-service knee pain at service entry. He passed all fitness tests in training and subsequently continued to be fit, taking part successfully in all physical training and representative team sports. From 2000-2005 he was P2L2. In 2007 he sustained a right knee twisting injury at football during an organised game. He was first treated conservatively. After the acute phase he did not attend medical centre, nor was he downgraded. In 2012 he again twisted the right knee at football and gave a history that his symptoms had not completely settled from 2007. He was downgraded P3 L3 in 2013. He came to arthroscopy in October 2014 when he was found to have a right knee meniscus bucket handle tear and the tibial platform showed grade two osteoarthritic changes. The meniscus was removed arthroscopically and tibial cartilage tidied up. He remains P3 (September 2015) and has now claimed under AFCS.

- From age 17 (1997) until 2007 there were no complaints and apparently full function.
- This suggests the pre-service pathology was one of the juvenile osteochondroses which usually remit as the skeleton matures.
- In 2007 we have an incident-related injury but no formal diagnosis. He was not downgraded.
- In 2012 he had another injury in an organised game, when he then said 2007 symptoms had not fully resolved.
- He was then downgraded and remained so at date of claim.
- He was investigated and required operative examination and treatment.
- He was given an award under Table 9 AFCS Musculoskeletal injuries.
- Because no investigation nor discrete diagnosis was made pre or in service pre 2005, no entitlement was given under WPS. He was assumed only to be predisposed to further injury/symptoms.
- AFCS awards in Table 9 include any associated expectable consequential osteoarthritis.

F Mental Health Disorders

In both schemes, no award is made for symptoms alone but only for discrete diagnosed disorder. For the SPO this requirement is a matter of case law, not legislation and specialist diagnosis is preferable but not required. For AFCS, on the other hand, the legislation provides that awards are made only for discrete diagnosed disorders and must be made by a consultant psychiatrist or clinical psychologist. Neither scheme accepts alcohol-related injury or injury from the non-therapeutic use of drugs. Both schemes have late onset/delayed onset presentation arrangements.

Example 1

CD is a fusilier. Born 1970, he joined up in 1988 and served in the Balkans. There was no pre-history nor family history of mental health problems, but he had a difficult tour on account of civilian and child casualties and on return to UK he began to drink heavily and run into relationship difficulty at home. Eventually he was persuaded to get help and was diagnosed as adjustment reaction in 1996. He was treated with Cognitive Behavioural Therapy (CBT) and made good progress, returning to full fitness

P2S2 within 24 months. He did well in his career, was promoted and went to Afghanistan as a platoon Commander in 2007. The 2007 tour was unremarkable but he redeployed in 2010 when three men and the Commanding Officer (CO) were lost from his regiment. After coming home he again started to drink and was very reluctant to seek further help, fearing a negative impact on further promotion. His wife gave him an ultimatum re treatment. In 2013 he was diagnosed with PTSD and depression. There was suggestion of self-harm and he continued to misuse alcohol, but often denied this. He found it difficult to engage with CBT or Eye Movement Desensitisation Therapy (EMDR) in military service and did not complete an adequate course of best-practice treatment. He was angry and was downgraded unfit to bear arms or work for more than a year. A Medical Board dated April 2016 recommended P8 medical discharge. The invaliding disorders were PTSD, alcohol misuse and depressive disorder. He deferred rehabilitation but said he would engage with civilian mental health services for the sake of his marriage and children. Transition from Defence Medical Services to his local NHS was arranged. He claimed these disorders under the AFCS. Run out date November 2017.

- He has long service and documented mental health symptoms during pre-2005 service, and a formal medical diagnosis. The evidence is he responded well to treatment.
- At service termination this adjustment disorder could be considered under the WPS but the history and that diagnosis suggests that residual assessable disablement from that formal diagnosis is unlikely.
- Its existence will however have predisposed him to further symptoms and disorder. His invaliding disorders are confirmed as PTSD, depressive disorder and alcohol misuse.
- The history confirms that PTSD and co-morbid depressive disorder are due on balance of probabilities to AFCS service. Alcohol misuse is excluded from the schemes.
- Under the SPO an option would be to accept adjustment disorder attributable to service. Assessed at service termination, given the documented case facts and the natural history of adjustment disorder, this would be assessed at Nil.
- His PTSD and depressive disorder would be accepted under AFCS Table 3.
- The award would be interim.
- Although case formulation records two diagnoses in this case, AFCS uses generic descriptors which cover, under one descriptor and award, all functional restriction and limitation resulting from all diagnoses for the appropriate duration. (This issue is further discussed in the QQR response section of this fourth IMEG report).

Example 2

DD is in the RAF. She joined in 1996, graduate entry aged 22, and attended officer training at RAF Cranwell. She was quickly promoted and had glowing reports. She had deployed service to Sierra Leone and in January 2002 attended training camp in Canada where she sustained a fractured ankle skiing. There were complications and she required multiple operations, and it was not until September 2003 that she was fully upgraded. During that time she complained of low mood and was seen by a consultant psychiatrist who felt this was reactive to her injury and no discrete diagnosis was present. She recovered by mid-2004 but suffered reversal of mood, apparently out of the blue, and including thoughts of self-harm in December 2005. She had family troubles around this time. Reluctantly, she again sought help and was seen a few times and given anti-depressants. She continued to function at work in an admin/personnel-type role and by July 2007 was recovered. She was not downgraded or on restricted duties. She began preparation for deployment to Afghanistan in late 2011. She looked forward to this because of the likely positive impact on promotion but on tour, starting in July 2013, she was very busy because of short staffing, and complained of exhaustion. She was sent home in October 2013 after four months and over the next few months became increasingly depressed. She

remained under medical care and was finally diagnosed with bipolar disorder in October 2015. A distant family history was revealed. She was retained in service during treatment but made slow progress and was progressively downgraded to P7. She is to be medically discharged in March 2018 to continue treatment in a civilian environment. The invaliding condition is bipolar disorder. Rehabilitation and resettlement deferred. She has now claimed under the AFCS.

- This lady, born 1974, will have completed 22 years service at service termination.
- Pre-service she enjoyed good mental health and no history of symptoms.
- During the nine years of pre-2005 service she had a serious service-related ankle injury which will be for acceptance under the WPS.
- There were complications and treatment and rehab was prolonged and accompanied by low mood, but no discrete diagnosable mental health diagnosis was made.
- All awards for injury or physical disorder under the AFCS include an element for mental health symptoms, short of a discrete diagnosable disorder.
- Eventually she made a good and full functional recovery.
- In 2005-7 she had another bout of low mood, apparently triggered by family issues. Again this remitted.
- In 2013 she deployed to Afghanistan. She was enthusiastic and looked forward to it but the tour was demanding and she became exhausted and had to be sent home. She became increasingly depressed and in October 2015 a diagnosis of bipolar disorder was made.
- She has been downgraded since late 2014.
- Treatment is ongoing and she is to be medically discharged in March 2018, S8P8.
- By its nature and given the case facts bipolar disorder is not due on balance of probabilities to AFCS service.
- The time course of events will preclude acceptance of worsening under AFCS.
- Given the history, the disorder can also be considered under Article 40 SPO.

Conclusion and recommendations:

1. We have carefully considered the issues raised by spanning service including the marked differences between the two no-fault compensation schemes.
2. As far as possible we have tried to recommend approaches based on case facts likely to be documented and which should lead to case determinations which are robust and defensible.
3. A particular issue is apportionment of disablement or functional compromise between the two schemes and the fact that that may not be scientifically possible.
4. Where, as with example 4 in the Section on hearing loss, apportionment on the basis of evidence is possible, any approach must also deliver a just outcome. We consider that this issue is most likely to arise in hearing loss cases because of the hearing compensation threshold found across UK no-fault personal occupational injury schemes, i.e. Industrial injuries, WPS and the AFCS.
5. We consider reasonable, fair, robust and defensible decision-making in spanning cases is potentially challenging and advise that spanning cases should be added to the list of case types where medical advice is mandatory.
6. IMEG should monitor from 2019-20, final outcome claims rates and disorder types of spanning cases.

Topic 7 - Recognised Diseases: Ultraviolet Light and Skin cancers

Key points

1. For a disorder to be a Recognised Disease in the AFCS, we look for evidence that service is consistently associated with an increase in its frequency and whether there are circumstances where the frequency is more than doubled, making it more likely than not in the individual case that the disease was attributable to a cause in service.
2. Skin cancers, the most common cancers in white skinned populations are usually divided into non-melanoma skin cancers (NMSC) and cutaneous malignant melanoma (CMM). The most important types of NMSC are basal cell carcinoma (BCC) and squamous cell carcinoma (SCC).

NMSC Basal cell carcinoma (BCC) is commonly called rodent ulcer. The mortality rate is low and they rarely metastasize but they may invade surrounding tissues including cartilage and bone causing significant destruction. Squamous cell carcinomas (SCC) may arise in scar tissue but the majority arise on sun damaged exposed skin, and most commonly in actinic keratosis (AK).

Cutaneous malignant melanoma. Cutaneous malignant melanoma (CMM) accounts for less than 5% total skin cancers, although the incidence is rising in all parts of the world for which data are available and it leads to 75% of all deaths from skin cancers.

3. By April 2005 public health education on the dangers of sun exposure were well developed including in the UK amongst the military medical services, the chain of command and Service personnel. The avoidance of direct UVR exposure and sunburn, use of suitable protective clothing, sunglasses, and sunscreens, were standard practice.
4. While total cumulative lifetime sun exposure is casually associated with AK and SCC, the evidence is that BCCs are more related to short intermittent burning episodes. Sun exposure plays a primary role and supporting role in most cases of CMM with the pattern of exposure in the sub-types varying. The risk for CMM in older people, developing over many years and of generally lower mortality is as for SCC, ie chronic long term excess UV exposure. Superficial spreading melanomas, the most common type in working age adults are related to short sharp episodes of burning exposure especially in youth and adolescence.
5. We conclude that in general none of these circumstances is likely to be met at this date due to AFCS service and so most cases of NMSC and CMM claimed under AFCS will be for rejection. However each case should be considered on its facts.

Introduction

Ahead of the detailed discussion on ultraviolet light and skin cancers we have reproduced the introduction to Recognised Diseases included in the May 2013 IMEG report.

1. Lord Boyce in his review of the AFCS raised the issue that while under the War Pensions Scheme the majority of medical discharge cases suffering from physical disorders receive entitlement to a war pension, this is not the case under the AFCS. This is a reflection of the different standards of proof required in the two schemes. The standard of proof in AFCS is “on the balance of probabilities” (or “more likely than not”), which is the standard of proof in both civil compensation and the statutory compensation scheme for civilian occupational injury and disease, the Industrial Injuries Scheme.
2. At its inception in 1917, the standard of proof used in the War Pensions Scheme was “on the balance of probabilities”. This was changed in 1943, at the height of the Second World War, when for injuries and disorders arising in service, the burden of proof transferred to the MOD to demonstrate that a service cause was “beyond reasonable doubt” not the cause of the disease or injury. The change was introduced at this time because inadequate record-keeping was leading to large numbers of claimants unfairly not receiving compensation.
3. In his report, Lord Boyce proposed that the IMEG should develop a list of Recognised Diseases for the AFCS. By this he meant that IMEG should review the medical literature and receive evidence from experts to provide guidance about the circumstances when “on the balance of probabilities”, a disease having onset in or around service was more likely than not to be attributable to service in the Armed Forces.
4. The normal burden of proof in civil compensation and other statutory compensation schemes such as the Industrial Injuries Disablement Benefit (IIDB) Scheme is “on the balance of probabilities”. For claims under AFCS, this implies demonstrating that military service is more likely than not (more than 50:50) the predominant cause of the injury or disease in the individual case. In the Industrial Injuries Disablement Benefit Scheme, for those conditions where there is sufficient evidence that this level of proof is satisfied, the disease is ‘prescribed’, i.e. attributable in the individual case to the particular cause in relation to clearly-specified circumstances of exposure.
5. In the individual case, attribution is usually based on sufficient evidence to answer the questions:
 - Does the particular agent or exposure cause the disease, at least in some circumstances?
 - If so, were the circumstances of the individual case such that the agent or exposure is more likely than not to have been the cause of the disease?
6. Recognition of a particular agent as the cause of a disease, and attribution in the individual case, is most clear when the cause is specific to the disease, or nearly so, and the probability of causation is high. Such conditions are now relatively uncommon but a relevant example is occupational asthma, where the primary cause is an agent inhaled at work. The majority of cases of occupational asthma are due to the development of an allergic reaction to the specific cause encountered in the workplace (e.g. flour in a bakery). Asthma develops after an initial symptom-free period of exposure and recurs on re-exposure to the specific cause, in concentrations which do not cause respiratory symptoms in others similarly exposed or previously in the affected individual. Inhalation testing with the specific agent will provoke an asthmatic reaction in the sensitised individual (but not in others not sensitised). Also, for many agents, evidence of a specific immunological reaction (i.e. specific IgE antibody) will be found. In principle the specific cause of asthma can be demonstrated in the individual case.

7. The majority of diseases, however, are not specific to a particular cause. A particular cause may increase the frequency of occurrence of a disease, which can have other recognised causes. As an example, lung cancer is well known to be caused by smoking cigarettes. More than 90% of cases in the general population occur in cigarette smokers. A smoker of 20 cigarettes a day during adult life will increase his or her chances of developing lung cancer by some twenty-fold. In the case of lung cancer in a smoker of 20 cigarettes a day for 40 years we can say with confidence that it is likely that the lung cancer is attributable to the smoking of cigarettes.
8. However, there are also other causes of lung cancer, such as asbestos and ionising radiation. When are we entitled to attribute lung cancer in an individual to asbestos exposure? The lung cancer caused by asbestos is indistinguishable from lung cancer from another cause, such as smoking, so it has no specific distinguishing features. We have to ask the question: in what circumstances would it be more likely than not that the lung cancer was caused by exposure to asbestos? As the individual case has no distinguishing (or specific) features, we have to look at populations of people exposed in their work to asbestos. Among these, are there any circumstances where the frequency of the disease has increased sufficiently to make it more likely than not in the individual case that the lung cancer would be unlikely to have occurred in the absence of occupational exposure to asbestos? The answer is that, among other circumstances, the frequency (or incidence) of lung cancer was more than doubled in asbestos textile workers, both smokers and non-smokers, who worked for 20 years or more in an asbestos textile factory. In these circumstances we can conclude it is more likely than not the lung cancer is attributable to asbestos.
9. Why is a greater than doubling in the frequency of the disease so critical in determining attribution to a particular cause? We can consider a hypothetical 100 men working in a particular occupation (figure 1). Among these 100 men, as in the general population, the number of new cases of a particular disease is ten each year, i.e. no different.

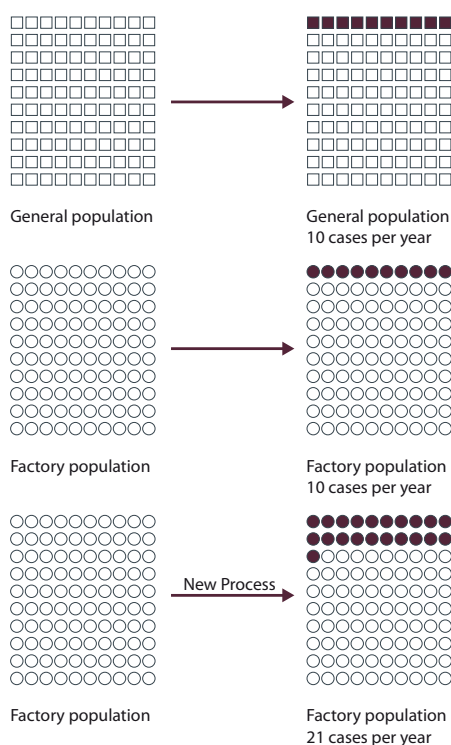


Fig 1. Increased incidence of disease from ten per year to 21 per year in factory population following the introduction of a new process.

Sometime later, after the introduction of a new process, the number of cases of the disease in these 100 men increases to 21 each year, i.e. more than two times the previous frequency. We cannot distinguish the additional 11 cases from the 10 in whom the disease would otherwise have occurred. What we can say is that in any particular individual among the 21 cases, there is a more than 50:50 chance, or a greater than doubling of risk, that the disease would not have occurred without exposure to the particular cause. On the balance of probabilities it is therefore more likely than not that the disease is attributable to the particular cause in the individual case. We can say that 'but for' his working in this factory it is unlikely the man would have developed the disease. The balance of probabilities has shifted to "more likely than not" and in this circumstance the disease can be attributed to the particular cause.

10. In the case of Recognised Diseases in the AFCS, we are therefore looking for evidence that service in the Armed Forces is consistently associated with an increase in the frequency of a particular disease or illness and whether there are circumstances where the frequency is more than doubled, making it more likely than not in the individual case that the disease was attributable to a cause in service.
11. It is also important to distinguish "all or none" diseases from "more or less" diseases. A well-recognised "all or none" physiological condition is pregnancy: one cannot be a bit pregnant. In contrast, many important conditions including high blood pressure, hearing loss and mental health disorders are "more or less" conditions. These have a continuum of frequency of symptoms without a clear distinction subject to expert opinion.
12. The epidemiological evidence informing these determinations should be of high quality, drawn from several independent studies and sufficiently consistent and robust that further research at a later date would be unlikely to overturn it.

Ultraviolet Radiation (UVR) and Skin Cancers

Clinical Issues

1. Skin cancers, the most common cancers in white-skinned populations, are usually divided into non-melanoma skin cancers (NMSC) and cutaneous malignant melanoma (CMM). The most important types of NMSC are basal cell carcinoma (BCC) and squamous cell carcinoma (SCC). Over the last 50 years the incidence of skin cancers of all types has increased and continues to do so. In Europe, the US and Canada the average increase incidence is about 3-8% a year (1). Precise rates of NMSC are difficult to compute because not all skin cancers are registered, and in some countries data is only collected on all NMSC (undifferentiated into SCC or BCC). Other issues with NMSC estimation include the occurrence of multiple lesions and recurrence. Skin cancers occur both in Caucasian and darker skins where incidence is lower but prognosis often poorer because of delay in detection and diagnosis.

Non-Melanoma Skin Cancers (NMSC)

2. Basal cell carcinoma (BCC) is commonly called rodent ulcer. There are no precursor lesions and the tumour arises from the basal cells of the epidermis and is usually grouped according to histology and clinical course into nodular, micronodular, superficial and morpheaform. The mortality rate is low and they rarely metastasise but the morpheaform and micronodular variants may invade surrounding tissues including cartilage and bone causing significant destruction. BCCs may recur locally. The great majority occur on the head and neck especially in the central section of the face bound by the inner canthus, sides of nose and the forehead. In Australia and other tropical/subtropical sunnier regions they also occur on the trunk and back where they may be multiple.

3. Squamous cell carcinomas (SCC) may arise in scar tissue but the majority arise on sun-damaged exposed skin or in precursor lesions such as Bowen's disease, and most commonly in actinic keratosis (AK). AK is common in white skin on the face, scalp in males and backs of hands in both genders and increases in incidence with age. It develops on sun-damaged skin in the form of raised scaly lesions which may bleed. They are often multiple and it is generally thought that the risk of malignant transformation is low. In the UK, once detected, they are usually treated to prevent development of SCC. It is not known through specific research whether this approach is necessary or cost-effective. It may be difficult to differentiate a large AK from a SCC. Both require similar treatment, surgical excision or radiotherapy. SCC can metastasise and should be followed up after initial treatment.

Cutaneous Malignant Melanoma (CMM)

4. Cutaneous malignant melanoma (CMM) is thought to account for less than 5% of total skin cancers although the incidence is rising in all parts of the world for which data are available (2). Present survival from treated CMM in Europe and the US is about 80% at five years (3) although in the US CMM leads to 75% of all deaths from skin cancer (4). CMM is typically pigmented and may arise in pre-existing naevi (moles). It is divided into four types (5):
 - Superficial spreading – the most common type on white skins accounting for about 70% of cases.
 - Nodular – 15-30% of cases. This may appear anywhere on the body including non-sun exposed sites. Although usually pigmented may be amelanotic. Usually invades the dermis from the start with no apparent horizontal spread. Tends to metastasise.
 - Acral – these make up less than 10% of cases in white skin although more frequent in dark skin. Occurs on palms, soles and nail-beds.
 - Lentigo maligna melanoma – accounts for less than 10% of total CMM and usually diagnosed in older people. Arises in a lentigo maligna and grows superficially over many years before invading the dermis and becoming lentigo maligna melanoma.
5. In men, CMM develops most frequently on the trunk between the shoulders and hips while in women lower limb lesions are more common. The prognosis for thin melanoma (less than 1.5 mm) is good but declines with thickness of the lesion and the associated risk of metastatic spread.
6. The precise aetiology and pathogenesis of CMM and NMSC are not yet understood but there are multiple factors:
 - 2-5% of CMM is familial and work is progressing to identify genetic susceptibility. About a third of CMM families carry mutation CDKN2A on chromosome 9, whose role is to control entry to the cell cycle. This allows damaged melanocytes to proliferate and go on to invade the dermis (6).
 - UVR is a major aetiological factor for CMM (7) with one study suggesting that as many as 65-90% of melanomas are attributable to UVR (8). Although there is a substantial research base investigating the role of UVR in skin cancer in general, particularly CMM, the findings of studies are inconsistent. This relates to study design, reliance on retrospective history, selection of controls and small numbers. There are few cohort studies and all are of short follow-up duration. The larger group of case control studies usually depend on self-recall of UVR exposure with high risk of bias especially in more recent studies, following worldwide campaigns on the dangers of excessive sun exposure. Study controls are often hospital patients and not community-based. In addition studies tend to focus on only one possible causal factor at a time and do not address possible confounders or interactions e.g. with age and gender, date or pattern of UV exposure.

- Occupational studies – there have been a significant number of occupational studies (9) (10), including military studies (11) (12) but findings are inconsistent (13). This is due to the difficulty in separating out occupational and non-occupational sun exposure. Some studies conclude that outdoor work, e.g. farming, is associated with high risk (14) (15) but negative associations have also been documented (16). Few studies have considered links between CMM and exposure to mineral oils, coal tar, metal working fluids and other agents positively linked with NMSC. Links have been recorded between CMM and high salary earners and professional occupations (17). Using CMM incidence data for 2011 and CMM mortality data for 2012, a recent study calculated the attributable fraction for CMM due to occupational UVR exposure in Britain as 2% (18). This represents about 50 deaths and 250 new cases of CMM annually. Almost half of these deaths relate to the construction industry with agriculture responsible for about a quarter and public administration, defence and land transport accounting for about 10%.

UVR

7. UVR is part of the continuous spectrum of electromagnetic radiation that is sunlight. It is divided arbitrarily into UVA, 315-400 nm, UVB, 280-315nm and UVC, 100-280nm. In terms of skin cancer, natural UVC is not relevant as it is absorbed by the earth's atmosphere but the longer wavelength UVB (1-10% of UVR reaching the earth's surface), and UVA which represents over 90-99% of UVR which might reach the skin are important. UVA can penetrate deep into the skin. Once thought to be innocuous, UVA is now considered very important in carcinogenesis if exposure is prolonged and excessive. UVA causes tanning and skin ageing and leads to indirect damage to DNA through the formation of reactive oxygen species. In turn these cause breaks in DNA, mutations and then cancer. UVB penetrates the upper layers of the epidermis and can cause sunburn, tanning, photoageing and skin cancer much more effectively than UVA through direct damage to DNA. UVC is completely filtered out by oxygen in the atmosphere and the ozone layer and so the main source is not natural sunlight but germicidal lamps where it can cause sunburn and skin cancer (19).

Factors affecting the emission of UVR

8. There are a number of factors that influence the emission of UVR. These include **season and time of day**. Intensity of UVR is highest in summer and the sun is at its most dangerous between 10.00 and 16.00 when the rays have the shortest distance to travel and UVB levels are at their highest. **Latitude** is important. The nearer the equator, the higher the UVR exposure. An increase in **altitude** of 1000m increases UVR intensity by 10-12% (20). **Cold, shade and fog** reduce UVR levels and **snow, sea foam and beach sand** can all significantly increase the percentage of UVR reflected on to the skin. Other influences are **type of exposure**, i.e. **chronic** as in outdoor occupations, e.g. fishing and agriculture, **intermittent or total**, i.e. lifetime exposure as well as episodes of **sunburn**. The increase in skin cancers has been associated with **ozone layer depletion** caused by chlorofluorocarbons and other ozone-depleting substances. The 2000 Montreal Protocol has led to some regeneration of the ozone layer (21).

Photoprotection in the person

9. The natural protection of human skin against the harmful effects of UVR developed millions of years ago and involves the **internal conversion of skin molecules** (so-called **natural photoprotection**) which absorb the UV photons, converting them into small harmless amounts of heat. Any UV photon energy which escapes generates reactive oxygen species which may go on to stimulate malignant transformation (22) (23). **Skin colour**, reflecting epidermal melanin, also provides protection with those with darker skin, and increased eumelanin, living nearer the equator where UVB is highest. The pigment eumelanin is present in all healthy people to an extent and absorbs 99.9% of UVR leaving only a very small fraction of melanin molecules at risk of harmful chemical reactions. As well as **skin**

pigmentation, skin type is important. Type 1, freckled skin which tans poorly, is the highest risk category for skin cancer. Another risk factor for skin cancers is the presence of melanocytic **naevi** (moles). These may be congenital or acquired and are common benign neoplasms of complex incompletely understood aetiology. If they are multiple, the risk of CMM is increased. Other influences include a **family history** of CMM, gender, **age at UVR exposure and duration, photoageing changes and gender**. A 2009 multi-centre pooled analysis of about 6000 CMM cases and a similar number of controls looked at CMM sites at different latitudes and concluded that excess sunbathing and total recreational sun exposure increased the risk of CMM of trunk and limbs but not head and neck (24).

10. These factors are all long-standing and they do not explain the rise in skin cancers over the last 50 years. The disease profile suggests that this is much more related to cultural and behavioural changes. Notably, the demand for a tan in Caucasians and changes to employment from rural to indoor work, with paid leave and increased access to international travel, so that white-skinned populations increasingly travel several times a year to much sunnier climes than their genetic endowment envisaged. At the same time artificial tanning sources are now widespread with highly variable types and intensity of UVR output. Overall UVA is usually high relative to UVB. Study findings are conflicting but age at exposure may be important and there is evidence that sunburn at any age, but particularly in youth, may increase the risk of melanoma (25). It is important to bear in mind the therapeutic use of phototherapy and PUVA for dermatological disorders: psoriasis, atopic eczema, mycoses fungoides, and vitiligo, etc. Here the short-term benefits need to be carefully balanced against the undoubted longer-term mutagenic and carcinogenic risks. Sunscreen based on organic chemical absorbers or inorganic physical blockers prevents sunburn but has not been conclusively shown to prevent skin cancer. Some studies actually suggest an increase of CMM while others do show a protective effect. There is some evidence that some ingredients in sunscreens protect against direct DNA damage but increase indirect damage (26) (27).
11. Some further useful insight into the changing incidence of melanoma is provided by a 2007 Swedish study based on the Swedish cancer registry for melanoma by body site for age and gender cohorts over the period 1960-2004 (28). This study aimed to identify behavioural changes as factors influencing the relative distribution of melanoma by body site. In total data were available on 46,337 melanomas. Trends were assessed by establishing CMM incidence per site, relative site distribution per age group and calendar period, taking into account UVR exposure pattern for the different body sites.
12. Between 1960-1964 and 2000-2004 in both men and women the study showed CMM increased most rapidly on the upper limbs (men 885%, women 1,216%) on the trunk (men 729%, women 759%) and on the lower limbs (men 418%, women 289%). The increase in head tumour incidence was slower. Across the lifespan, head tumours were more common in those over 70 years, while for those under 70 years, tumours of the trunk and lower limbs were most common. Trunk tumours formed an increasing proportion of all CMM, especially in females over the period 1960-2004. Looking at the pattern of UVR exposure at the different CMM sites, for the head it is continuous; for the trunk, intermittent, and for the legs probably best described as a mixture. There was no preponderance of naevi in any group or site. The study concluded these findings can best be explained by changed behaviours and much increased intentional intermittent exposure to UVR, with most people having indoor employment for most of the year with low exposure to UVR but short periods of intense UVR exposure through paid holiday entitlement/access to affordable air travel and/or access to artificial sun tanning. In Sweden in 1962 there were 70,000 flights south of the 40th parallel compared with 860,000 in 2004, an increase of 1,229%.
13. The AFCS provides awards for injury and disorder due on balance of probabilities to military service on, or after, 6 April 2005. At that date, public health education on the dangers of sun exposure was well developed, including in the UK, amongst the military medical services and the chain of command and Service personnel themselves. The avoidance of direct UVR exposure and sunburn, use of suitable protective clothing, sunglasses and sunscreens was standard practice. While total

cumulative lifetime sun exposure is causally associated with AK and SCC, the evidence is that BCCs are more related to short intermittent burning episodes. Most importantly, in mortality terms sun exposure plays a primary role and supporting role in most cases of CMM with the pattern of exposure in the four main sub-types varying. The risk for lentigo maligna seen in older people, developing over many years and of generally lower mortality, is as for SCC, i.e. chronic long-term excess UV exposure. Superficial spreading melanomas, the most common type, are related to short sharp episodes of burning exposure in younger ages.

Conclusion:

14. In general, none of these circumstances is likely to be met due to service on or after 6 April 2005 and so most cases of NMSC and CMM claimed under AFCS will be liable to rejection. However each case will be considered on its facts.

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IMEG Stakeholder Meeting

5 June 2017

1. Professor Sir Anthony Newman Taylor, Chair, welcomed the guests and the opportunity of the meeting to increase visibility of IMEG and its work, and provide a forum for members of the audience to raise issues and ask questions of the expert members, and for IMEG members to hear their concerns. The expert members were introduced and Professor Newman Taylor first gave an overview of the Armed Forces Compensation Scheme (AFCS) and some of its key features, including that it was a no-fault scheme where awards were made on balance of probabilities, and the claimed injury or disorder was due to service on or after 6 April 2005. Awards were tariff-based and the aim was that the most seriously disabled due to service should receive the highest awards. These were made up of a lump sum for pain and suffering and, for the more serious injuries which reduced capacity for future civilian employment, an additional income stream, the Guaranteed Income Payment (GIP), was paid from service termination for life. To provide financial security and allow people to plan and move on with their lives, awards were made final as soon as possible after the claim and when the injury or disorder was in a treated optimal medical state.
2. Professor Newman Taylor then turned to the background to IMEG itself. IMEG was set up following a recommendation of Lord Boyce's 2010 review of the AFCS. It is a non-departmental public body with members appointed in accordance with Cabinet Office rules; their role is to advise the Minister on the medical and scientific aspects of the AFCS. IMEG advice is independent, expert, evidence-based and transparent. In terms of topics to explore, suggestions come from many sources, including individual claimants, representative bodies, Service personnel and members of the public, and IMEG is then tasked by the Minister. To date, three IMEG reports have been published, in January 2011, May 2013 and March 2015. All recommendations have been accepted by the Minister.
3. Professor Newman Taylor provided some background on some key concepts in the scheme, e.g. the meaning of "on the balance of probabilities", and the hierarchy of attribution, as well as the thinking behind the GIP.
4. The first 2011 report included injury to external genitalia in men and women, brain and spinal cord injury, loss of the use of a limb and paired injuries, e.g. eyes, ears, hands and a first look at mental health disorders and hearing loss. The second 2013 report included a more in-depth consideration of mental health, hearing loss and facial disfigurement, and IMEG also explored the concept of recognised diseases in relation to multiple sclerosis, epilepsy, meningitis, encephalitis and asthma. The third 2015 report considered Infectious diseases, especially Q fever, and their sequelae in recent deployed service as well as mesothelioma and non-freezing cold injury, and included two sections on lower limbs. These were outcomes after traumatic extremity amputation, non-cardiovascular and cardiovascular and combat-related retained complex lower limb injuries. IMEG also covered some more recognised diseases, diabetes mellitus, testicular cancer and leukaemia. Professor Newman Taylor went on to say that IMEG were now working on the fourth report, due for publication in the Autumn, which would include sections on musculoskeletal disorders, an update on traumatic brain injury, scientific and medical aspects of the approach to spanning and worsening cases, validation of the medical and scientific aspects of the Department's policy statement on ionising radiation-related adverse health effects, and a response to medical issues identified in the 2016 Quinquennial Review (QQR) of the AFCS.
5. Professor Newman Taylor introduced Professor Linda Luxon to speak on Hearing Loss and the Armed Forces.

- 6.** Professor Luxon began with some definitions and a brief introduction to hearing loss, its different types and causes, before focussing on noise-related sensorineural loss. Following discussion of sources of hazardous noise, Professor Luxon confirmed the many remaining unknowns in sensorineural hearing loss and the fact that noise exposure accounts for only 5% of the variance in hearing thresholds. Turning to diagnosis, she highlighted diagnostic methods and some of their limitations, including audiometric variability. She then set out some diagnostic challenges, including the lack of a direct correlation in individuals between hearing loss measured by pure tone audiometry and reported disability. Professor Luxon then spoke about hearing loss in military populations. Worldwide, hearing loss was the biggest single category of claims and awards in military compensation schemes during the 20th century. The majority of claims were for chronic noise injury, while in 21st century conflicts, more often, sudden hearing loss due to acute acoustic trauma and blast injury was more common. While there was an audiometric pattern consistent with chronic noise injury that is less the case for acute acoustic trauma. An important aspect not yet fully resolved is the relationship between noise damage to hearing and age-related loss. Are they additive? Or more than additive or what? Professor Luxon then turned to major issues in the IMEG 2013 AFCS review of hearing loss. A major issue for that review was the threshold for compensation set at a level of bilateral 50dB averaged over 1,2 and 3 kHz. The same threshold applies to the AFCS, the War Pensions Scheme (WPS) and Industrial Injuries Disablement Benefit. In war pensions and industrial injuries this level of deficit equates to 20% disablement. IMEG recognised this as a high threshold, but also recognised the variability of audiometric measurement. Even in trained hands with calibrated instruments there will be a 6-11dB variance in a single measurement. There was also the absence of a direct and consistent relationship between measured audiometric impairment and hearing disability, and so functional compromise in future civilian employability. Finally, in all topics and disorders explored, IMEG has to uphold consistent and equitable outcomes and ensure that within one category of claims, e.g. amputations, there is vertical equity, i.e. the more serious injuries receive higher awards, and that that relationship also applied across the nine tables and categories of injury.
- 7.** Despite scrutiny of the international literature and discussion with both civilian and military experts, in 2013 IMEG had to conclude that there was insufficient robust scientific evidence to recommend a reduction in the threshold at the date of the second IMEG report. The full findings and recommendations, including on further research, notably a prospective study of the long-term effects of acute acoustic trauma and on issues such as frequencies to measure hearing threshold, the routine use of objective testing, use of experts and quality-assured audiometry to assess hearing levels, and the merits of aligning the audiometric descriptors for military medical employability standards and military compensation are set out in the 2013 IMEG report. IMEG will continue to routinely scrutinise the literature.
- 8.** In the subsequent brief discussion, reference was made to the stigma associated with hearing loss, and the tendency amongst military personnel to conceal it because of potential impact on deployability and military employability. Comment was also made that, at present, medical downgrading and even medical discharge could take place at a level of hearing deficit insufficient to attract an AFCS ongoing income stream or GIP.
- 9.** Dr John Scadding then gave a presentation on non-freezing cold injury (NFCI).
- 10.** Dr Scadding outlined the history of the military experience going on to more recent and current issues and scale of NFCI. He highlighted the 2011 Expert Task Force set up by the then Surgeon General, stressing its major role in identifying uncertainties and goals in definition, description, pathogenesis, diagnosis, the role and reliability of special investigations, natural history and clinical course, best-practice clinical management and prognosis as well as prevention. NFCI was a major topic of the third IMEG Report.

11. Dr Scadding confirmed that although NFCl had been around for centuries and the prolonged cold and wet conditions of the 1982 Falklands war generated 2-3,000 cases, most of these recovered well and subsequently there were few war pension claims. That changed from about 2006, and to date 550 civil claims have been settled at a total cost of almost £60 million.
12. IMEG's investigation of NFCl included literature review and discussion with an expert from the Institute of Naval Medicine (INM). He was able to share an unpublished retrospective analysis of over 600 new cases presenting before mid-2013. Of these about 100 were considered not to have NFCl. Most exposures occurred in the UK and affected hands and feet in 50% of cases, 36% feet only and 6% hands only. There was a high incidence of cases in those of Afro-Caribbean origin. While most clinicians with experience of NFCl considered that pain usually developed within two weeks of exposure, AFCS claimants frequently reported late onset of pain, months or years after the cold exposure in a limb or limbs not previously reported as affected.
13. Dr Scadding described IMEG's findings and suggested definitions for acute and chronic NFCl in the light of overall current evidence and understanding. He also discussed the current limitations in diagnosis, first in the clinical assessment where there was often limited documentation, and absent or poorly-documented clinical neurological examinations testing large and small nerve fibre function. He then discussed the uses and limits of the more specialist examinations, thermography and thermal threshold testing. Finally he went on to describe current research techniques likely soon to become more widely available. These included Quantitative Skin Testing (QST), skin biopsy and genetic analysis. He touched on the recently-updated HQ Surgeon General guidance in Joint Service Publication (JSP) 539 on clinical management and prevention of heat and cold illness. Finally, Dr Scadding stressed the need for more research on definitions and description of NFCl, its diagnosis and prognosis. A prospective longitudinal clinical assessment study from the time of recruitment, through training and deployment and with post-service follow up, would be especially valuable, allowing establishment of the epidemiology of NFCl, its relationship to cold exposure, its natural history and long-term prognosis. It is only as that information becomes available that descriptors and tariffs in AFCS as well as civil damages awards will be robust and, as intended, fully and fairly address the claimed disorder.
14. Points raised in the subsequent discussion included a question to clarify the temperature above which NFCl can occur. Dr Scadding confirmed this as a range from just above freezing to about 20 degrees. The lack of studies on the social and psychological impact, including on families, of chronic severe NFCl and neuropathic pain of any type was also mentioned.
15. Lastly, Professor Peter White spoke on Mental Health Disorders and the AFCS. Following a general overview of mental health disorders in Service personnel, Professor White went on to reference the 2010 Lord Boyce Review and subsequent 2011 legislative changes. He then discussed the 2013 IMEG report on mental health disorders, the findings and recommendations and then turned to current issues and challenges.
16. There remains much interest in mental health amongst the media, public and parliamentarians in the general UK community, as well as on military and veterans' mental health, and there is much opportunity for myths and anecdote. Professor White provided up-to-date evidence on the matter, based on recent reports from King's Centre for Military Health Research. He noted recently higher rates of common mental health disorders amongst military personnel compared with age and sex-matched civilians. There were also increasing referrals amongst serving personnel in service for specialist help with mental health symptoms and illness. Post-Traumatic Stress Disorder (PTSD) (4%) was not the most common diagnosis in military personnel, but rather depression and anxiety disorder and alcohol misuse. PTSD incidence was raised in deployed Reservists (5% versus 2% in non-deployed) and in those deployed in combat versus non-combat roles. Alcohol misuse was increased in Regulars deployed to Iraq and Afghanistan (16% versus 11%) and generally increased in Service personnel. Suicide rates were similar or lower than in civilians except in young (less than 20 years) Army males and early service

leavers or young veterans aged 16-24 years. Risk factors for veterans' mental health disorders included multiple overlapping health and social problems such as debt, housing issues, unemployment, violence, substance misuse and leaving the military early.

- 17.** Professor White spoke about the three main findings of the 2010 Lord Boyce Review. First, it recommended establishment of an independent expert group to advise MOD on medical and scientific aspects of the Scheme. Mental health disorders were a particular focus. Lord Boyce wanted IMEG to consider whether there should be a separate scheme for mental disorders as opposed to physical disorders and injuries. IMEG should also keep the level of mental health awards under review and should consider in particular the impact on civilian employability of some more serious mental health conditions. Should the highest award be increased to a level 6 and 75% GIP? The Lord Boyce Review also strongly supported interim awards in cases where treatment was not complete and the final steady state not achieved, nor prognosis clear at time of claim decision.
- 18.** In the 2011 report, IMEG recommended an increase in the highest award for mental health disorder to level 6 with a 75% level GIP. The 2013 report set out the reasons for that recommendation. The award was appropriate where a permanent mental disorder caused severe functional limitation and restriction. In this context "severe" was defined in the legislation as "unable to undertake work appropriate to qualifications and skills at the time of onset of the illness and, over time, able to work only in less demanding jobs". Professor White also reminded listeners of the meaning of "permanent" in relation to mental health disorders, and described in the IMEG 2013 report as: "Following appropriate clinical management of recommended duration an injury has reached steady or stable state of maximum medical improvement and no further medical improvement is expected".
- 19.** The 2013 report which followed extensive review of the topic and compensation aspects concluded that there should be no separate system for mental health problems. This was because all awards for injury, physical and mental disorders critically depend on associated functional compromise and the need for vertical and horizontal equity, such that a level 8 award for a mental disorder produced a similar level of functional disability to a traumatic injury or physical disorder. It also concluded that interim awards – effectively a payment on account, ahead of the disorder reaching maximum state of medical improvement, were useful and should be retained. IMEG recommended that diagnoses should be made based on one of the two international classification systems, i.e. the World Health Organisation (WHO), International Classification of Disease (ICD) or the US American Psychiatric Association Diagnostic and Statistical Manual (DSM). IMEG also concluded that for robustness and defensibility, diagnoses in the scheme should be made by consultants in psychiatry or clinical psychology. In assessing cases, the 2013 report considered establishment of attribution on balance of probabilities and approaches to the assessment of the functional effects of disorders. The report concluded that it was useful to have details of interventions provided, their frequency, duration of course, etc. The report also included some discussion on the role of psychometric tests and how these might inform case determination and award level.
- 20.** Since the 2013 report, mental health disorders amongst military personnel and veterans have continued to be a key issue including amongst the media and in Parliament. This year has seen a QOR of the AFCS with a number of mental health issues raised by stakeholders and directly with IMEG. For the forthcoming fourth report. IMEG will consider parity of esteem in treatment of physical and mental disorders, the question of the highest level of award for mental health disorders and whether diagnoses should be accepted from doctors and clinical psychologists who are not of consultant grade, as well as from other core mental health specialists.
- 21.** Professor White concluded by saying the evidence was that mental health symptoms and illness affected a minority of Service personnel and veterans. Anxiety states, mood disorders and alcohol misuse were more common than PTSD. Permanent severe functional disability can occur but in relatively small numbers. Before finalising awards, decision-makers and medical advisers should be confident that optimum treatment of sufficient duration has taken place.

22. Subsequent audience questions included comment on the difficulty of determining causation in mental health cases, particularly whether service was the predominant cause of a disorder. Other points raised included the different impressions that could be gained of the frequency of disorders dependent on the population studied, e.g. rates of PTSD were much higher in help-seeking populations. A question was raised about whether there was increased risk of mental health disorder in the presence of physical injury. This was confirmed by Professor White. A similar comment was made about a link between mental health symptoms or disorder and low back pain, and finally Professor White confirmed that further episodes/exacerbations of PTSD could occur if a person was re-exposed to a stressor.
23. Professor Newman Taylor then highlighted some of the issues identified by the QQR for IMEG comment. These included a series of questions on musculoskeletal disorders (MSK) and the appropriate level of awards. Clarification on the Scheme's approach to infectious diseases – specifically, what disorders are covered – and some comment on Zika virus were also referred for IMEG comment as well as mental health issues, as summarised by Professor White.
24. IMEG will report back on these in the Autumn 2017 Fourth Report. This report will also include a section on Interim awards, on worsening and spanning cases, i.e. where service spans 6 April 2005, and potential awards may be due under both the WPS and AFCS.
25. Finally, Professor Newman Taylor thanked Admiral of the Fleet, the Lord Boyce, members of the Tribunal Service, the 2016 QQR Team and all other members of the audience for coming and contributing to the meeting.

Attendees included:

Admiral of the Fleet, the Lord Boyce, the 2016 AFCS QQR Team, representatives of the Tribunal service, Service and veterans' charities, Defence Business Services, HQ Surgeon General, the Defence Medical Rehabilitation Centre, military welfare and recovery staff.

