# The Independent Medical Expert Group (IMEG) 5th Report

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

February 2020

**From: Doctor John W Scadding OBE, MD, FRCP**

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26 February 2020

Minister of State for Defence People and Veterans
Minister of Defence
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Dear Minister,

Having recently taken over as Chair of the Independent Medical Expert Group (IMEG) following the retirement of Professor Sir Anthony Newman Taylor I am pleased to submit the Fifth Independent Medical Expert Group (IMEG) report. The bulk of the work was achieved under Professor Sir Anthony Newman Taylor 's leadership and I am most grateful for his very considerable contribution and insights into this Report.

The establishment of an independent expert group to provide ministers with evidence based medical and scientific advice on the Armed Forces Compensation Scheme (AFCS) was a recommendation of Lord Boyce's 2009/10 AFCS review. The medical members are all senior experts in specialities relevant to military medicine, including trauma surgery, audiovestibular medicine, psychiatry, neurology and occupational medicine. IMEG became a non-departmental public body in 2012 and is tasked by, and reports to, Minister for Defence People and Veterans.

Claims for AFCS can be made in service and at this interval following the recent conflicts, AFCS claims are increasingly for sporting and training traumatic injuries and overuse related musculoskeletal disorders. Claims for mental health disorders also continue to increase and many claimants suffer both types of disorder.

Topics for the Fifth report were proposed mainly by claimants and their supporters. The Chief of the Air Staff asked Sir Anthony to consider the hazards, risks and adverse health effects of remotely piloted aircraft systems, and then Minister for Defence People and Veterans asked for an update on aircraft cabin air quality.

During 2019 we met with Professor Anthony Bull, Imperial College, and the military lead of the Advance study who described both the study progress and its emerging findings. This was a most informative session and we hope that it may become a regular event.

The approach of IMEG to topic investigation is to identify and appraise the relevant evidence, both reviewing the published peer-reviewed international literature and discussing topics within the group and with recognised military and civilian experts.

In this Fifth report IMEG has considered the hazard, risks and adverse health effects of remotely piloted aircraft systems (RPAS). Current RAF squadrons provide continuous intelligence, surveillance and reconnaissance, close air support and targeted weapon strikes 365 days a year. An increase in operational tempo has led to concern that RPAS crews may be stressed. Sir Anthony visited a UK RPAS station where he was briefed on the work and spoke informally with RPAS crews. Published peer-reviewed studies of Remotely Piloted Aircraft Systems (RPAS) operators are few and do not show any increase in incidence of clinically diagnosed mental health disorders. Similarly, there are no studies on physical health e.g. neck and back pain, or headache which might relate to ergonomics of workstations or organisational issues such as shift work. We found one distinct feature of RPAS service. RPAS crews are not alone in being required to kill but they do so without risk to themselves. There is risk of killing non-combatants and direct visual exposure to atrocities including human remains. These features may breach normal ethical standards and lead to moral ambiguity and moral injury. US research from conflicts with high levels of killing show severe treatment resistant post-traumatic symptoms in those who killed or observed killing. In that light IMEG recommends a follow-up study of RPAS operators to include examination of the impact on mental health of killing humans.

During the last twenty years there have been reports from commercial aircrew of short-term and sometimes more chronic non-specific symptoms which crew relate to fume incidents and breathing contaminated air. There are no objectively verifiable clinical signs and imaging and routine laboratory tests are negative. In 2005, the Committee on Toxicity (COT) a non-departmental public body was asked to review evidence on the matter provided by the British Airline Pilots' Association (BALPA). COT concluded that the evidence was inadequate to reach definitive conclusions and advised further research. A 2013 COT position paper following scrutiny of the research found that contamination of cabin air does occur and could produce a chemical irritant effect. They also advised that the very low levels of chemical contaminants made that unlikely. Rather, the explanation might be a nocebo effect where disabling illness arises from exposures that are perceived as hazardous. IMEG examined the updated evidence concluding that an acute irritant effect was plausible, but the precise cause was not established nor the existence of a later chronic disabling disorder.

Mental health disorders continue to be commonly claimed in AFCS and the issue of a connection between stress, mental health symptoms and disorders and cardiovascular diseases has been raised. We reviewed the literature including the pathogenesis, mechanism and the effects of treatment of mental health problems on cardiovascular disease incidence and mortality. We also discussed these matters with UK experts in the field. We conclude that present overall evidence does not support a direct causal relationship with new cases of cardiovascular disease. We note that international expert bodies such as the American Heart Association, American College of Cardiologists and the Task Force for the European Guidelines on cardiovascular disease prevention adopt a

similar position. However, we consider that available evidence does support a trigger effect where there is asymptomatic undiagnosed atherosclerosis, and an acute service-related severe emotional or physical stressor occurs in the hour preceding an acute coronary event.

Musculoskeletal (MSK) disorders remain the largest group of disorders claimed and awarded under AFCS. The 2017 Fourth IMEG report included MSK disorders Part 1 and for the present report we have prepared MSK disorders part 2. This is divided into section A, covering general aspects of MSK disorders in the UK armed forces at this date including the challenges of recruitment and retention, gender issues, medical downgrading and discharge. Also included are sections on awards paid, occupational aspects of MSK problems and an overview of Pain, the most prominent symptom and cause of functional disability. Section B of the paper sets out further summaries of MSK disorders presenting in military practice including definition, clinical features, cause, prevention, best practice clinical management and prognosis. Pain frequently becomes severe and disabling even in the absence of objective signs and imaging findings. The overview makes reference to pathophysiological evidence on the abnormalities in affected structures, discusses the different types of pain, the role of the peripheral nervous system in signalling pain and the increasing evidence of wider changes in the central nervous system. Finally, the paper covers diagnosis, treatment and rehabilitation stressing the key role of multidisciplinary approaches including physical therapy, psychological support and education about the positive effect of maintaining activity, especially work-related activity.

Claims for mental health problems continue to increase. Mental health and aspects of the AFCS approach are the most frequently raised issues by claimants and their supporters. Much of present AFCS policy and decision making was informed by the findings and recommendations of the second 2013 IMEG report and we have carried out an in-depth review. Areas of controversy recommended in 2013 include the need for diagnosis of disorders by a consultant level psychiatrist or clinical psychologist, the use of interim awards where a person is not in optimal medical state following an adequate course of best practice treatment, the definition of permanent and the view that mental health awards compare unfavourably with AFCS physical disorder awards and general civil damages.

We considered advances and changes in UK civilian and military practice and services since 2013 and revisited the 2013 report findings, conclusions and recommendations in the light of more recent evidence. That includes new editions of the psychiatric diagnostic classifications and in December 2018, new NICE guidelines on Post Traumatic Stress Disorder (PTSD) clinical management were published.

The present report includes sections on suicide, and mild traumatic brain injury including its diagnosis, differentiation from PTSD and the relevance of new functional neuro-imaging techniques, notably magnetoencephalography. Our scrutiny broadly confirmed the 2013 findings and recommendations. An exception is functional recovery from PTSD where we conclude that while most cases do improve over time and with best practice, there are cases with persistent symptoms and functional disability which are treatment resistant. This issue was raised in the 2016 AFCS Quinquennial Review (QQR) and following consultation with UK-wide national authorities on psychological trauma, in April 2019 an additional level four descriptor attracting a 100% Guaranteed Income Payment (GIP) was added. We are clear its use should be exceptional. In terms of inequity between AFCS mental health and physical awards the evidence does not support this. From April 2005 until 31 March 2019, 4,395 awards were made for mental health disorders of which 19% have a GIP. This compares with 67,930 awards for physical injuries and disorders of which 6% have a GIP. We have also consulted the 14th edition of the Judicial College guidelines on general damages for personal injury owing to mental health disorders and find no evidence that AFCS lump sum awards are too small.

Attention has recently been drawn to the significant literature concerning the risk of Cutaneous Malignant Melanoma (CMM) in commercial air crew. While mortality and incidence of most common cancers is lower in this group than in the general community, incidence and mortality for CMM appears higher than in the age and sex adjusted general population. Risk factor studies have focused on occupational Ultraviolet Radiation (UVR) and cosmic radiation. On this topic many of the studies are small, based on data from the sixties and seventies, when work conditions such as aircraft types, flight durations, shift patterns etc were very different from to-day. The studies are often reliant on self-report for diagnosis, with controls matched only for age and sex, not skin colour and type, presence of naevi and family history. A 2005 study looked at UVR transmittance through aircraft windshields. This study found raised CMM incidence in pilots, cabin crew and also in Air Traffic Controllers (ATCOs). Neither cabin crew nor ATCOs are at risk of occupational UVR exposure, suggesting other factors must be involved. The study did not measure cosmic radiation dose but from other studies, average annual exposure of cabin crew is low, in the range 2-6 mSv. Most international expert bodies do not consider CMM radiogenic.

Scrutiny of the literature reveals inconsistent findings, and studies of military aircrew are limited. One 2017 US study showed an increase in CMM diagnoses over time, but diagnoses were clinical, not all histologically proven. Principal service occupations were assessed only at a single point in time and despite average short service duration, follow-up ceased at service termination. IMEG had to conclude that UVR exposure might well be non-occupational and even pre-date employment. We also recognise the very different aircraft, flight duties, speeds and heights, work patterns and flight durations for military aircrew compared with commercial flying. Overall, the evidence in commercial aircrew, with some heterogeneity, does suggest a raised risk of CMM in pilots and aircrew but does not identify mechanisms. We therefore concluded that we should continue to monitor the literature and recommend that claim determinations for CMM from pilots and flight crew should routinely have medical input and be based on individual case facts.

Tinnitus remains a scientific and clinical enigma. It is the perception of sound in the absence of actual external sound and is a manifestation of underlying pathological factors rather than a single disease. It may relate to ear disease or to head and neck trauma, neurological, vascular, endocrine and psychiatric disorders, or medication side effects and co-morbidities, particularly psychological and psychiatric disorders. The paper provides a summary of evidence on the present understanding of tinnitus, its characteristics, epidemiology, risk factors and correlates, as well as its clinical management, based on multidisciplinary approaches. There is also a section looking at current thinking on mechanism and pathology. IMEG reviewed UK and international public compensation approaches to tinnitus and the restraints imposed by the many gaps in understanding. We concluded that tinnitus is heterogeneous and may or not be associated with noise exposure or hearing loss. The underlying pathogenesis and mechanism are unknown and there is no standard objective test for its presence, agreed scale or method of severity assessment. As a result, we recommend no change to present UK military no fault compensation for tinnitus and conclude that awards should not be made for tinnitus alone.

For completeness, and despite its rarity and being unaware of any claims under the AFCS, we include in the Report a short section on Ocular Melanoma (OM) as a recognised disease. There are two types of OM, the more common Uveal Melanoma (UM) arises from the iris, choroid, ciliary body and the much rarer conjunctival melanoma. Age standardised rate is 0.4-1.2 cases per 100,000 and OM occurs most commonly in Caucasians, presenting in the sixth or seventh decade of life. The review covered diagnosis, clinical management, treatments and prognosis. If UM metastasises, spread is mainly blood-borne to lung, bone or subcutaneous tissues. Spread may occur early or only 10 plus years after initial treatment. When the tumour spreads, survival is limited to about 10-15% at one year.

The aetiology of OM and its sub-types is unknown. Risk factors include age, sex, ethnicity, socio-economic group, smoking, light eyes, fair skin, poor tanning, ocular melanosis, dysplastic naevi, family history as well as certain mutations in the tumours. A role for UVR has been investigated with conflicting results. The 2003 US Survivor Epidemiological and End Results (SEER) study found no population increase in OM over the period 1974-98 in contrast to the position with skin melanoma. Other studies suggest that personal factors such as light eyes, fair skin and burning easily were predictors. We conclude that at this date OM cannot be accepted as a recognised disease.

All members of IMEG took part in the discussions and agreed the findings, conclusions and recommendations. I believe these reflect contemporary evidence and the scheme principles.
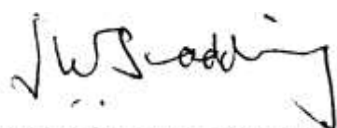
I am sad to report the recent untimely death of Professor David Alexander, emeritus professor in mental health and director of the Aberdeen Centre for Trauma, Robert Gordon University. David played a vital role in the response to the 1988 Piper Alpha disaster and received awards for his humanitarian work after the 2005 Pakistan earthquake and supporting families before and after kidnapping. In recent years his published work included studies on military personnel and veterans He was a founder member of IMEG, playing a major part in the 2013 mental health report and although retiring from the group in 2015, he continued to provide generous, wise and expert counsel on professional and wider matters relating to IMEG business.

I am indebted to Col. John Oldroyd, the army pay colonel who left the group in June 2018 and has been replaced by Lt. Col. Philip Bassingham-Searle and to AVM Alastair Reid, HQ Surgeon General observer who left in December 2017 on promotion to Surgeon General. Alastair has been succeeded by Air Cdre Rich Withnall. We also welcome J.J. Chalmers representing injured personnel in receipt of an AFCS award.

I am grateful to the secretariat for their expertise, willing help and commitment.

The report also includes a note on the Stakeholder meeting held at the Royal Society of Medicine on 28 October 2019. The meeting was well attended and provoked lively discussion. We hope that it helped to maintain the necessary visibility and engagement with AFCS and IMEG's role.

Yours Sincerely

**Dr John W Scadding OBE, MD, FRCP**
**Chair**
**Independent Medical Expert Group (IMEG)**

# Independent Medical Expert Group (IMEG) – List of Members

## Chair

Professor Sir Anthony Newman Taylor CBE, FRCP, FFOM, FMedSci (until December 2019)

Dr John Scadding OBE, MD, FRCP (from December 2019)

## Expert Members

Professor Linda Luxon CBE, FRCP

Professor James Ryan OBE, OStJ, MB, BCh, BAO(NUI), FRCS(Eng), MCh (NUI), FRCEM, DMCC(SoA)

Dr Anne Braidwood CBE, MRCP, MRCGP, FFOM

Professor David Snashall MSc, FRCP, FFOM, LLM

Professor Peter White OBE, MD, FRCP, FRCPsych

## Lay Members

Barry Le Grys MBE

JJ Chalmers

Col John Oldroyd (until June 2018)

Col Philip Bassingham-Searle (from July 2018)

## Secretariat

Beryl Preston (until October 2019)

Melanie Court (until December 2018)

Sandra Rose (until May 2018)

Dawn Mosa (from June 2018)

## Obsever

Air Cdre Alistair Reid QHP, MBChB, Msc, DAvMed, FFOM, RAF (until December 2017)

Air Cdre Richard Withnall QHS, MD, MA, MSc FRCGP, FAcadMEd, CMgr SFFMLM (from January 2018)

The IMEG report and recommendations on medical and scientific aspects of the Armed Forces Compensation Scheme

# Contents

The IMEG report and recommendations on medical and scientific aspects of the Armed Forces Compensation Scheme

# Key Points

## Topic 1 - The Hazards, Risks and Adverse Health Effects of Remotely Piloted Aircraft Systems

1.  Since 9/11, weaponised unmanned aerial vehicles have become key in combat operations. Current RAF squadrons provide 24-hour, 365 days a year, intelligence, surveillance and reconnaissance, close air support and targeted weapon strikes.

2.  Combat involving remotely piloted aircraft systems (RPAS) offers precision targeting, avoids the need to fly long distances or refuel aircraft, provides no traumatic physical risk to operators, no need to deploy or be separated from family.

3.  Increase in operational tempo has led to concern that crews may be stressed. The Chief of the Air Staff asked Professor Sir Anthony Newman Taylor, Chair of IMEG, to carry out an investigation and provide a report on the hazards, risks and adverse health effects of RPAS service. Sir Anthony visited a UK RPAS station where he was briefed on the work and had opportunity to speak informally with RPAS crews.

4.  One UK questionnaire-based survey of 40 male RPAS operators considered functional impairment, alcohol use and used psychometric tests to determine "probable" mental health disorders. The results suggest high perceived functional impairment, but unremarkable rates of "probable " mental health disorders compared with the wider armed forces and general community and suggesting that functional impairment was not due to poor mental health.

5.  Published peer-reviewed studies of RPAS service are few and evidence does not show any increased incidence of clinically diagnosed mental health disorders. IMEG found no studies concerned with physical health e.g. neck, back pain and headache due to ergonomics of work stations or organisational issues, such as shift work and long hours.

6.  To date, from a medical and scientific perspective, we have found no strong evidence of the development of higher levels of discrete diagnosed psychiatric disorders in RPAS operators compared with other RAF personnel. However mental health disorders may present after some delay.

    Recommendation 1.  Defence should consider a follow-up surveillance study of RPAS operators looking at physical and mental health, including suicide, as compared with a suitable control population.

7.  A distinct feature of RPAS service is "moral injury". RPAS crews are not alone in being required to kill but they do so without risk to themselves and while viewing detailed events, often of family life, with which many identify, over a long period. There is risk of killing non-combatants, women and children, and friendly forces as well as direct visual exposure to human remains and atrocities. These features may breach normal ethical standards and lead to moral ambiguity and "moral injury".

8.  US research from the Vietnam and Iraq generations shows high levels of killing and severe post traumatic symptoms in those who killed or observed killing. Symptoms often respond poorly to conventional best practice interventions with risk of persistent disabling effects, characterised by peri-traumatic dissociation, functional impairment and violent behaviour.

9.  These aspects of PTSD phenomenology, described in the new ICD 11 classification as "complex PTSD", may be particularly resistant to treatment with poor response to conventional best practice

interventions, risk of chronic medium and long-term symptoms and disabling effects on normal functioning.

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

1.    Some commercial aircrew have reported short and longer term non-specific, sometimes disabling symptoms, related to fume incidents and breathing contaminated cabin air. The symptoms are not accompanied by objectively verifiable clinical signs; imaging and routine laboratory tests are also negative

2.    Analysis of cabin air contaminants after fume incidents has identified more than a hundred mainly organic compounds but all with levels below 12 parts per billion. Organophosphates (OP) are present in jet oil but OP derivatives have not been demonstrated.

3.    In 2005 the then Department of Health (DH) sponsored Committee on Toxicology (COT), reviewed evidence on the issue submitted by British Airline Pilots Association (BALPA) and concluded that it was inadequate to resolve the issue. They recommended further monitoring of fume incidents and more research.

4.    The subsequent COT 2013 position paper concluded that the symptom pattern was not suggestive of an OP effect. They found that contamination of cabin air by some components of engine oil and other substances does occur and the acute illness reported by some crew members might be a chemical irritant effect. Equally, given the very low levels of chemical contaminants it could also be a nocebo effect i.e. where disabling illness can arise from environmental exposures that are perceived as hazardous.

5.    We examined present evidence, finding an acute irritant effect plausible, but the precise environmental cause(s) was not established nor the existence of a later onset chronic disabling disorder.

# Topic 3 - The Connection between Mental Health Symptoms and Disorders and Cardiovascular Disease – Present Evidence.

1.    Multiple risk factors, blood pressure, diabetes and cholesterol level predict development of atherosclerosis and associated cardiovascular disorders, but they do not account for all cases. One suggestion is a connection between emotion and the heart.

2.    The approach of the AFCS to claims for cardiovascular disorders secondary to mental health symptoms and disorders has been raised. IMEG reviewed the evidence on pathogenesis, mechanisms and the effects of treatment of mental health disorders on cardiovascular disease incidence and mortality, concluding that that present evidence does not support a direct causal association between psychosocial factors such as stress, mental health symptoms and discrete disorders including PTSD and incident cardiovascular disease.

3.    Some observational studies on chronic stress in adulthood and discrete psychiatric disorders suggest an association with incident cardiovascular disease, but the effect is small and inconsistent. Studies have design and size limitations and the connection is not presently recognised by expert international

bodies such as the American Heart Association, American College of Cardiologists and the Task Force on the European Guidelines on cardiovascular disease prevention.

4.  We consider that available evidence supports a trigger effect for acute physical or emotional stressor on acute cardiac syndromes where there is asymptomatic undiagnosed atherosclerosis. If an acute service-related physical or emotional stressor occurs in the hour preceding an acute myocardial infarction, an award may be made.

5.  Mental health disorders can affect lifestyle choices and ability to give up smoking, alcohol consumption, diet, all of which impact atherosclerosis. IMEG strongly supports the Defence Health and Well-Being Strategy commitments on healthy eating, weight management, smoking, alcohol and mental health

# Topic 4 - Musculoskeletal Disorders (MSK Disorders) Part 2

1.  The Musculoskeletal (MSK) Disorders Part 2 report has two sections, A and B. Section A covers general aspects of MSK disorders in the UK military at this date; the challenges of recruitment and retention, gender issues, medical downgrading and discharges, AFCS compensation awards and occupational aspects of MSK disorders.

2.  Section B comprises summaries of disorders seen in military practice, with definition, a brief description of clinical features, aetiology, prevention, best practice clinical management and prognosis.

3.  MSK disorders are the most common category of injury and disability in military populations often leading to medical downgrading and discharge. Between 1 April 2018 and 31 March 2019 there were 1,869 medical discharges from the UK armed forces made up of 391 from the naval service (RN and RM), 1,316 from the army and 162 from the RAF. This equates to rates of 12 per 1,000 for the naval service, 17 per 1,000 for army and 5 per 1,000 for RAF (1).

4.  "At risk" age groups are for the naval service, 25-34 years, for the army, 20-24 years and for the RAF, 45-49 years. In line with this age distribution, discharge from the army is high in untrained personnel with short service. Since AFCS began in April 2005, awards for MSK diagnoses account for 45% of total awards made, and 51% of awards made in 2018/19.

5.  To understand the generation of pain from affected musculoskeletal structures and why pain in these disorders so frequently becomes chronic, even when objective signs and radiological findings are minimal or absent, a brief overview of pathophysiological evidence is included. This considers local abnormalities in affected structures, the role of the peripheral nervous system in signalling pain, and the increasing evidence on the part which may be played by consequent changes in the central nervous system. Wider aspects of chronic pain and its co-morbidities and its diagnosis, treatment and rehabilitation are also considered.

6.  Pain is the leading symptom and cause of disabling effects in MSK disorders. A key aim of treatment is that the patient should be able to accept and manage his pain. Multidisciplinary approaches including psychological therapy are key, and clinical management to reduce pain and/or improve function, education to inform about the disorder and emphasise the positive effects of maintained activity, especially work activity, are the norm.

# Topic 5 - Review of 2013 IMEG Second Report on Mental

1. Since the 2013 report, adverse comment re AFCS has continued on the IMEG recommended requirement for diagnosis of disorders by a consultant psychiatrist or clinical psychologist, the use of interim awards, the definition of "permanent" and the general view that awards for mental health disorders compare unfavourably with awards for physical disorders and civil general damages.

2. Revised mental health disorders classifications DSM 5 (2013) and ICD 11 and a new edition of the National Institute of Health and Care Excellence (NICE) Post Traumatic Stress Disorder (PTSD) guideline have been introduced, and from April 2019 a new descriptor and level 4 AFCS award for mental health disorders came into the legislation.

3. This report updates on treatment and support services since 2013 and includes sections on suicide, mild Traumatic Brain Injury (mTBI), diagnosis, differentiation from PTSD and the relevance of emerging functional neuro-imaging techniques, notably magnetoencephalography

4. As in the Fourth (2017) IMEG report, we conclude that, at present, mTBI and PTSD can be best differentiated by clinical history and examination, rather than any specific investigation. While accepting that research on MEG shows promise in mTBI investigation, and its possible differentiation from PTSD, we find at this date that it is premature to consider MEG a specific diagnostic test for either mTBI or PTSD.

5. As part of the ongoing ministerial tasking to maintain an overview of mTBI, it is recommended that IMEG undertakes a comprehensive review of MEG as part of the 2020/21 Forward Work Plan for publication by the end of 2020.

6. The present review of the 2013 report broadly upheld its conclusions on "permanency", interim awards, parity of esteem between physical and mental disorders, horizontal and vertical equity across the range and level of awards and the need for diagnoses to be made by a consultant level clinician as specified in AFCS legislation

7. We may have been too optimistic about functional recovery from PTSD and revisited the evidence on its chronicity. We conclude that while in most cases there is functional improvement over time or best practice treatment, there are rare cases with persistent symptoms and disabling effects. Literature search provides inconsistent findings on early predictors of chronicity and we identify no reliable early predictors.

8. From April 2005 until 31 March 2019 there were 4395 awards for mental health disorders with 19% including a guaranteed income payment (GIP). This compares with 67930 awards for physical disorders with 6% having a GIP. At 31 March 2019, 55 full and final mental health awards were at level 6 and 75 at level 8, attracting a GIP of 50 and 75% respectively.

9. We consulted the latest 14th edition of the Judicial College Guidelines on general damages awards (2017) and found no evidence that AFCS lump sum awards for mental health disorders are too small.

# Topic 6 - Cutaneous Malignant Melanoma (CMM) in Air Crew

1.  The 2017 IMEG report considered skin melanoma as a recognised disease and concluded that the evidence available then did not support a doubling of risk from any service exposure or factor and so the criterion for presumption of service causal connection was not met.

2.  Attention has recently been drawn to the significant literature concerning the risk of Cutaneous Malignant Melanoma (CMM) in commercial air crew. While mortality and incidence of most common cancers is lower in this group than in the general community, the evidence suggests overall that incidence and mortality for CMM is higher than in the age and sex adjusted general population.

3.  Risk factor studies have focused on occupational Ultraviolet Radiation (UVR) and cosmic radiation. On this topic many of the studies are small, reliant on self-report for diagnosis, and work conditions such as aircraft types, flight durations, shift patterns etc are very different from today. Controls are often matched only for age and sex, not skin colour and type, presence of naevi and family history.

4.  A 2005 study looked at UVR transmittance through aircraft windshields. This study found raised CMM incidence both in pilots and cabin crew and also in Air Traffic Controllers (ATCOs). Neither cabin crew nor ATCOs are at risk of occupational UVR exposure, suggesting other factors must be involved. The study did not measure cosmic radiation dose but from other studies, average annual exposure of cabin crew is low, in the range 2-6 mSv. Most international expert bodies do not consider CMM radiogenic.

5.  Considering the literature, findings are often inconsistent, and studies are almost entirely based in the Northern hemisphere. The one Southern hemisphere (Australia) 2019 study of commercial pilots followed-up from 2001-2016 for a total of 91370 person-years found 114 CMM tumours, 52 invasive and 63 in situ. When age-specific incidence rates (SIR) were compared with the corresponding general population rates there was a slightly increased rate of melanoma in situ but no increase in invasive melanoma compared with the general population.

6.  Studies of military aircrew are limited. One 2017 US study showed an increase in CMM diagnoses over time, but diagnoses were clinical, not all histologically proven. Principal service occupations were assessed only at a single point in time and despite average short service duration, follow-up finished at service termination. Overall, the evidence in commercial aircrew, with some heterogeneity, does suggest a raised risk of CMM in pilots and aircrew but does not identify mechanisms.

7.  This review had to conclude that UVR exposure might well be non-occupational and even pre-date employment. We also recognise the very different aircraft, flight duties, speeds and heights, work patterns and flight durations for military aircrew compared with commercial flying.

8.  We will continue to monitor the literature and recommend that claim determinations for CMM from pilots and flight crew should routinely have medical input and be based on individual case facts.

# Topic 7- Can Tinnitus be Regarded as a Stand-alone Condition under the AFCS?

1.  Tinnitus remains a scientific and clinical enigma. It is the perception of sound in the absence of actual external sound and is a manifestation of an underlying pathology rather than a single disease. It may relate to ear pathology or to head and neck trauma, neurological, vascular, endocrine and psychiatric

disorders or medication side effects and co-morbidities, particularly psychological, psychosomatic and psychiatric disorder.

2. The paper provides a summary of evidence on the present understanding of tinnitus, its characteristics, epidemiology, risk factors and correlates, as well as its clinical management, based on multidisciplinary approaches. There is also a section looking at current thinking on mechanism and pathology.

3. IMEG reviewed UK and international public compensation tinnitus approaches and the restraints imposed by the many gaps in understanding and concluded that tinnitus is heterogeneous and may or not be associated with noise exposure or hearing loss. The underlying pathogenesis and mechanism are unknown and there is no standard test for its existence, agreed scale or method of severity assessment.

4. We recommend no change to present UK no fault compensation for tinnitus and conclude that awards should not be made for tinnitus alone. We consider the AFCS approach generous and will continue to monitor the literature.

# Topic 8 - Recognised Diseases: Radiation and Ocular Melanoma

1. For completeness, and despite its rarity and our being unaware of any claims under the AFCS, we include a short section on Ocular Melanoma (OM) as a recognised disease.

2. Literature scrutiny provided information on definition and epidemiology. There are two types of OM, the more common Uveal Melanoma (UM) arising from the iris, choroid, ciliary body and the much rarer conjunctival melanoma. Age standardised rate is 0.4-1.2 cases per 100,000 and OM occurs most commonly in Caucasians and presents in the sixth or seventh decade of life.

3. The review covers diagnosis, clinical management, treatments and prognosis. If UM metastasises, spread is mainly blood-borne to lung, bone or subcutaneous tissues. Spread may occur early or only 10 plus years after initial treatment. When the tumour spreads, survival is limited to about 10-15% at one year.

4. The aetiology of OM or its sub-types is unknown. Risk factors include age, sex, ethnicity, socio-economic group, smoking, light eyes, fair skin, poor tanning, ocular melanosis, dysplastic naevi, family history as well as certain mutations in the tumours.

5. A role for UVR has been investigated with conflicting results. The 2003 US Survivor Epidemiological and End Results (SEER) study found no population increase in OM over the period 1974-98 in contrast to the position with skin melanoma. International Agency for Research on Cancer (IARC) investigated the relation between OM site and sites deemed accessible by sun exposure. Two studies suggested that tumours occurred in areas exposed to sunlight but the third did not. In a further ten studies of different design, findings on the OM link with UVR exposure were inconsistent. Other studies suggest that personal factors such as light eyes, fair skin and burning easily were predictors.

6. We conclude that at present neither OM nor its sub-types can be accepted as recognised diseases in the AFCS. More research, which we will keep under routine review, is awaited. Where AFCS scheme members make a claim, the determination will be based on the individual case facts, including full occupational history, contemporary medical understanding of causation and progress, and the relevant legislation.

# Topic 1 - The Hazards, Risks and Adverse Health Effects of Remotely Piloted Aircraft Systems

## Key Points

1. Since 9/11, weaponised unmanned aerial vehicles have become key in combat operations. Current RAF squadrons provide 24-hour, 365 days a year, intelligence, surveillance and reconnaissance, close air support and targeted weapon strikes.

2. Combat involving remotely piloted aircraft systems (RPAS) offers precision targeting, avoids the need to fly long distances or refuel aircraft, provides no traumatic physical risk to operators, no need to deploy or be separated from family.

3. Increase in operational tempo has led to concern that crews may be stressed. The Chief of the Air Staff asked Professor Sir Anthony Newman Taylor, Chair of IMEG, to carry out an investigation and provide a report on the hazards, risks and adverse health effects of RPAS service. Sir Anthony visited a UK RPAS station where he was briefed on the work and had opportunity to speak informally with RPAS crews.

4. One UK questionnaire-based survey of 40 male RPAS operators considered functional impairment, alcohol use and used psychometric tests to determine "probable" mental health disorders. The results suggest high perceived functional impairment, but unremarkable rates of "probable" mental health disorders compared with the wider armed forces and general community and suggesting that functional impairment was not due to poor mental health.

5. Published peer-reviewed studies of RPAS service are few and evidence does not show any increased incidence of clinically diagnosed mental health disorders. IMEG found no studies concerned with physical health e.g. neck, back pain and headache due to ergonomics of work stations or organisational issues, such as shift work and long hours.

6. To date, from a medical and scientific perspective, we have found no strong evidence of the development of higher levels of discrete diagnosed psychiatric disorders in RPAS operators compared with other RAF personnel. However mental health disorders may present after some delay.

### Recommendation 1

Defence should consider a follow-up surveillance study of RPAS operators looking at physical and mental health, including suicide, as compared with a suitable control population.

7. A distinct feature of RPAS service is "moral injury". RPAS crews are not alone in being required to kill but they do so without risk to themselves and while viewing detailed events, often of

family life, with which many identify, over a long period. There is risk of killing non-combatants, women and children, and friendly forces as well as direct visual exposure to human remains and atrocities. These features may breach normal ethical standards and lead to moral ambiguity and "moral injury".

8.  US research from the Vietnam and Iraq generations shows high levels of killing and severe post traumatic symptoms in those who killed or observed killing. Symptoms often respond poorly to conventional best practice interventions with risk of persistent disabling effects, characterised by peri-traumatic dissociation, functional impairment and violent behaviour.

9.  These aspects of PTSD phenomenology, described in the new ICD 11 classification as "complex PTSD", may be particularly resistant to treatment with poor response to conventional best practice interventions, risk of chronic medium and long-term symptoms and disabling effects on normal functioning.

### Recommendation 2

We recommend research on the impact on mental health of killing humans within a longitudinal study of RPAS teams.

# Introduction and Background

1.  Although remotely piloted aircraft systems (RPAS), began to be developed in the US in the 1960s, it is only since 9/11, in both the US and UK, that weaponised unmanned aerial vehicles (predominantly General Atomics MQ-9 Reapers) have played a significant and increasing part in combat operations. Presently the RAF has two RPAS squadrons, 13 Squadron based at RAF Waddington and 39 Squadron at Creech United States Air Force (USAF) base, Nevada. Together they provide 24 hour, 365 days a year, intelligence, surveillance and reconnaissance, close air support and targeted weapons strikes. From 2003 in the USAF, as demand increased, unmanned aerial vehicle pilots were recognised as being uniquely trained and qualified personnel and were given a specific military occupational code.

2.  Combat involving weaponised RPAS offers the obvious advantages of precision targeting, avoids the need to fly long distances or refuel aircraft, presents no traumatic physical risk to the operators, and no need to deploy or be separated from family. Strike decisions are taken by a team, not necessarily a single person, and the role of RPAS operators has come to be viewed as more akin to routine non-deployed work than manned combat. Aircrew roles and duties were initially not subject to the measures usually associated with deployed combat service, harmony guidelines, set tour durations, mandatory enhanced psychological support such as decompression etc.

3.  Since 2014 UK RPAS crews have been engaged in combat in Iraq and Syria. With significant increase in operational tempo, UK demand for RPAS aircrew as a sustainable core occupation, increased and under-manning, associated extra duties and longer working hours for those in post became an issue. Concerns that crews were stressed and reporting ill-health, followed. A similar pattern was seen in the US.

4.  Against this background and, following concerns raised by the chain of command and RPAS medical staffs about the mental well-being of UK RPAS operators, the Chief of the Air Staff asked

Professor Sir Anthony Newman Taylor if IMEG would carry out an investigation and provide an evidence based report to include findings on the hazards, risks and adverse health effects associated with Reaper service. Minister (DPV) endorsed the task. Following submission to minister and the Air Chief Marshal, the report forms part of the 2020 Fifth IMEG Report.

5. On 27 February 2018, Sir Anthony accompanied by ACDS PersCap DSSec visited RAF Waddington, the UK base of RPAS operations. Briefings, covering the nature of RPAS work and working conditions, were provided by the station and squadron commanders and senior medical staffs, including the RAF Consultant Adviser in psychiatry. Sir Anthony was also able to speak informally with the RPAS crews.

# RPAS Operations

6. There are three phases in an RPAS flight: take-off, mission phase and landing. The aircraft are located in the Middle East where a Launch and Recovery element carries out the take-off and landing. Once an aircraft is in flight its control is passed to the UK or US based crew. RPAS UK crew fly unmanned aircraft from a cockpit or Ground Control Station (GCS) at RAF Waddington or Creech Air Force Base, Nevada, USA. The RPA are the size of a small standing manned aircraft, 36 feet long and 66 feet wide and the cockpits replicate that of a manned bomber. RAF Reapers are manned on the ground by the pilot, sensor operator and mission intelligence co-ordinator. The crew is observed by an authorising officer and senior mission intelligence coordinator in the Operations Room of each squadron.

7. The operational roles of RPAS flights are reconnaissance, intelligence and strike. The pilot is responsible for flying the aircraft. Pilots may be directly recruited and trained but typically are drawn from other aircraft fleets. The sensor operator works the camera and laser which guides the weapon to its target. Like pilots they are aircrew and often come from other aircraft fleets and roles. The mission intelligence co-ordinator integrates all sources of information, communicating them to other crew members and the Operations Room. Mission Intelligence co-ordinators are not aircrew. They have an intelligence background and, in addition, specialist imaging training. The authorising officer and senior mission intelligence officer are senior and experienced pilots or sensor operators. They monitor the same audio-visual images as the crew and their role is to provide advice and support to the duty teams. At the aircraft location, a senior designated officer authorises weapon release. However, any member of the crew can call for a strike to be aborted at any time up to the final few seconds before impact.

8. From his discussions, Sir Anthony learnt about UK RPAS operators' working patterns. From the beginning of operations until September 2018, both RPAS squadrons used a 6-3 schedule with six days on and three off. For individual crew members this involved varying start times often changing significantly over a working week, with shift lengths of minimum 10 hours rising to 12 hours with the addition of briefing and debriefing times. In 2015 to alleviate fatigue, a method of switching control from one squadron to another with the aircraft in flight was devised. Shift lengths remained at 10 hours but using the time difference between UK and US, personnel could be protected from flying during, and switching in and out of, circadian lows. From September 2018 another system focusing on Monday–Friday working has been implemented for 13 squadron. The squadron has been divided into four "families" with the intention that each team member has three weekends off in a month. In reality operational demand has meant that many have to fly two weekends per month. 39 squadron remains on the 6-3 model with shift lengths of 10-12 hours as the norm. One of the contrasts with the manned combat role is potential over a day for rapid psychological switches. To distinguish the enemy from friendly forces with accuracy,

demands high and sustained concentration on large amounts of audio-visual data, requiring attention to multiple screens and high-tech equipment. There may be several days' surveillance of often very monotonous terrain (1), but operators may then suddenly observe very harrowing events without being able to intervene. The prolonged surveillance also means that operators may become very familiar with their targets and family before the strike and directly observe the reaction of the family to the loss of a family member. Operators experience a compression of time and space being inches away from the screen while thousands of miles from the actual operational theatre. Finally, at the end of the working day the combat role is abruptly replaced by the resumption of domesticity and family life.

9.     Separation anxiety can be a major stressor for deployed combat personnel and being close to home, as for RPAS operators, may be judged helpful in accommodating their fighting role. On the other hand, the small teams and relatively isolated work model of RPAS operators provide limited opportunity for effective peer support and development of unit cohesion. RPAS operators can be considered as fighting a war in a foreign country without being deployed.

10.    It is Defence and Head Quarters Surgeon General policy to implement evidence-based interventions and treatments to protect individuals from hazards at work and prevent injury and illness. There is good evidence from the scientific literature, both civilian and military, that following a traumatic incident, workplace peer support is effective in addressing minor common mental health symptoms, preventing their becoming functionally disabling or a discrete diagnosable disorder (2). Such support also helps normalise such reactions to trauma, reducing stigma and fear of negative career impact. For operations across the three services but, as yet, not for RPAS service, Trauma Risk Management is available. Here trained non-professional practitioners, trusted members of the group who have shared the traumatic experience, provide support and, as required, a gateway to expert help. In addition, during the recent conflicts, decompression was introduced and delivered at an intermediate location for personnel returning from the conflict zone to home base. This allowed personnel to adjust and process their experiences amongst colleagues who had shared the deployment. As yet, evidence of the effectiveness of these two interventions is not available, but personnel generally find them helpful (3). Other issues being explored in relation to RPAS service include training for RAF medical officers and appropriate support and awareness for RPAS families.

# RPAS Operations The Evidence of Adverse Health Effects in RPAS Operators

## A. Surveys and Unpublished Research

11.    There is unpublished UK evidence, mainly survey based and without appropriate comparison groups, of stress amongst RPAS operators. During the past three years, there have been reports of recruits withdrawing from training as RPAS operators because they feel stressed. In the last two years, 10% of those joining the RPAS squadron had been previously downgraded for mental health problems. Of these, 10% developed recurrent psychological symptoms while with the squadron. Although few formal clinical diagnoses have been made, and there is no evidence of increased referral rates of RPAS Squadron members to specialist mental health services, a significant number of UK RPAS crew members, confirmed by their families, report tiredness, stress, increased alcohol use, lowered mood and emotional symptoms that are common features of autonomic arousal, immediately before and less commonly, after weapon strikes.

**12.** Sir Anthony was informed of a UK RAF questionnaire-based survey using psychometric screening tools undertaken by 40 male RPAS operators, but no controls. The results of this survey have been published since this report was written (4). The operators had been in the role for at least two years and the survey took place at an Away Day which included a stress briefing delivered by a military psychiatrist. The aim was to record alcohol use, detect probable mental health disorders, and functional impairment. The tools used were the Work and Social Adjustment Scale (WSAS), Alcohol Use Disorders Identification Tool (AUDIT), Primary Health Care Questionnaire 9 (PHQ-9), Generalised Anxiety Disorder 7 (GAD-7) and PTSD checklist civilian version (PCL-C).

**13.** The WSAS (5) has five items measuring self-reported functional impairment in the context of work, home life, relationships, social and leisure activity. For each item the maximum score is 8 with a low score indicating better function. A score of 10 or more implies probable functional impairment. AUDIT (6) has ten items with scores ranging from nil to 40. Again, a higher score, in this instance, more than 8, is taken as suggesting possible problem drinking. PHQ-9 (7) uses nine items to assess depression. Maximum score is 27 and anyone scoring 10 or more is held to have moderate depressive symptoms. Anxiety severity was estimated using the seven item, GAD-7 (8). Score range is nil to 21 with 10 or more suggesting moderate anxiety symptoms. Finally, for PTSD symptoms, PLC-C, i.e. the 17 item PTSD checklist–civilian version was used (9). Again, for each item possible score is 1-5 where 5 is the highest severity. As in other military studies, an overall score of 30 or more implied subclinical potentially occupationally impairing symptoms, while for "probable" PTSD the cut-off was 50.

## 14.   Findings:

- WSAS score suggested that 70% of respondents believed their operational effectiveness was impaired because of how they felt emotionally.

- AUDIT scores showed 40% reported drinking alcohol at possibly hazardous levels (as defined by AUDIT score of over 8). Because different AUDIT measures and normative data may be used in studies, valid comparison of findings with other contemporary populations and studies may not be possible. A cross-sectional postal study published in 2007 assessed alcohol consumption in 2003 (10). This found 67% men in the armed forces with an AUDIT score of over 8, compared with 38% men in the general population. The general population data were derived from the Office of National Statistics (ONS) National Psychiatric Morbidity Survey, conducted between March and September 2000 and weighted to be representative of the household population of GB. It is also of note that since these data were collected there have been campaigns both in the general community and armed forces re alcohol awareness.

- PHQ-9 suggested that 20% had symptoms meeting criteria for moderate depression, although not requiring specialist referral. This is similar to the armed forces and the UK general community as a whole.

- GAD-7 suggested 10% met criteria for moderate anxiety. Again, this is lower than in the wider armed forces and the general UK community.

- No one reported symptoms of probable PTSD.

- There was a widely held view that the RPAS role was undervalued and unrecognised by the armed forces and general public with consequent perceived impact on career progression and morale.

**15.** The published paper included the response to a free text question on work terms and conditions. The most frequent suggested change was that shift pattern and work time were problematic. The high level of WSAS based functional impairment is of interest as the other survey outputs and lack of

association suggest that this is not primarily explained by a diagnosable mental disorder. One might speculate that a possible explanation is "burnout"; i.e. emotional exhaustion, cynicism and functional impairment, a situation which is not a psychiatric diagnosis requiring medical support or treatment, but which is addressed by attention to work-related factors

## B. Published Peer-Reviewed Evidence

**16.** To date, published peer-reviewed evidence on the health impact of RPAS operations is limited and mainly from the US. Although the US and UK work closely on RPAS, there are clear differences in UK and US weaponised RPAS policy as well as societal and cultural differences and approaches to management of mental health symptoms and illness. US results cannot be generalised beyond the particular group studied. Other published peer-reviewed data sources considered by IMEG in this investigation included studies, in the civilian context, of issues pertinent to RPAS operations such as shift work, long working hours and PTSD in civilian studies.

**17.** Limitations of the US RPAS studies often include sample bias, e.g. how representative of the overall group were volunteers, and the fact that perceived impact of stigma on career, which applies in both civilian and military contexts, may have led to delay in seeking help, failure to present or to report symptoms. The studies and surveys have other limitations including cross-sectional design, use of different assessment measures for psychological disorders (e.g. psychometric tests giving "probable" diagnoses or the gold standard clinical examination), the populations assessed; e.g. all RPAS team members or just aircrew or pilots, differing response rates (almost always less than 50% of those eligible), reliance on self-report, and in many studies, no or fewer than ideal controls.

**18.** Few of the published papers comment on the nature of stressors, particularly whether combat related, workplace or domestic stressors, and how they relate to RPAS service. Many UK RPAS operators have been in service for many years and have previously piloted manned aircraft in combat situations. For some the stressor might relate more to that earlier service or might have arisen in some different aspect of work, service or private life.

**19.** As in the UK, evidence to date, from the US RPAS studies, does not show any increase in incidence of clinically diagnosed mental health disorders, although almost all published reports do not have a contemporary matched control group. About 4-5% of US RPAS operators in one self-report online study, with a 49% response rate, met diagnostic criteria for PTSD as compared to less than 1% by clinical diagnosis in another contemporary study (11). This also contrasts with a 4-18% rate of PTSD amongst those returning from the battlefield (12) and is lower than the 2005 lifetime prevalence of PTSD in the US general population of 7% (13). One retrospective study calculated the incidence rates of 12 specific mental health outcomes in all active RPAS pilots between 2003 and 2011, comparing rates with USAF manned aircraft pilots deployed to Iraq and Afghanistan during the same period. During the period there were 709 RPAS pilots and 5,256 Manned Aircraft (MA) pilots. Of the 709 only 82 were solely RPAS pilots and had never been deployed. The majority had previously deployed as MA pilots. Compared to MA pilots, a greater percentage of RPAS pilots had deployed three or more times, had prior mental health diagnoses and six or more years' service. Adjusted incidence rates of the 12 specific mental health outcomes (adjusted for time in service, age, number of deployments and history of mental health symptoms or discrete diagnoses) were the same for both groups and lower than in other USAF branches e.g. medical and administration, and USAF overall (14).

**20.** The retention and manning issues found in the UK RPAS squadron were replicated in the USAF, and US findings on self-reported tiredness and stress studies and are similar to the British experience. US studies have specifically considered burnout in RPAS operators (15) where burnout is defined as a state of functioning typified by high levels of exhaustion, a distant and negative attitude to work and low sense of professional efficacy. 14-26% of the 296 investigated reported exhaustion and 7-17%

reported negative attitude. The outcomes on professional efficacy were varied and for the most part high levels of efficacy were maintained despite the exhaustion. The operators attributed these effects not to combat but to workplace/occupational stressors; primarily long work hours (51 or more hours a week), periods of boredom, family issues and shift work. Other US work has demonstrated safety risks associated with exhaustion, particularly secondary to long hours and shifts in RPAS operators, where mishaps are twice as common as in manned aircraft (16). Mishaps are defined by the total direct cost or severity of injury or occupational illness. For RPAS no personal injury was caused and so included in the total mishaps were those causing damage of $20,000 or more as well as near misses deemed important to investigate for mishap prevention. Between 17-69% of these RPAS mishaps have been ascribed to human factors (17). To date there are no comparable UK studies.

21. Since the Great War most research on military stress has focused on combat but a recent UK systematic review aimed to identify non-deployment factors, particularly work, social, interpersonal and family stressors, which might affect the mental well-being of military personnel (18). Non-deployment related stressors were as defined by HSE and applicable to all employments. These included work demands, work control, worker support, relationships, leadership, harassment and bullying, role clarity (i.e. do people understand their role and responsibilities) and, perhaps less relevant to the military context, how much involvement had they in organisational change. 2018 UK government statistics suggest that, while overall civilian sickness absence days, notably from musculoskeletal disorders, have been reducing, from 2009, sickness absence due to work-related stress, depression/anxiety symptoms and discrete mental health disorders has increased, currently accounting for 15 million days of sickness absence a year. Mental health problems are now the third most common cause of sickness absence after acute minor illness and musculoskeletal disorders (19). By contrast a degree of pressure or challenge is associated with most jobs and, although stressors are perceived differently and uniquely by individual people, in many cases the effect of stressors is positive, raising performance and providing job satisfaction. It is where pressure exceeds coping resources, especially for a prolonged period, that symptoms and ill-health can result (20).

22. As well as similarities, differences between military and civilian employment include the 24 hour/ 365 days a year commitment of military employment and the fact that both employer and individual personnel have responsibilities beyond the workplace, to the living and recreational space. The Defence Health and Well-Being Strategy and Plan is designed to deliver the right mix of capable and motivated people through life and across the whole force of regulars, reservists, civil servants and contractors. The emphasis is on primary prevention, i.e. job modification with control of risks and hazards and individual personal protection, to prevent ill health. This is essentially a chain of command responsibility covering health education and promotion, healthy lifestyles, injury and illness prevention, good living and working conditions. Secondary prevention is appropriate when symptoms and illness have developed. It is concerned with early detection and referral to support, expert diagnosis and, as required, best practice evidence-based treatment. Here the main responsibility is medical care, through Headquarters Surgeon General and Defence Primary Health Care. Equally important is the need for the organisation and its senior leaders to endorse anti-stigma campaigns. Although not unique to the military, delay in seeking help is an issue, and the armed forces have embraced peer and line management support for those with mental health problems to access help early.

23. International military studies show that under-manning, being posted or deployed, can all be associated with an increased risk of psychological symptoms, lead to poor work-life balance with excessive hours and limited opportunity for relaxation, sporting and social activity or interaction with family and peers. These are associated with a high turnover of military personnel and psychological symptoms (21). Opposite effects result from good peer and chain of command support, high quality leadership, shared ethos, teamwork, a quality work environment, and support from the chain of command for families; that leads to effective functioning, retention in service and high morale (22).

There is also a significant literature, well beyond the medical, that provides testimony that deployed service and combat can support organisational identity, unit cohesion and coping with stress.

24. For RPAS operators other factors reported as contributing to stress include physical working conditions, the ergonomics of work stations and digital equipment, often with monitoring of multiple screens, leading to musculoskeletal symptoms, headache, eye strain and difficulty alternating their work with family responsibilities acutely and on a daily basis. Job satisfaction and morale in any context, including the military, is enhanced by recognition, a feeling of being valued and rewarded. A particular issue in UK RPAS operators, as noted in the Away Day survey and discussed with Sir Anthony, is feeling undervalued by public and peers alike, with limited career progression. Some of this relates to limited or misunderstanding of the role and its challenges and failure to appreciate the RAF Reaper Force and the personal ethos of team members. This goes well beyond adherence to the Geneva Convention which states that civilians may be killed in war provided numbers involved are not excessive in relation to the military advantage anticipated. UK policy is zero civilian casualties.

25. Another issue is shift work. There is an extensive literature, predominantly civilian, on shift work, but study designs are variable, and many questions remain unanswered (23). Shift work means work time arrangements out with normal daytime hours of 0600-1800. This includes fixed early morning, evening and night work, roster work and rotating three shifts work, where there is regular rotation between day, evening and night shifts. Shift work disrupts the normal sleep-wake cycle causing shortened sleep and excess tiredness (24).

26. Individual studies suggest that shift work may affect health and safety, lead to increased accidents and may even be associated with chronic disorders including coronary disease and some cancers. A recent review looked at 38 meta-analyses and 24 systematic reviews of shift work, and its relation to insufficient sleep, chronic diseases and accidents (25). A weak association was found between shift work and accidents, diabetes type 2, coronary heart disease, and some cancers. The evidence of individual studies is however inconsistent, and it is unclear as to whether shift work is a causal factor for these diseases. Good evidence does exist for a relationship between insufficient sleep and immunological and metabolic changes, increasing the risk for chronic physical disease. It seems plausible that the adverse effects of shift work are mediated via sleep and circadian rhythm disturbances. Other possible mechanisms, relevant to RPAS operators, include changed lifestyle behaviours, by their own admission: less attention to diet, reduced physical activity, increased consumption of caffeine and alcohol and poor work life balance with disrupted exercise, social and family commitments. Shift work affects some people more than others with the suggestion that the ability to compartmentalize (i.e. separating work, personal and home duties) is helpful in preventing adverse health effects. More research is required, especially longitudinal studies, to identify best practice on shift scheduling to support improved sleep, and also to investigate what happens when shift working ceases, including whether there is any difference if the shift pattern is long established or of recent and short duration.

27. Previous research has linked long working hours with physical disease, e.g. coronary disease, reporting a relative risk of about 1.4, i.e. a 40% increase in risk, (26)(27). However, limitations to generalising from these studies include publication bias, i.e. the tendency to publish studies with a positive outcome, reverse causation (where employees with advanced disease may reduce their working hours in the years before the cardiovascular event); and possible confounding factors. For example, - cardiovascular disease is more common in people from lower socio-economic groups (SEG), while working longer hours is a feature of those from higher SEGs. A 2016 systematic review and meta-analysis of longitudinal published and unpublished studies included over 600,000 individuals; it looked at long working hours (45-55 hours weekly) and incident risk of both coronary disease and stroke in individuals free of symptoms at entry to the study (28). The results showed a 30% increased risk for stroke in those working 55 hours or more, while the risk for coronary heart disease was raised, but only weakly and, in most studies, the risk was not statistically significant.

# Findings:

**28.** The IMEG investigation has led to four main findings: -

i. An adequate high-quality published peer-reviewed evidence base on hazards, risks and adverse health effects of RPAS service does not as yet exist. The emphasis of most research has been on possible mental health effects. We found no RPAS studies concerned with the physical health of personnel.

ii. Neither in US or UK studies was there an increased risk of discrete diagnosed mental health disorders or problems, leading to help seeking, at levels above that of manned combat pilots or other military personnel.

iii. There is some survey and questionnaire evidence from UK and US, confirmed by families, of reported stress and exhaustion in RPAS crew members. In discussion, some RPAS operators identified challenges related to shift work and long hours, particularly at times of increased operational tempo and manning shortage, leading to physical symptoms such as neck and back pain, related to the ergonomics of the ground control station, and daily psychological switches between the role of war fighter and family member.

iv. In addition RPAS operators reported low morale, feeling undervalued and unrecognised by peers and the general public. They also perceived restricted opportunity for career progression. They were clear that their roles as pilot, sensor operator and mission intelligence co-ordinator were not replicated in manned combat aircraft. Different training and competencies are required, such as rapid processing of audio-visual data, concentration and self-reliance. Coupled with the work pattern and content, the rapid alternation of war fighter and family roles and the limited time for off-duty support and team building, the roles were felt to be similarly demanding as in manned combat aircraft.

**29.** It is established that, in general, the health and well-being of employed personnel and primary prevention of symptoms and illness is supported by high quality jobs and conditions, issues primarily for the chain of command. We recognise that care is needed to avoid implementation of changes in areas such as selection for RPAS duties, screening and ongoing routine extra medical examinations or surveillance where there is no clear evidence of such requirement nor of the effectiveness of the change. Inevitably such action can do harm and convey a message that the core duties of the occupation are thought to be risky or hazardous.

**30.** The medical risks of screening are well known (29). There is a significant literature, US based, that "screening out" of military service of those judged to be at risk of mental health symptoms and illness is ineffective. In the early part of US involvement in the Second World War, personality testing was used to predict those likely to break down when faced with the stress of combat. By 1944 they were running out of personnel and General Marshall reversed the practice. Many of those previously turned down now enlisted and for the most part made adequate soldiers.

**31.** One reason for the failure of screening in prevention of traumatic psychological injury is that not everyone alleged to have predisposing risk factors will in fact be exposed to a traumatic stressor, the best single predictor for development of PTSD or adjustment disorder (30). These disorders are not more likely where there is a family history of mental health disorder or dysfunction etc. While risk reduction is important for good mental health, so too is building enhanced resilience. Many studies confirm good mental and physical health at times of obvious public risk, e.g. during the Second World War and, more recently, in the aftermath of 9/11 and the London, Paris, Berlin and Madrid bombings. In these situations, people, especially professionals, police, fire and paramedics, were able to see and

accept that total prevention of such events is unlikely, but there is good reason for accepting the risk. Such a philosophy has long been the tradition of the UK armed forces and an aim is for it to remain so at this time of smaller volunteer forces, increasing change, new challenges, new technology and principal service occupations. Support of this tradition demands prevention and protection and where there are suggestions of stress or lowered morale, early detection, recognition and, proportionate response by the chain of command sponsored by senior leaders.

# Recommendations:

**32.** Apart from the musculoskeletal and other physical sequelae related to the ergonomics of workstations and ground control stations, the reported health and well-being effects of RPAS service focus on nonspecific and psychological symptoms. The chain of command, senior personnel staffs and Headquarters Surgeon General are already engaged in addressing many of the issues raised in this paper.[1] The IMEG role is to consider contemporary evidence on the issues from a scientific and medical perspective and, as relevant, make recommendations.

**33.** To date, from a medical and scientific perspective, we have found no strong evidence of the development of higher levels of discrete diagnosed psychiatric disorders in RPAS operators compared with other RAF personnel. However mental health disorders may present after some delay.

## Recommendation 1

Defence should consider a follow-up surveillance study of RPAS operators looking at physical and mental health, including suicide, as compared with a suitable control population.

**34.** We identified one distinct feature of RPAS service. PTSD was first defined in DSM 111 in 1980 in the aftermath of the Vietnam War and a guilt symptom was included. "guilt about surviving while others have not, or about behaviours required for survival" which in later editions disappeared (31). RPAS crews are not alone in being required to kill, but unusually they do so without risk to themselves and while viewing detailed events often of family life, with which many identify, over a long period. There is also risk of killing non-combatants, women and children, and friendly forces and of direct visual exposure to human remains and atrocities. These features may breach normal ethical standards and lead to moral ambiguity and injury. Research from the Vietnam generation (32) and more recently in Iraq War veterans (33), has shown similar levels of killing in both conflicts and severe post- traumatic stress (PTS) symptoms in those who killed or observed killing, sometimes with delay of years to onset or presentation. This is often referred to as "moral injury". After controlling for exposure to general combat, and viewing atrocities, body parts etc, killing predicts PTSD, characterised by peri-traumatic dissociation, functional impairment and violent behaviour. There is increasing evidence (34) that these aspects of PTSD phenomenology, described in the new ICD 11 classification as "complex PTSD", may be particularly treatment resistant with poor response to conventional best practice interventions, risk of chronic medium and long-term symptoms and disabling functional effects.

## Recommendation 2

We recommend research on the impact on mental health of killing humans within a longitudinal study of RPAS teams.

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**1** The RPAS branch has now been restructured such that a cross-over to manned flying is now possible, with the blue laurels of the former RPAS flying badge changed to brown, the same as the badge for pilots of manned aircraft. RPAS crews are now also available for the Operational Service Medal (Iraq and Syria).

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# Topic 2 - The Aircraft Cockpit and Cabin Air Contamination by Bleed Air - The Evidence

## Key Points

**1.** Some commercial aircrew have reported short and longer term non-specific, sometimes disabling, related to fume incidents and breathing contaminated cabin air. The symptoms are not accompanied by objectively verifiable clinical signs; imaging and routine laboratory tests are also negative.

**2.** Analysis of cabin air contaminants after fume incidents has identified more than a hundred mainly organic products but all with levels below 12 parts per billion. Organophosphates (OP) are present in jet oil but OP derivatives have not been demonstrated.

**3.** In 2005 the then Department of Health (DH) sponsored Committee on Toxicology (COT), reviewed evidence on the issue submitted by British Airline Pilots Association (BALPA) and concluded that it was inadequate to resolve the issue. They recommended further monitoring of fume incidents and more research.

**4.** The subsequent COT 2013 position paper concluded that the symptom pattern was not suggestive of an OP effect. They found that contamination of cabin air by some components of engine oil and other substances does occur and the acute illness reported by some crew members might be a chemical irritant effect. Equally given the very low levels of chemical contaminants it could also be a nocebo effect i.e. where disabling illness can arise from environmental exposures that are perceived as hazardous.

**5.** We examined present evidence finding an acute irritant effect plausible, but the precise environmental cause(s) was not established nor the existence of a later onset chronic disabling disorder. We will continue to monitor the literature and AFCS claims made.

## Introduction and Background

**1.** Aircrew routinely experience unusual physical conditions at work. These include exposure to jet fuels, changes in atmospheric pressure, temperature, gravitation, exposure to ionising and non-ionising radiation and, sometimes, hypoxia. They may also undertake shift work, long hours of duty and are subject to time zone changes. In the last 20 years some aircrew have reported both short term and more lasting non-specific symptoms such as ear, nose and throat irritation, fatigue, dizzy spells, anxiety, headache and nausea and vomiting (1). They ascribe these symptoms to breathing cabin air contaminated by engine oils or other chemicals. The symptoms are not accompanied by objectively verifiable clinical signs and imaging and routine laboratory tests are also negative. At times such symptoms have been associated with reported functional compromise and several small case studies have reported evidence of neuropsychological impairment and altered cerebral white matter structure and function. Successful lawsuits against employers have followed. In 2000 the term aerotoxic syndrome was applied to these adverse health effects but since the reported symptoms are non-specific, common in the general community and there is no discrete diagnosable pathology, the term is not medically recognised (2).

**2.**　As first introduced in military aircraft in the nineteen fifties and sixties, cockpit and cabin air in modern commercial aircraft is managed by an Environmental Control System (ECS). There are different systems for different aircraft but broadly, outside air enters the engines and is compressed, forming "bleed air", which is then used for cabin air conditioning. That air is then re-circulated before being exhausted from the cabin. Seals ensure that engine bearings are continuously lubricated with no leakage of oil into the compressed air stream. If a seal fails or is poorly maintained leakage may occur with the leaked oil or hydraulic fluid, then subject to a range of temperatures in the engine and air conditioning system thermal decomposition might then take place with release of volatile organic compounds and associated unpleasant or irritating fumes and odours.

**3.**　Smoke or fume incidents are unfortunately not always assiduously recorded. Internationally they are considered rare and one UK estimate is that they occur in 0.05% of flights. Few data are available on products of thermal degradation of lubricant and hydraulic oils and certainly not over the range of possible temperatures experienced, where different chemical products may be formed from one primary chemical compound. Analysis of cabin air contaminants, using an engine test rig in an aircraft previously involved in a cabin air fume incident, resulted in identification of about 100 possible pyrolysis products including ketones, acids, aldehydes, esters, oxygen, carbon monoxide, carbon dioxide and ozone. Levels of these were all below 12 parts per billion (ppb). Other sources of potential contaminants in the cabin include de-icing fluid, the galley and lavatories. Any or all of these might contribute to a fume incident.

**4.**　In the context of aircraft cabin air quality, there has been interest in organophosphates present in jet oil. Trimethylol propane phosphate (TMPP) can theoretically be formed from trimethylol propane esters and tri-ortho-cresyl phosphate (TCP), but this has not been demonstrated in experiments replicating pyrolysis conditions. While there are no monitoring data in the aftermath of a documented fume incident, it is considered unlikely that TMPP would be formed during fume incidents in commercial aircraft.

**5.**　In theory, exposure to many of these chemicals can produce short term symptoms e.g. irritation of throat and mucous membranes.　It has also been reported that in some aircrew with more prolonged exposure to cabin air there can be long term disabling symptoms, chronic ill-health and ultimately ill-health retirement. There has been no consistent pattern of symptoms reported by those affected. Short term symptoms are described with a clear temporal relationship to exposure. Symptoms include non-specific irritant effects such as itchy weeping eyes, scratchy sensation in throat, chest tightness and itchy skin. There are also reports of loss of memory, poor concentration, tiredness, confusion and headaches. There is no report of these symptoms causing safety issues or crew becoming incapacitated and unable to carry out their duties. The evidence of chronic illness and its nature is also inconsistent, with a series of case reports of symptomatic illness, often with different symptoms, without objective clinical signs, imaging or laboratory test abnormalities reported and no identified underlying pathology. While exposure to a neurotoxic substance is a plausible biological mechanism for symptoms, at least some of these symptoms are more characteristic of anxiety and hyperventilation. The current published epidemiological evidence is insufficient to resolve the issue.

**6.**　In 2000 a group of about 20 Australian aircrew successfully applied for workers' compensation for symptoms attributed to toxic fumes on the aircraft they worked on, while in Britain there was an incident where a captain and first officer became unwell while landing at Birmingham International Airport. They landed safely but were taken to hospital where they quickly recovered with no lasting effects or cause found for the episode. It was eventually linked to a similar episode some years earlier where formaldehyde used as a cleaning agent was identified as the potential hazard. This became the subject of a Civil Aviation Authority (CAA) notification to operators.

**7.**　Over the next few years there were a number of civil claims and international sporadic media coverage as well as, in 2000, government sponsored enquiries, including in Australia and the UK. These included

the UK Department for Transport (DfT) research, which found no link between fume exposure and long term ill-health; an Australian senate investigation, which considered the background to the workers' compensation group action, their Civil Aviation Safety Authority Expert Panel on Aircraft Air Quality considering the scientific evidence; and, in response to many complaints focused on possible organophosphate effects, an investigation by the UK parliament's Select Committee on Science and Technology. This relied heavily on the Australian Senate investigation, noting the absence of confirmed cases of TCP poisoning and going on to find that claims of ill health effects due to organophosphates were not substantiated.

# Independent Expert Scientific Review by UK Committee on Toxicology

**8.** In 2005 the then Department of Health sponsored expert Non-Departmental Public Body (NDPB), the Committee on Toxicology (COT), was asked by the Department for Transport (DfT) to undertake an independent scientific review of data submitted by the British Airline Pilots Association (BALPA) on their concerns regarding possible health and safety effects on aircrew due to fume incidents. Following examination of the BALPA evidence and further literature scrutiny, COT concluded that the evidence was inadequate to resolve the issue although the time sequence of exposure and symptoms made an acute toxic effect plausible. They recommended further monitoring of fume incidents and cabin air contaminants and, for the long term reported symptoms, a cross-sectional study on neuropsychological symptoms in aircrew including people working on different aircraft types and who had variously reported or had not reported, fume incidents (3).

**9.** In 2013 COT published a position paper on cabin air (4). This commented on reports of four research projects commissioned by the DfT in response to the 2007 COT report recommendations. First, there were two on air sampling devices that might be used to monitor air quality. It was concluded that detection and monitoring was very difficult, especially quality assurance, and that in the absence of major fume events, levels of chemical contaminants were likely to be very low and certainly well below levels which cause symptoms. A third study considered surface residues, specifically four types of organophosphate. Only very low levels of chemicals consistent with those from cabin air sampling were recorded. However, none of the aircraft studied had been subject to a fume incident. The fourth project, a review of fume incidents, was limited by failure to record timing of the incident during the flight and so an opportunity to consider possible trigger events was missed. Finally, the COT literature review update again showed only low levels of pollutants in the absence of a major fume event. One 2013 study included in the review concerned urine monitoring carried out where pilots and air crew reported fumes/odour during their last flight. No samples contained detectable TCP, but the study showed that such an approach was feasible. Another study (2011) illustrated another possible biomarker by monitoring metabolites of TCP in blood using butyryl cholinesterase. This confirmed their presence at very low levels in 6 out of 12 passengers.

**10.** The committee recorded in its conclusions that the pattern of symptoms reported following fume events was not that expected from exposure to tri-aryl phosphates such as TCP and which itself differs from the pattern seen with over-exposure to organophosphate insecticides and nerve agents. Over-exposure to TCP might be expected to cause delayed peripheral neuropathy but only at much higher exposure levels than the current peak level recorded by air sampling in any study. Other volatile irritant or malodorous organic chemicals could be present in fume, including ketones, aldehydes, esters and ozone. To date, test rig analyses on nearly 100 compounds, simulating flight including aircraft involved in fume incidents, show contamination levels to be low, generally below 100 parts per billion (ppb).

**11.** The Committee on Toxicology (COT) position paper set out some overall conclusions informed by the recent investigations and the 2007 report findings:

- Contamination of cabin air by components of engine oil and other substance does occur.

- Acute symptoms and illness have been reported in close time proximity to such contamination.

- Some air crew report long term disabling illness which they ascribe to repeated chronic exposure to contaminated cabin air.

- The acute illness in close time proximity to exposure might be a chemical irritant effect of an as yet unidentified chemical or combination of chemicals, but in light of the consistent findings of only very low levels of chemical contaminants, it could also represent a nocebo effect.

# Placebo and Nocebo Effects

**12.** There has been recent interest in the psychobiological mechanisms of placebo and nocebo effects (5). The nocebo effect was first defined in 1961 by Kennedy (6) as an adverse effect from an inert treatment (6). This compares with a placebo effect where a non-active treatment produces a beneficial health effect. While the nocebo effect has been less studied, there is much research interest in the psychological and neurobiological mechanism of the placebo effect in relation to medical treatments. Previously an aim was to reduce placebo effects but today the focus is on maximising them to enhance treatments allowing lower doses of potentially harmful or expensive medications. Placebo effects influence patient satisfaction and there is some evidence that positive expectation may also cause physiological change e.g. reduction in heart rate and blood pressure.

**13.** In a recent study (7), patients recovering from heart surgery were randomized to three interventions:

- Standard medical care;

- Standard care plus emotional support and encouragement; and

- Care which raised expectations of an excellent functional outcome post- surgery and good quality of life.

Six months after surgery those in the third "expectation" group reported the best outcomes for subjective working capacity and psychological quality of life. The interventions to support the "expectation" group were quite minimalist involving two face to face sessions and three phone calls of which one, six weeks after surgery served to reinforce the earlier interventions. This is a placebo effect.

**14.** An example of a nocebo effect is where negative expectations limit the effectiveness of a treatment. This can reduce compliance with therapy, patient quality of life and increase costs (8). The media can play an important role, e.g. a new study may be reported as showing that a widely used drug commonly causes unpleasant side effects. This may generate more reports of side effects from patients on that medication and a decision by patients to discontinue the drug. An important example is statins and cholesterol lowering. A meta-analysis of double-blinded randomised controlled primary and secondary cardiovascular prevention trials, involved 83,880 patients and compared statins against placebo for cardiovascular prevention, separately reporting information on side-effects in the statin and placebo arms. The study focused on symptoms (adverse effects). The proportions of patients reporting symptoms (such as muscle pain and fatigue) did not differ between those taking statins and those taking placebos, suggesting that only a minority of problems reported as side-effects of statins are genuinely due to statins (9). A 2017 Scandinavian unblinded statin trial of over 10,000 patients

illustrates the nocebo effect. Side-effects were reported when patients knew that statins were being used but not when the treatment was blinded (10).

## Military Compensation Aspects

**15.** At present we are unaware of any claims for either acute or more chronic disabling symptoms under either AFCS or the War Pension Scheme. It is known that some types of military aircraft continue to use similar environmental control systems for cockpit and cabin air as in some commercial aircraft. It may be that the military working pattern, flying hours and shifts differ such that the problems do not arise.

## Recommendation:

**16.** Current evidence has not identified an environmental basis for the reported   acute discrete disorder following fume incidents in aircraft, or the existence of a later onset chronic disabling disorder. We will continue to monitor the literature and AFCS claims made.

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# Topic 3 - The Connection between Mental Health Symptoms and Disorders and Cardiovascular Disease – Present Evidence

## Key Points

1.  Multiple risk factors, blood pressure, diabetes and cholesterol level predict for development of atherosclerosis and associated cardiovascular disorders, but they do not account for all cases. One suggestion is a connection between emotion and the heart.

2.  The approach of the AFCS to claims for cardiovascular disorders secondary to mental health symptoms and disorders has been raised. IMEG reviewed the evidence on pathogenesis, mechanisms and the effects of treatment of mental health disorders on cardiovascular disease incidence and mortality, concluding that that present evidence does not support a direct causal association between psychosocial factors such as stress, mental health symptoms and discrete disorders including PTSD and incident cardiovascular disease.

3.  Some observational studies on chronic stress in adulthood and discrete psychiatric disorders suggest an association with incident cardiovascular disease but the effect is small and inconsistent. Studies have design and size limitations and the connection is not presently recognised by expert international bodies such as the American Heart Association, American College of Cardiologists and the Task Force on the European Guidelines on cardiovascular disease prevention.

4.  We consider that available evidence supports a trigger effect for acute physical or emotional stressor on acute cardiac syndromes where there is asymptomatic undiagnosed atherosclerosis. If an acute service-related physical or emotional stressor occurs in the hour preceding an acute myocardial infarction, an award may be made.

5.  Mental health disorders can affect lifestyle choices and ability to give up smoking, alcohol consumption, diet, all of which impact atherosclerosis, IMEG strongly supports the Defence Health and Well-Being Strategy commitments on healthy eating, weight management, smoking, alcohol and mental health.

## Introduction and Background

1.  Mental health symptoms and illness remain a major focus of the Defence Health and Well-Being Strategy and are important reasons for compensation claims. From April 2005 until 31 March 2019, 4,395 AFCS awards, including 3,370 for PTSD, have been made from the descriptors in Table 3: Mental disorders. Of these, 825 (19%) of which 680 are PTSD awards, included a Guaranteed Income Payment (GIP). This contrasts with physical injuries and disorders over the same period with a total of 67,930 awards of which 3,750 (6%) also had a GIP (1). There is a body of published peer-reviewed literature suggesting a connection between mental health disorders and cardiovascular disease. The approach of the AFCS to awards for cardiovascular disorders claimed as secondary to stress, mental

health symptoms and disorders, especially PTSD, has been raised, and this paper reviews the present evidence, focussing on coronary artery disease, ischaemic stroke and hypertension as the most studied Cardiovascular Disorders (CVD).

# Association and Causation

**2.** Awards are made under the AFCS where an injury or disorder is, on the balance of probabilities, predominantly caused by service on or after 6 April 2005. Article 5 of the AFCS Order 2011 provides that all AFCS descriptors encompass the expected effects of a primary injury and its appropriate clinical management, including psychological effects, short of a diagnosable disorder. Claims and awards may be made for discrete mental health disorders including outside the normal AFCS claims time limits. Awards may also be made for secondary disorders, including mental health disorders, developing due to an accepted injury or disorder.

**3.** Causation and causal inference are important in philosophy and central to epidemiology, a discipline whose goal is to identify the causes of diseases so that they or their consequences can be prevented. As in other empirical scientific disciplines, proof of causation is impossible. Thinking on causation has evolved over the last 100 years but remains much influenced by early life experience and observation, logic and beliefs, and there is no agreed definition of the concept. It is now accepted that the traditional view of causation, as due to a single agent, exposure or event, is too limited and that disease aetiology is usually multifactorial. In addition to an agent, exposure or event, the host and environment play a major and co-ordinated role. Causal inference in epidemiology today can be thought of as a quantitative speciality which measures the size of effects rather than applying a checklist of criteria to decide whether an effect is present. A glossary at Annex A provides definitions of statistical terms used in the paper.

**4.** To demonstrate attribution in an individual AFCS case we need to have evidence:

i) that the factor, i.e. exposure/incident/circumstance, under consideration is a cause of the disease being studied, at least in some circumstances and;

ii) that in the individual case the factor was in fact the cause of the disease (2).

In medicine and the AFCS the standard of proof is balance of probabilities, i.e. more likely than not.

**5.** Investigation of causation usually relies on observational approaches including cohort and case control studies. Cohort/longitudinal studies need two population samples, as similar as possible in all respects other than exposure to the potential causal factor, with follow up prospectively over time to see if the exposed group develop the disease in question more often than the non-exposed controls. Case control studies examine cases of the disease and suitable non-diseased controls and explore retrospectively whether cases have been more frequently exposed to the proposed causal factor than controls.

**6.** Key to rigour and quality are study design, size and avoidance of bias. By being prospective, and measuring exposure prior to the development of disease, cohort studies are a stronger design than case control studies, which are retrospective and may be affected by recall and other biases. In case control studies, the control sample should be representative of the population at risk of developing the disease under investigation. In many studies control populations are drawn from the general parent community. In occupational studies, including of the military, this choice of general population controls may be inappropriate leading to false conclusions because the military cases are selected, fitter and, in the early years, with lower mortality than the general community. Another risk with

case control studies, is volunteer cases who, aware of a potential cause of their disease, can be more likely than controls to report exposures/events based on memory of self or family members without documentation, i.e. recall bias.

7.  Lastly, confounders, which may affect any study design and are factors associated both with the causal factor under study and with the disease outcome, but not as an effect of the risk factor. Studies on causation are always at some risk of bias and confounding and so the findings of a single observational study are never definitive. Other relevant issues include how the proposed causal agent/exposure has been identified and how the outcome under study has been diagnosed. For example, in the present context mental health disorders may have been diagnosed by expert clinical evaluation, a screening tool or psychometric test, or from medical records. Lastly to determine whether further research might overturn the finding, the totality of evidence and its consistency must be considered.

8.  In 1965 Sir Austin Bradford Hill published a set of nine "viewpoints" to help determine if observed epidemiological associations are causal (3). The Bradford Hill viewpoints included:

    i. Strength of association: Those exposed to the relevant agent as compared to those not exposed (risk ratio) e.g. lung cancer in asbestos workers (4).

    ii. Consistency: The finding has been repeatedly observed by different researchers at different times in different populations.

    iii. Specificity: The association is limited to specific people and types and sites of disease.

    iv. Temporality: The cause should always come before the effect. Of relevance to our question may be whether developing or early CVD, not clinically apparent, might lead to mental symptoms rather than a mental health condition causing the CVD.

    v. Biological gradient: There is an exposure response, ie the greater the level of exposure the greater the risk of disease.

    vi. Plausibility: The finding accords with the current understanding of pathophysiology.

    vii. Coherence: The finding is coherent with contemporary understanding of the natural history and biology of the disease.

    viii. Experiment: There is a reduction in the incidence of the disorder when the factor is reduced or limited; e.g. by reduction or elimination of the exposure.

    ix. Analogy: If there is say, a drug or virus which is accepted as a cause of congenital defects in pregnant women, another such finding is reasonable.

9.  From his initial lecture at the Royal Society of Medicine, Bradford Hill made it clear that the listed factors were not rigid or a checklist but were guidelines to inform epidemiological investigation. Of the nine viewpoints, temporality is the only one which is inarguable. Bradford Hill also reminded us of the play of chance and the utility of a test of statistical significance to prevent hasty conclusions on the generalisability of a finding in a single study. Over fifty years on, with a fuller understanding of genetics and molecular mechanism of diseases and enhanced analytical capabilities, the Bradford Hill viewpoints still remain the foundation of causal inference in medicine (5). These principles have informed the approach taken in this paper.

# Background to Cardiovascular Disease

**10.** The underlying pathology of coronary artery disease and ischaemic stroke is atherosclerosis, a generalised disorder of medium and large arteries, beginning in childhood, but usually taking at least thirty years to become symptomatic. It is due to inflammation and damage to the lining of involved blood vessels, notably the development of plaque. In turn this can lead to superimposed thrombosis, narrowing of vessels and decreased vascular reactivity, with reduced blood flow and oxygen supply to the heart, brain, lower limbs and gastrointestinal structures. Atherosclerosis is prevalent world-wide. Over the last thirty years the incidence has reduced, particularly in the US and western Europe, due, at least in part, to reduction in smoking, and effective treatment of hypertension. At the same time the increasing incidence of obesity and diabetes type 2 in these societies are maintaining factors and coronary disease remains the commonest cause of death in the UK and, across the world, a major cause of disability and care costs.

**11.** Atherosclerosis in the coronary arteries may be generalised, but if localised and large enough, a plaque may compromise blood supply to the heart muscle with development of angina on exercise. Plaques can also rupture acutely causing thrombus formation and consequent Acute Coronary Syndromes (ACS), which include myocardial infarction with potentially permanent heart damage and reduced function, heart failure, cardiac arrest or sudden cardiac death (6).

**12.** As well as age, sex and family history, modifiable and long-established classic risk factors for coronary disease include age, male sex, lack of physical activity, socio-economic group, cigarette smoking, a high calorie/high fat diet, obesity, hyperlipidaemia, hypertension, and diabetes. For these classic risk factors, relative and attributable risks have been calculated; there are risk calculators for particular populations and effective, cost-effective prevention strategies available at the individual and population level (7). However, these factors do not account for an individual's total risk. Some people with them do not develop clinical symptoms while others, apparently lacking the classic risk profile, become ill.

**13.** A potential link between emotion and the heart has been recognised for hundreds of years, and over the last thirty years more detail on constitutional and environmental factors and mechanisms has emerged. Advances in genetics, molecular biology and behavioural psychology have allowed the study of factors like the stress response, work related stress, social isolation, personality traits (including hostility and obsessiveness), and mental health symptoms such as anxiety and depression. In one 2004 study of almost 30,000 people from 52 countries, psychosocial factors accounted for about a third of the population attributable risk of heart attacks (8). Cardiac technology improvements (e.g. 24-hour Holter monitoring) have shown that acute psychological stress can give rise to objectively verifiable physical effects, increased blood pressure and heart rate, changes in arterial blood flow, haemostasis and the risk of arrhythmia (9).

# Epidemiology of Psychological Symptoms, Anxiety Disorders and PTSD

**14.** Stress, notably work-related stress, is common in our society and often cited in AFCS claims as a cause of disorders. A major controversy is its definition. The term has been used to describe both the event (difficulty or experience) which has led to the state of unease and the emotional state itself. The Health and Safety Executive defines stress as "the adverse reaction people have to excessive pressure or other types of demand placed on them" (10). Demands and pressure are part of life with, in all cases, an individual response. They may be a positive influence, eliciting greater effort and achievement, but they can also be threatening, while buffered by the person's coping resources and behaviour. Response

patterns depend on personality traits (e.g. a person may be predisposed to anxiety or hostility), previous experience of the stressful situation or something similar, and available social support in the aftermath of the stressor. These factors vary among people and may do so in the same person over time. It is when there is imbalance between demands and coping resources that distress results. Demands may be too great (or not great enough). Response will also differ dependent on the nature of the stressor (e.g. bereavement, combat, physical illness, debt, relationship breakdown, work related stress), when it occurs (in childhood or late life), its duration and severity (11).

15.  Common stress symptoms and signs, present immediately after a stressful period, represent exaggerated but normal physiological, biochemical, psychological and behavioural responses, e.g. sweating, tachycardia, feeling anxious, poor concentration, and difficulty sleeping. Stress symptoms may be short-lived and an appropriate reaction, but more discrete psychiatric disorders may develop over time (12). Stressor exposures are not associated inevitably with any one diagnosis, such as PTSD, but may give rise to depressive illness, anxiety state, adjustment disorder or PTSD.

16.  Psychological symptoms are common and may or may not be disabling. While the American Psychiatric Association's Diagnostic and Statistical Manual and the World Health Organisation's International Classification of Disease classifications provide published criteria for diagnoses of discrete mental health disorders, criteria in the two classifications for the same diagnosis are sometimes different and may also differ from one edition to the next. There are particular issues in the AFCS context in relation to diagnostic criteria for PTSD, which differ significantly in the classifications since 1980, when PTSD first appeared in DSM 111. DSM 5, published in 2013, reclassified PTSD as a "trauma and stressor related disorder" rather than an anxiety disorder. While the approach of DSM 5 is to lower the level of threat inherent in traumatic incidents, and expand the symptom criteria to include symptoms of co-morbid disorders, the criteria in ICD 11, introduced by WHO in May 2019 for adoption by January 2022, continue to focus on catastrophic traumatic events and the central role of re-experiencing symptoms and behaviour avoidance (13). Rates of anxiety disorders differ across the world. In high income societies, such as the USA, lifetime prevalence rates of anxiety disorders are typically around 30%.

17.  A particular issue within the literature on the connection between PTSD and cardiovascular disorders is the validity of the diagnosis of PTSD in studies. The accurate diagnosis of PTSD even by expert clinical examination is challenging because of the heterogeneity of the disorder, the revision of diagnostic criteria over time and by different classifications, and the high rates of co-morbidity with other disorders including mood disorder and substance misuse (14). PTSD is a multifactorial disorder with predisposing, precipitating and perpetuating factors. Many types of trauma can result in PTSD with a range of incidence and prevalence rates. In all societies the numbers exposed to severe traumatic events vary but are much higher than clinically diagnosed or "probable" PTSD rates.

# Epidemiology of Psychological Symptoms, Anxiety Disorders and PTSD in Military Personnel and Veterans

18.  As expected in selected, fitter than average military populations, rates of severe and enduring mental health disorders, such as schizophrenia, are lower in the UK military and veterans' populations than in the general community. Such conditions are unlikely to be caused by service. High alcohol consumption is commoner overall in the UK military community, than in the general population, although it has been reducing in recent years. Otherwise rates of common mental health symptoms and illnesses (i.e. anxiety and depressive disorders) are similar in the civilian and military communities and more common in the UK military population than PTSD (15). As with PTSD rates in the general community, US military rates of PTSD are higher than in the UK (16), (17). In the early years of the Iraq and Afghanistan conflicts, UK rates of military PTSD were similar to that of the general UK population, at about 4% but by the end of the British involvement in the Iraq and Afghanistan conflicts overall

prevalence of probable PTSD in the military was 6%, with an increase particularly notable in ex-serving personnel who had had a combat role (18). This legacy pattern is reminiscent of the post-Vietnam US experience. Stress, in particular work-related stress, with consequent symptoms rather than a discrete diagnosis also occurs in the armed forces but with few published studies.

# Stress and Psychological Symptoms, common Psychiatric Disorders and Consequential CVD

19. There is a large body of prospective research in civilian populations, including meta-analyses, exploring links between **work stress** and increased rates of coronary artery disease, stroke and cardiac arrythmia (19), (20). In general, these studies suggest an association between stress and CVD, but there are obvious biases and confounding, and issues about the generalisability of findings, especially in selected populations like the armed forces. Risk estimates may reflect factors that cluster in occupations. For example, people with certain personality types or predisposing vulnerabilities may be drawn to particular occupations.

20. **Anxiety disorders** are commonly co-morbid with each other and with depressive disorders. While amongst the most common mental health problems in our society, there have been relatively few studies on possible links between anxiety disorders and cardiovascular risk or stroke. In a 2010 meta-analysis of 20 studies, initially healthy but highly anxious individuals were at significantly increased risk of incident coronary artery disease and cardiac death (21). There is also evidence of increased all-cause mortality (22), (23).

21. A seven-year retrospective cohort study of US veterans found that anxiety disorders were a risk factor for incident myocardial infarction (Hazard Ratio (HR) 1.3; 95% CI 1.2-1.5), as was panic disorder (HR 1.4; 95% CI 1.1-1.8). These hazard ratios were reduced, but still significant, in the presence of depressive illness (24). A 2016 meta-analysis on risk of CVD in patients with anxiety disorders identified 46 cohort studies with 2,017,276 participants and 222,253 subjects with anxiety. Anxiety was associated with a significantly elevated risk of mortality due to any type of cardiovascular disease, coronary artery disease, stroke and heart failure (25). Other studies of mortality show mixed results. Some find increased recurrent cardiovascular events and mortality (26), while others record no effect (27), or even apparent protection (28). A Finnish study of 29,895 men and women similarly reported an association of any anxiety disorder and incident coronary artery disease over 7 years of follow-up (29). However, when adjusted for confounders and concurrent depression no significant associations remained.

22. Based on the US National Epidemiologic survey on alcohol and related conditions, Liu and colleagues have recently published a cohort study of 32,345 people, free of symptomatic **Coronary Artery Disease (CAD)** at baseline and followed up for three years (30). Those with (persistent) **General Anxiety Disorder (GAD)** (n 137), **Major Depressive Disorder (MDD)** (n 680), or both (n 877) at both baseline and follow up developed CAD more often than those free of these disorders (Relative Risk (RR) 2.1, CI 1.2–3.6, for GAD; RR 1.8, CI 10.3, 2.4 for MDD, and for both GAD and MDD, RR was 2.0, CI: 1.5–2.6). All regression models were adjusted for some lifestyle risk behaviours (e.g. smoking and alcohol), BMI, and hypertension. Those who developed one or both of these psychiatric disorders de novo by follow up at three years had similar relative risks of developing CAD. Those who recovered from one or both of these disorders had a smaller but still significant risk of CAD at follow up (RRs: GAD 1.7, MDD 1.4, GAD/MDD 1.4). The observational nature of this reduction means that it cannot be attributed to remission of the psychiatric disorder. In this study psychiatric disorders were diagnosed using a structured diagnostic interview. However, the diagnosis of CAD was made on the basis of patient report that their doctor had told them that they had had a "chest pain/angina pectoris or heart attack/myocardial infarction".

23. Considering **stress related disorders**, **notably Post Traumatic Stress Disorder (PTSD)**, multiple longitudinal studies following almost half a million participants over 2-30 years, and adjusted for clinical and psychosocial factors, calculated the hazard ratio (HR) between PTSD and acute incident coronary syndromes and mortality as 1.6 (CI 1.3-1.8). When adjusted for depression that fell to 1.3 (CI 1.1-1.5) (31). A recent population-based cohort study followed up 136,637 Swedish patients, diagnosed at a hospital as suffering from a stress related psychiatric disorder (acute stress reaction, adjustment disorder, PTSD) for a median of six years (32). There were two control cohorts: 171,314 unaffected siblings and 1,366,370 matched but unexposed controls. Compared to the two control cohorts, those with stress related conditions were significantly more often diagnosed with a cardiovascular disease (hypertension, ischaemic heart disease, arrhythmia, heart failure, cerebrovascular event, and cardiac deaths) (HRs of 1.3 and 1.4 respectively) in the following six years, particularly in the first year after diagnosis (HRs of 1.6 and 1.7 respectively). There were increased HRs for acute CVD events, such as cardiac arrest and acute MI. Controlling for comorbid psychiatric disorders, such as depressive illness, had no substantial effect on the HRs. This cohort study did not examine the classic CVD risk factors of smoking etc, so their mediating role in the association cannot be ruled out. It is important to note that the hazard ratios were similar across all the stress related diagnoses, rather than being highest for PTSD, so there was no severity related association with CVD. An association of PTSD with incident hypertension has been documented in US veterans, with small but statistically significant hazard ratios of between 1.1 and 1.3, depending on how hypertension was assessed. Treatment of PTSD was associated with less hypertension, but this was an observational finding, and not a randomised trial (33).

24. As well as a range of PTSD case ascertainment methods, many studies consider the association at only one point in the patient's life often many years before symptomatic CVD would be expected. The 2014 prospective cohort study of over 60,000 participants in the Millennium Cohort study investigated the effects of recent combat exposure and PTSD in young US service personnel following patients for 5.6 years (34). Those with combat exposure were more likely to have incident coronary heart disease (CHD), by self-report (OR 1.6) and by medical record (OR 1.9), compared with those deployed but without combat exposure. Adjustment for classic risk factors, PTSD, depression and anxiety attenuated but did not annul the association. PTSD was not associated with incident CHD in models adjusted for co-morbid psychiatric conditions. It is important in this study to note the relative youth of the cohort at baseline (mean age 34 years). It may be that any effect will take more time to manifest. Follow-up of this cohort continues.

25. Some studies have looked at PTSD and CVD using objective cardiovascular testing. The Vietnam Era Twin Registry study used positron emission tomography to examine 281 Vietnam era veteran twin pairs, mono- and dizygotic, of average age 48 years and followed over 13 years. Those with PTSD had twice the risk of coronary events during the 13-year follow-up, which was independent of traditional cardiovascular risk factors, depression or substance misuse (adjusted odds ratio (OR) 2.2) (35). The study compared PTSD discordant twin pairs who shared genetic, socioeconomic and childhood environmental factors. This only slightly reduced the association of PTSD and CVD outcomes. A further study of the same population measured carotid artery intima and media thickness. PTSD was associated with greater media thickness (36). This finding was not observed within twin pairs, whether mono- or dizygotic, suggesting it was determined by shared genetic and childhood environmental factors. Finally, a group of veterans from Department of Veterans Affairs medical centres were tested for myocardial ischaemia using exercise treadmill testing. Those with PTSD were more at risk of ischaemic changes, independent of traditional risk and other psychosocial factors (adjusted OR 2.24) (37).

26. Trauma related psychological symptoms and PTSD have been associated with risky lifestyle behaviours: e.g. smoking and difficulty giving up, lack of exercise, obesity as well as non-adherence to medication (38), (39). In a recent prospective study of 2,519 US veterans with PTSD, there was a significant association with CVD by four years follow up, compared to veterans without PTSD. This became non-

significant once confounders, such as comorbid metabolic, mood and substance misuse disorders and risk behaviours, such as smoking, were adjusted for. The authors concluded that these comorbid disorders and behaviours mediate the association between PTSD and CVD (40). A 2019 UK systematic review of 20 studies of CVD associated with PTSD in Iraq and Afghanistan male service personnel and veterans, again confirmed a positive association between PTSD and CVD, but also found associations with possible mediators, such as obesity, hyperlipidaemia, hypertension and smoking (41). Koenen and colleagues described the five different explanations of how PTSD and CVD might be related, only one of which is a directly causal relationship. The others were reverse causality, confounding, mediating, and birectionality (see glossary). They concluded: "At this writing, PTSD has not been established as a causal risk factor for CVD … from the perspective of the larger medical community" (42).

27. To summarise, significant associations have been found between acute stressors, anxiety disorders, PTSD and cardiovascular events. These associations are generally reduced but not always banished once confounders, such as behavioural risks, are considered.

# The Evidence on Possible Mechanisms Connecting PTSD and Cardiovascular Disease

28. Cardiovascular effects and exaggerated physiological responses have long been recognised to accompany stressful threatening events and experiences.  These return to pre-trauma levels quickly and by about a month after the trauma are back to normal. Exaggerated activity continues in some people, and this group may go on to develop PTSD. To date mechanisms which might connect PTSD and cardiovascular disease remain to be determined. The element most investigated is the **physiological and biochemical response to stress**, particularly the hypothalamo-pituitary-adrenocortical axis and the sympathetic adrenal medullary system. Much of this work is in animals, while most human studies are laboratory based, often restricted to investigation of the short-term effects of an acute single stressor, rather than a more physiological situation or considering the effects of a discrete psychiatric diagnosis.

29. An autonomic imbalance between the sympathetic and parasympathetic systems seems to be present in PTSD. A substantial amount of evidence replicated over many years suggests that PTSD, especially trauma cues, causes an increased responsiveness of the sympathetic nervous system. This is reflected in a high resting heart rate. In turn, in those with underlying cardiac disease, this has been observed to increase the risk of recurrent acute cardiac events and mortality (43). By contrast evidence suggests the parasympathetic response which normally dampens the sympathetic stress "fight or flight" reaction is inefficient in PTSD. Heart Rate Variability (HRV) is a useful measure of the balance between sympathetic and parasympathetic activity and reduced HRV has been associated with PTSD on 24-hour Holter monitoring (44). Baroreflex dysfunction and increased Q-T intervals have also been reported in those with PTSD. If chronic, these changes may lead to cardiac ischaemia and increased risk of incident and recurrent coronary artery events (45). Prolonged Q-T interval may predict sudden cardiac death (46).

30. In terms of Hypothalamic-Pituitary-Adrenal (HPA) activity, while patients with PTSD have a lower basal cortisol output, they have an enhanced cortisol response to stressor challenge. HPA dysregulation has been implicated in heart failure, cardiac ischaemia and cardiac mortality and also affects blood pressure and clotting (47). For most people the cortisol response returns to normal within a month of exposure to an acute stressor, but for those who develop PTSD, an exaggerated response continues (48). When sustained, the increased cardiovascular effort associated with the HPA activity leads to an inflammatory state, endothelial dysfunction and worsening atherosclerosis, raised blood pressure and cardiac ischaemia. This sequence of events has been confirmed in PTSD, with decreased dilatation of blood vessels and reduced blood flow in the brachial artery (49).

31. The second possible mechanism connecting PTSD and CVD is inflammation. Numerous studies have suggested **raised levels of inflammatory bio-markers** in patients with PTSD (50). Results are conflicting regarding C Reactive Protein (CRP), with Passos and his group finding no raised level in PTSD (51), while a contemporary study reported that serum CRP level was associated with PTSD severity, and genetic variation in the CRP gene (52). CRP is released by adipose tissue, so it may be relevant that US service personnel and veterans with PTSD symptoms, in the Millennium cohort study mentioned above, were more likely to gain 10% or more in weight at follow up (adjusted ORs of between 1.3 and 1.5 depending on current diagnosis) (53). There is also a report of raised inflammatory pathways in those with PTSD (54).

32. The experimental approach to investigating the relation between PTSD and CVD is to study the **impact of preventing or treating the PTSD** on the development of the CVD. The gold standard in treatment studies is the randomised controlled trial (RCT). Unfortunately to date there have been no randomised controlled trials of treatment of PTSD which examine cardiovascular disease or related mortality as a long-term outcome. Encouragingly, 2,457 Israeli veterans, who had been treated for mainly combat related PTSD, had a similar age adjusted all-cause mortality rate when compared with veterans without PTSD (HR 0.73, CI 0.4–1.0, p = 0.26) in a matched cohort study (55).

33. Written in the context of a selected young fit armed forces population this IMEG review has not discussed the substantial evidence on the now generally accepted causal links between childhood stress and adversity, especially multiple adverse childhood experiences which tend to co-occur and lead to early damage to health  including development of atherosclerosis and symptomatic cardiovascular disease in middle life (56),(57),(58). Other factors associated with poor physical health and premature mortality include social isolation and loneliness in older age adults (59), and in those with severe and enduring metal illness (particularly psychotic disorders such as schizophrenia and bipolar disorder) (60),(61).

34. To summarise, there is evidence for the biological plausibility of the associations between PTSD and CVD, but experimental evidence of its causal impact is weak or absent.

# Depressive Symptoms and Discrete Diagnosable Disorders

35. As in the wider community, depressive illness is common in armed forces personnel, either on its own or co-morbid with other disorders including PTSD and substance misuse. The link between depression and cardiovascular disease in people with existing cardiac disorders has been extensively studied. If present, depressive symptoms or a discrete disorder can indicate poorer cardiac prognosis and poor health-related quality of life (62). Risk factors linking depression with poor prognosis in patients with cardiac disorders include behavioural and biological factors, such as poor adherence to risk reducing lifestyle behaviours (63). In 2014 the American Heart Association issued a scientific statement recommending that depression be considered a risk factor for poor prognosis in acute coronary syndrome survivors (64).

36. In terms of the relationship with incident CVD, a 2006 meta-analysis found that depression was significantly associated with incident coronary heart disease (pooled HR from 21 studies was 1.8), but the authors noted significant heterogeneity across these studies; with six finding no significant association (65). A meta-analysis has also found evidence of an association between depression (by self-report scale or clinician diagnosis) with incident cerebrovascular disease (pooled adjusted HR from 28 studies was 1.45), but again with significant heterogeneity noted between studies (66). The evidence of a causal link to hypertension is less clear cut (67), (68). The Whitehall 2 study suggested a dose response relationship between depressive symptoms and major cardiac events (cardiac

death and MI), but reverse causality with cerebrovascular disease (69). Cohen and colleagues in their 2015 state of the art review noted the consistent association between depression and CVD, but that underlying mechanisms to explain the increased incidence of CVD or worse prognosis remain unclear. Adjusting models for behavioural risk factors, such as smoking, reduces but does not entirely remove the significant association (70).

# Treatment Studies of Depressive Illness

**37.** In our review of the links between depression and cardiovascular disease, the paucity of RCTs was notable. The best-known study reviewed was the Enhancing Recovery in Coronary Heart Disease (ENRICHD) trial (71). 2,481 myocardial infarction patients were recruited into a trial of CBT versus usual care. At 29 months follow up, there was no difference in cardiac events between groups. A secondary analysis suggested a protective effect of taking SSRIs. This latter finding was a post hoc analysis, so confirmation is required by an RCT. A 2016 RCT found no significant effect of the antidepressant escitalopram versus placebo on either mortality or hospital admissions in 372 patients with both depression and heart failure (72). Another RCT published in 2018 looked at the effect of depression treatment with escitalopram compared with placebo, on the long-term cardiac outcomes in patients with ACS and found a protective effect (73), while Rajeswaran's 2018 systematic review of the effects of antidepressant medication in patients with heart failure again found no protective effect (74). A cohort study of 4,067 patients with acute myocardial infarction found elevated risk of one-year mortality in those depressed versus those without depression but no increased mortality in those whose depression was treated versus those without depression (75). However, this was again not a randomised controlled trial (RCT), and therefore subject to confounding, so one cannot conclude that treatment of depression was responsible for reducing the risk.

**38.** To our knowledge, there has been only one trial of treating depressive illness in those without heart disease, examining incident cardiac events as later outcomes. The IMPACT trial of 235 depressed elderly primary care attenders (with or without symptomatic cardiac disease), found a significant reduction in cardiac events in those who did not initially have cardiac symptoms and who had received the active intervention of collaborative care with antidepressants and psychotherapy versus usual care (28% vs. 47%, HR = 0.5, 95% CI: 0.3–0.9). Cardiac outcomes were no different in those with already established heart disease (76).

**39.** The recently reported multicentre FOCUS trial involved 3,127 adult patients at 103 UK hospitals (77). Eligible patients had a diagnosis of a clinical stroke and focal neurological deficits. Between 2 and 15 days after onset, they were randomly assigned to 20 mgm. of fluoxetine or placebo once daily for six months. The primary outcome was functional status assessed at 6 and 12 months after allocation. Patients who had fluoxetine were less likely to develop depression (13%) than those who had placebo (17%), but they had more bone fractures. No other functional outcomes were impacted. The results do not support the routine use of fluoxetine to prevent post-stroke depression or improve functional status.

**40.** In summary at this date, preventing or treating depression seems to have little effect on cardiovascular events, mortality or function, at least in those with established heart or cerebrovascular disease, although these results need to be considered in light of the challenges of treatment for depressive illness even in the absence of other pathologies (78), (79).

# Triggers of Acute Coronary Syndromes (ACS)

**41.** In AFCS, claims for Acute Cardiac Syndromes (ACS) triggered by service -related physical or emotional stress or anger are not uncommon. These occur predominantly in serving middle-aged personnel in

whom atherosclerosis has developed but without symptoms and undiagnosed. Previous studies have suggested anger and or physical exertion may trigger acute myocardial infarction, but studies have been small and carried out in a single country or region. The 2016 INTERHEART case control study of 12,461 cases of first acute myocardial infarction (AMI) included men and women of all ages (mean age 58 years) and from 52 countries; it considered the effects of physical exertion, anger and emotional upset on first AMI. The study design was case crossover and first AMI was the outcome, diagnosed by typical symptoms and ischaemic ECG changes occurring within one hour of a trigger. 13.6% cases had engaged in physical activity and 14.4% were angry or emotionally upset in the hour before symptom onset. Physical activity was associated with an increased odds of AMI (OR 2.3, CI 2.0-2.7). Anger or emotional upset was associated with an OR of 2.4 (CI 2.1-2.9). These effects were not modified by geographical region, prior cardiovascular disease, prevention medication, classic risk factors, time of day or day of onset of AMI. When both physical activity and anger or emotional upset were present in the hour before the AMI the OR was 3.1 (CI 2.3-4.1) (80).

# Conclusion of Expert Organisations

**42.** In 2014 the American Heart Association (AHA) said "stress is not a confirmed risk factor for …. heart disease and has not been proven to cause heart disease" (81). More recently the 2019 American College of Cardiology (ACC)/AHA primary prevention of cardiovascular disease guideline does not include psychosocial factors, mental health symptoms or discrete diagnoses within its scope (82). The 2016 European guidelines on cardiovascular disease prevention in clinical practice similarly does not discuss mental health symptoms and discrete disorders but includes a section on psychosocial risk factors. On the basis of "limited evidence", the guidelines recommend that psychosocial risk factor assessment should be considered to identify possible barriers to lifestyle change or adherence to medication, but only in individuals already at high risk of cardiovascular disease or with established cardiovascular disease (83).

# Conclusion and Recommendations on the Relationship between Stress, Psychiatric Symptoms and Discrete Disorders and Cardiovascular Disease in the AFCS

**43.** So how does present evidence map on to Bradford Hill's viewpoints? We have reviewed evidence that supports four of the nine viewpoints; namely consistency of the associations, coherence with current understanding, temporality in that at least the clinical outcomes of CVD followed the stressor, and plausibility in that there are known pathophysiologies that might explain the association. The strength of the association is partially supported, but reduced once confounders are considered. There is mixed evidence for a biological gradient ie dose response relationship. We suggest the current evidence does not support the other three viewpoints. The association is not specific, since different psychiatric disorders are associated with several cardiovascular events. Alternative explanations are available, such as lifestyle risk behaviours. Analogy is not met because although causal links between stress, psychiatric symptoms and discrete disorders and other disorders (e.g. cancer, autoimmune conditions and multiple sclerosis) and causes of mortality have been proposed and investigated, the studies have similar limitations to the cardiovascular research. Finally, experimental evidence of a reduction in risk after treatment is weak or absent. If one considers the most important viewpoints noted by Bradford Hill, consistency is supported, as is biological plausibility. Temporality is supported, but only at a clinical level, since pathology of heart disease may precede clinical events by decades. The strengths of the associations are relatively weak, with hazard and other ratios around two or less, which are either

diminished or banished by confounders. The exposure response gradient is inconsistent, and analogy and experimental data are predominantly absent or negative.

**44.** Based on the contemporary evidence we make the following findings and recommendations: -

(i) Considered against the Bradford Hill viewpoints, present evidence and expert opinion does not support a direct causal association between psychosocial factors such as stress, mental health symptoms and discrete psychiatric disorders, including PTSD, and incident cardiovascular disease. In terms of AFCS claims and appeals PTSD is the most frequently claimed and awarded psychiatric diagnosis. More research is needed on PTSD prevention and treatment, the effect of PTSD on CVD risk markers and risky behaviours and how these might change when PTSD is treated or remits. The Vietnam Era Twin study also suggests a need to further explore genetic factors shared between PTSD and CVD, and finally more work is needed on possible mechanisms.

(ii) Observational evidence is that chronic stress in adulthood and discrete psychiatric disorders have an observed association with incident cardiovascular disease, but the effect is small and inconsistent, studies have limitations as discussed above and the association is not presently recognised as causal among international cardiology experts. For compensation purposes each case should be considered on its merits. In most cases we judge medical advice will be helpful in reaching a robust defensible decision.

(iii) For people with established but asymptomatic atherosclerosis affecting the coronary arteries, acute stress – physical or emotional in the preceding hour – can trigger a first AMI. Where a member of the armed forces is subject to acute severe service-related physical or emotional stressor within one hour of an AMI, and there is documented confirmatory contemporary evidence, this will be accepted, on balance of probabilities, as due to service where AFCS service is judged the predominant cause. Assessment and award should reflect the circumscribed disabling functional effects arising from that single event and within close time interval, not all future atherosclerotic cardiovascular disabling effects.

(iv) The armed forces are a selected population, young and fitter physically and mentally than the age and sex matched general community sample and symptomatic cardiovascular disease is rare in service. However, by its nature atherosclerosis begins in childhood with development of symptoms and disorders much influenced by the classic risk factors, many of which can be prevented or treated. We note and strongly support the Defence Health and Well Being strategy commitments on lifestyle, including exercise, healthy eating, weight management, smoking and alcohol, and the initiatives on good mental health (60). Applicable to the whole force, these will all contribute to better quality of life and enhanced well-being and to reduction in cardiovascular disorder, disability and death including in those where mental health factors are relevant.

(vi) We will continue to monitor the literature.

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# Annex A

## Glossary

**BIAS**. Deviation of results or inferences from the truth, or processes leading to such systematic deviation. Any trend in the collection, analysis, interpretation, publication, or review of data that can lead to conclusions that are systematically different from the truth.

**CASE-CONTROL STUDY**. A type of observational analytic study. Enrolment into the study is based on presence ("case") or absence ("control") of disease. Characteristics such as previous exposure are then compared between cases and controls.

**COHORT STUDY**. A type of observational analytic study. Enrolment into the study is based on exposure characteristics or membership in a group. Disease, death, or other health-related outcomes are then ascertained and compared.

**CONFIDENCE INTERVAL**. A range of values for a variable of interest, e.g., a rate, constructed so that this range has a specified probability of including the true value of the variable. The specified probability is called the confidence level, and the end points of the confidence interval are called the confidence limits.

**CONFOUNDER**. A confounding variable is an "extra" variable that you didn't account for. ... Confounding variables are any other variable that also has an effect on your dependent variable. They are like extra independent variables that are having a hidden effect on your dependent variables.

**INCIDENCE RATE**. A measure of the frequency with which an event, such as a new case of illness, occurs in a population over a period of time. The denominator is the population at risk; the numerator is the number of new cases occurring during a given time period.

**MEDIATION ANALYSES**. are employed to understand a known relationship by exploring the underlying mechanism or process by which one variable influences another variable through a mediator variable. Mediation analysis facilitates a better understanding of the relationship between the independent and dependent variables when the variables appear to not have a definite connection. They are studied by means of operational definitions and have no existence apart.

**MEDIATION STATISTICS**. A mediation model seeks to identify and explain the mechanism or process that underlies an observed relationship between an independent variable and a dependent variable via the inclusion of a third hypothetical variable, known as a mediator variable (also a mediating variable, intermediary variable, or intervening variable). Rather than a direct causal relationship between the independent variable and the dependent variable, a mediation model proposes that the independent variable influences the (non-observable) mediator variable, which in turn influences the dependent variable. Thus, the mediator variable serves to clarify the nature of the relationship between the independent and dependent variables.

**META-ANALYSIS**. A method often used in systematic reviews to combine results from several studies of the same test, treatment or other intervention to estimate the overall effect of the treatment.

**PREVALENCE**. The number or proportion of cases or events or conditions in a given population.

**RANDOM SAMPLE**. A sample derived by selecting individuals such that each individual has the same probability of selection.

**RANDOMISED CONTROLLED TRIAL**. A study in which a number of similar people are randomly assigned to 2 (or more) groups to test a specific drug, treatment or other intervention. One group (the experimental group) has the intervention being tested, the other (the comparison or control group) has an alternative intervention, a dummy intervention (placebo) or no intervention at all. The groups are followed up to see how effective the experimental intervention was. Outcomes are measured at specific times and any difference in response between the groups is assessed statistically. This method is also used to reduce bias.

**RELATIVE RISK**. A comparison of the risk of some health-related event such as disease or death in two groups.

**RISK RATIO**. A comparison of the risk of some health-related event such as disease or death in two groups.

**STANDARD DEVIATION**. A measure of the spread, scatter or variability of a set of measurements. Usually used with the mean (average) to describe numerical data. The most widely used measure of dispersion of a frequency distribution, equal to the positive square root of the variance.

# Topic 4 - Musculoskeletal (MSK) Disorders Part 2

## Key Points

**1.** Musculoskeletal (MSK) Disorders Part 2 has two sections, A and B. Section A covers general aspects of MSK disorders in the UK military at this date; the challenges of recruitment and retention, gender issues, medical downgrading and discharges, AFCS compensation awards and occupational aspects of MSK disorders.

**2.** Section B comprises summaries of disorders seen in military practice, with definition, a brief description of clinical features, aetiology, prevention, best practice clinical management and prognosis.

**3.** MSK disorders are the most common category in military populations often leading to medical downgrading and discharge. Between 1 April 2018 and 31 March 2019 there were 1,869 medical discharges from the UK armed forces made up of 391 from the naval service (RN and RM), 1,316 from the army and 162 from the RAF. This equates to rates of 12 per 1,000 for the naval service, 17 per 1,000 for army and 5 per 1,000 for RAF (1).

**4.** "At risk" age groups are for the naval service, 25-34 years, for the army, 20-24 years and for the RAF, 45-49 years.  In line with this age distribution, discharge from the army is high in untrained personnel with short service. Since AFCS began in April 2005, awards for MSK diagnoses account for 45% of total awards made, and 51% of awards made in 2018/19.

**5.** To understand the generation of pain from affected musculoskeletal structures and why pain in these disorders so frequently becomes chronic, even when objective signs and radiological findings are minimal or absent, a brief overview of pathophysiological evidence is included. This considers local abnormalities in affected structures, the role of the peripheral nervous system in signalling pain, and the increasing evidence on the part which may be played by consequent changes in the central nervous system. Wider aspects of chronic pain and its co-morbidities and its diagnosis, treatment and rehabilitation are also considered.

**6.** Pain is the leading symptom and cause of disabling effects in MSK disorders. A key aim of treatment is that the patient should be able to accept and manage his pain. Multidisciplinary approaches including psychological therapy are key, and clinical management to reduce pain and/or improve function, education to inform about the disorder and emphasise the positive effects of maintained activity, especially work activity, are the norm.

## Introduction

**1.** This report follows from Musculoskeletal (MSK) Disorders Part 1 published as part of the Fourth IMEG report, December 2017. In AFCS compensation many MSK disorders (Tariff Table 9) arise over time from overuse or repetitive attrition damage rather than from a discrete physical traumatic injury listed in Tariff Table 2, Injuries, wounds and scarring. Musculoskeletal (MSK) Disorders Part 2 has two sections, A and B. Section A covers general aspects of MSK disorders in the UK military at this date; the challenges of recruitment and retention, gender issues, medical downgrading and discharges, AFCS compensation awards and occupational aspects of MSK disorders. Because pain is the leading

symptom and cause of disabling effects in MSK disorders, an overview is also included. Section B comprises summaries, with definition, a brief description of clinical features, aetiology, prevention, best practice clinical management and prognosis, on a further list of specific injuries seen in the military context. As previously, the report is informed by literature scrutiny and discussion within the group and with military and civilian clinical experts on the various topics.

# Background

2.  MSK disorders are common across the age groups in Western societies but are a particular issue amongst working age adults and a major cause of sickness absence and ill-health retirement in civilian society despite the reduction in physical workloads. Similarly, MSK disorders continue to be the most common category of injuries in military populations often leading to medical downgrading and discharge. Between 1 April 2018 and 31 March 2019 there were 1,869 medical discharges from the UK armed forces made up of 391 from the naval service (RN and RM), 1,316 from the army and 162 from the RAF. This equates to rates of 12 per, for the naval service, 17 per 1l000 for army and 5 per 1,000 for RAF (1). For all three services, groups at significantly higher risk of medical discharge include women and other ranks. "At risk" age groups are for the naval service, 25-34 years, for the army, 20-24 years and for the RAF, 45-49 years. In line with this age distribution, discharge from the army is high in untrained personnel with short service. Given the demanding physical requirements of army and RM training these facts are not unexpected, especially against a background of societal change with decline in school team games and less physically active adolescent recreational pursuits. In all three services the main cause of medical discharges remains MSK disorders. In some cases, MSK disorders are accompanied by a mental health disorder, with both disorders contributing to the need for medical discharge. In 2018/19 MSK disorders made up 56% of naval service and army discharges and 49% RAF discharges. Back and knee disorders are the most common diagnoses.

3.  MSK awards continue to be the most common category of injuries awarded under the AFCS, particularly in the army (2). Since the scheme began in April 2005, they account for 45% of total awards made, and 51% of awards made in 2018/19. Although the most commonly awarded disorders in terms of lump sums, MSK descriptors accounted for only 14% of Guaranteed Income Payments (GIP). This reflects the high physical fitness requirements of service compared with civilian work and the fact that Defence and single service policy is to accommodate personnel with disability or chronic illness by fully exploring possible alternative roles ahead of service termination. In some services, e.g. Royal Marines (RM) and parachute regiments, military options are limited, although the person may be functionally capable of a range of suitable full-time civilian work, where the Equality Act and the employer requirement to make reasonable adjustments to support his or her being in work, may apply.

4.  While some MSK disorders which occur in the military are well defined with known clinical course, accepted best practice management and swift return to training or duty, many of the most common problems, typically affecting knees are much less matters of consensus in terms of most appropriate investigation, definitive diagnosis, recognised effective treatment and successful outcome. Terms still common in military practice but less used in civilian orthopaedic and sports injuries include anterior knee pain and chondromalacia patellae. In recent years, as in civilian practice, the use of MRI has become almost universal although many pathologies reported on scans are not confirmed on direct arthroscopic inspection. Over-reliance on MRI scans to inform clinical management may impact recovery, which may be incomplete and prolonged, with medical downgrading and ultimate discharge. This may result in long term compromise and cost to military operational capability, disruption and detriment to the person and his family, and post service civilian employability.

5. In terms of treatment, surgery has a limited role in overuse injuries. Physical therapies are first choice based on exercise, massage and medication, with surgery usually only considered when disorders remain resistant to conservative treatment. There is a lack of treatment evaluation studies and for some common injuries and disorders individual specialists use different diagnostic terminology and vary in their recommendations for the range of possible treatments and timelines for more specialist referral. To address some of these issues and better standardise Defence care, Defence Primary Health Care (DPHC) has developed best practice clinical guidelines and quality standards on a range of topics, e.g. exercise induced leg pain. Regardless of specific diagnosis, common principles apply with management first in primary care including at Primary Care Rehabilitation Facility (PCRF). If at a certain interval, (e.g. six or twelve weeks), progress is limited, then the guidance will suggest onward referral to the Regional Rehabilitation Unit (RRU) and, dependent on further progress, patients may be seen at the Defence Medical Rehabilitation Centre, (DMRC) Stanford Hill.

6. Where progress and recovery from MSK disorders are slow there may be a need to confirm the diagnosis, with exclusion of other pathologies and systemic disorders. Evidenced best practice guidelines stress the need to be alert to symptoms or physical signs which suggest serious underlying pathology. For MSK disorders these may include fever, skin erythema, history of weight loss, a mass or swelling over soft tissue or bone, intense bone pain, and particularly in relation to low back pain, symptoms of bladder or bowel disturbance and the presence of focal neurological signs. Important disorders to exclude include deep vein thrombosis, acute compartment syndrome, osteomyelitis, bone tumours and compression of spinal nerve roots (3).

7. Physical disorders or injury often have emotional sequelae and patients may be anxious or low in mood. Relevant psychosocial factors may include attitudes and beliefs, comorbid discrete psychiatric disorders, unresolved financial compensation, work issues (including poor job satisfaction, alleged lack of peer or management support, complaints of bullying or harassment) and family attitudes, which may be critical or overprotective. Clues that psychosocial factors may be hindering progress include complaints of prolonged pain, sometimes associated with other sensory or motor symptoms, but without consistent objective neurological signs being found at different examinations. A tendency to catastrophize may induce a fear that movement or activity will cause worsening, with over-reliance on aids and appliances, adoption of a disabled lifestyle of prolonged incapacity, overall decline in fitness and failure to return to work either in the military or the civilian community. Pain cannot always be effectively relieved, and a key aim of treatment is that the patient should be able to accept and manage his pain. Multidisciplinary approaches including psychological therapy are key, and clinical management to reduce pain and/or improve function, education to inform about the disorder and emphasise the positive effects of maintained activity, especially work activity, are the norm.

8. As well as discrete diagnosed disorders, MSK aches and pains, often recurrent and without objective signs or imaging abnormalities are a particular issue amongst the working age population and, both in civilian and military populations, because they may impact working capacity at least temporarily, and it is commonly believed that these are traumatic physical injuries caused by work. Focus on prevention and clinical management has failed to substantially reduce incidence and prevalence of disabling MSK symptoms, and it is increasingly clear that psychosocial factors are relevant with the best practice approach, collaboration between patient, clinicians, and the management or chain of command. Wherever possible, workplace or task modification should support maintaining the person in work or expediting their early return.

9. Many aspects of UK military MSK problems, downgrading and discharge etc are common globally. At a time when young people's choice of career routinely takes into account lifestyle, family and work life balance, recruitment and retention in the military can be challenging. Other factors include the changing shape of war, with more reliance on technical expertise as opposed to physical prowess and the need to reflect equality and diversity principles. There remains much debate about required mental and physical fitness standards, including whether these should be generic, regardless of gender and

related to combat roles or otherwise occupation specific. Training programmes and how fitness might most effectively and efficiently be achieved and maintained over time are also subjects of discussion. In terms of physical requirements, the physiology, muscle composition and bone density of the genders differ, and UK data confirms higher rates of MSK overuse injury in women, at a time when most armed forces aspire to an increasing proportion of women, with the option of traditionally male roles e.g. in front line combat. In training, "gender free" policies have been trialled where similar fitness levels are required of both men and women. As expected, this leads to higher female discharges for MSK overuse injuries. The alternative "gender fair" policies adopt lower entry and retention standards for females compared with males and while discharges for overuse injuries amongst women compared with men may be lower than with "gender free", the experience is that discharge rates are still higher than for men (4). These approaches illustrate the conflict between health and safety and equality legislation and make the point that selection tests and standards should take into account gender difference.

10. Beyond gender there are more general issues about MSK injury in initial military recruit training across the world, with some studies recording 60-70% of trainees being injured in the initial eight-week period (5), (6). Not only do we need consistent best practice management of injury and disorder, but prevention measures, including well designed training programmes are key. Programmes should reflect the overall reduced levels of fitness of young people today, changing gender balance amongst entrants and service occupations. Both best practice clinical management and injury prevention are informed by data on specific injury type and incidence and rehabilitation times.

11. Such studies were recently carried out in British army recruits at Catterick Infantry Training Centre. The first was a prospective study of diagnoses, giving specific incidence and rehabilitation times (7). Over a two-year period in 2006-2008, 6,608 military recruits were followed up. The overall incidence of MSK injuries in the 26-week initial training period was 49%. The most common diagnosis was iliotibial band syndrome (6%) and a significant proportion of injuries occurred in the first week of training. The longest rehabilitation times were for stress fractures of the femur (mean 116 days with standard deviation (SD) 17 days), calcaneus (mean 92 days with SD 12 days and tibia (mean 85 days with SD 11 days). Medial tibial stress syndrome accounted for almost 20% of days spent in rehabilitation. The second study was retrospective and considered the incidence of MSK injuries and training outcome in different infantry regiments over five consecutive training years (2013-2017) (8). From a total of 12,501 recruits there were 4,777 injuries. Overuse injuries were the most common, mainly affecting the lower limb and especially the knee. Almost half the total injuries occurred during the first eight weeks of training. Successful training outcome varied widely across the different regiments e.g. Parachute regiment 37%; Guards 53%; Line regiments 65%; and Ghurkha's 98%.

12. Prevention measures for training injuries divide into extrinsic and intrinsic. Extrinsic factors relate to the training programme itself and include footwear, hard surfaces, failure to warm up, cold weather training, too rapid increase in training intensity and its maintenance at a high level especially where there is no prior experience of such training. Intrinsic factors are about the individual e.g. BMI (body mass index), pre-injury level of fitness, pre-service injury or congenital biomechanical abnormality. MSK disorders also occur in all other groups of service personnel and some services, corps and regiments are innately more physically demanding, such as RM, commando and parachute regiments. Personality and behavioural issues are also important, with desire for career progression or to deploy, often leading to delay or failure to present MSK symptoms early or continuing at a high level of physical training when rest and activity reduction have been advised.

13. It is sometimes assumed that armed forces' service in any capacity is innately very physically demanding and, even without significant discrete traumatic physical injury, likely to lead to overuse attrition-related damage and osteoarthritic change in joints. As always there are limitations due to study design, size, selection bias etc, but overall, the extensive evidence from international civilian occupational studies in heavy industry, e.g. construction and mining, does not confirm inevitable

disabling degenerative change over time (9). Civilian study subjects' work pattern centres on the same tasks and activity for around 40 hours a week, 45 weeks a year for many years, a rather different pattern from military service. Similarly, sporting studies up to elite level do not consistently support degenerative change in the absence of documented traumatic physical injury (10). In terms of compensation under AFCS, all cases are considered on their individual specific facts including type, duration and activities of service, whether there are documented injuries, the applicable legislation and contemporary accepted medical understanding of causation progress and likely outcome, including best practice treatment. Where, on balance of probabilities, AFCS service is the predominant cause of the claimed disorder, an award will be madeand with military and civilian clinical experts on the various topics.

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## Pain in Musculoskeletal Disorders

**14.** To understand the generation of pain from affected musculoskeletal structures and why pain in these disorders so frequently becomes chronic, even when objective signs and radiological findings are minimal or absent, a brief overview of pathophysiological evidence follows. This is a technical and complex topic, and a more detailed discussion is given in Wall and Melzack's Textbook of Pain (2013) 6th edition (1). This overview considers local abnormalities in affected structures, the role of the peripheral nervous system in signalling pain, and the increasing evidence on the part which may

be played by consequent changes in the central nervous system, in particular, central sensitization. Wider aspects of chronic pain and its co-morbidities and the benefits of a biopsychosocial approach to diagnosis, treatment and rehabilitation are also considered.

15. Pain has been defined as "an unpleasant sensory and emotional experience associated with acute or potential tissue damage or described in terms of such damage" (2). Acute pain has a key bioprotective function, alerting an individual to the presence of injury, and prompting appropriate action. Following an injury, in the short term, continuing pain may protect the injured body part by causing immobilization of the affected part, with avoidance of further injury and promotion of healing. Peripheral sensory nerves signal acute pain. With skin injury, there is usually precise localisation of the injury, but deep injury to muscle, joints, fascia and bone is often less well localised.

# Nociceptive and Inflammatory Pain

16. Nociceptive pain is pain that is detected by nociceptors, which are small diameter myelinated nerve fibres and unmyelinated nerve fibres and their terminals in peripheral tissues. These fibres respond specifically to high threshold, potentially tissue-damaging stimuli. Following injury in which there is tissue damage, an inflammatory response develops. In the skin, this is obvious, as with an insect bite or sunburn. In deep tissues there is often no obvious sign other than limited mobility and pain provoked by use of the affected part. An inflammatory response to injury is normal and potentially completely reversible with healing of the injury. This inflammatory response leads to "primary hyperalgesia" in which the threshold of nerve fibres to stimulation is decreased, so that normally non-painful stimulation is perceived as being painful (allodynia), and ongoing pain at rest may develop. The cascade of injury-related chemical changes in acute inflammation is complex with, within a few minutes of acute injury, release of inflammatory substances including bradykinin, prostaglandins, and histamine and serotonin from circulating mast cells and platelets (3). In primary hyperalgesia the heightened pain and tenderness is fairly well-localised to the injured tissue. With a persistent intensely painful stimulus, over minutes and hours secondary hyperalgesia develops, in which pain, tenderness and allodynia spreads well beyond the region of the original injury (4). This involves spinal cord mechanisms, notably central sensitisation, described below.

# Neuropathic Pain

17. Neuropathic Pain is pain is caused by trauma or disease-related damage to the somatosensory system, comprising peripheral sensory nerves, and sensory pathways in the spinal cord and brain (5)(6)(7). The practical consequence of this definition is that in order to label pain as being neuropathic, there must be clinical evidence of a lesion in some part of this system. In other words, a neurological diagnosis is required. This can be challenging clinically, because sensory deficits and associated neuropathic signs may be subtle and difficult to detect. Diagnosis may be improved by specialist investigation such as quantitative sensory testing, histological examination of biopsies for nerve fibre density, and identification of abnormal ion channels as in some small fibre neuropathies (8). Persistent pains of obscure origin are sometimes labelled as being neuropathic in the absence of a rigorous clinical approach to diagnosis. This is unhelpful, particularly for the individual mis-diagnosed with such pain, because subsequent treatment may be inappropriate and less successful.

18. Chronic nociceptive pain is potentially completely recoverable, while the same may not be true for many patients with neuropathic pain. It has long been recognised that neuropathic pain is associated with a poorer prognosis, and the reasons for this are now becoming clearer, largely through experimental investigations (9). A range of abnormal properties may develop following primary damage to peripheral and central nervous system sensory pathways involved in pain transmission. These include ectopic impulse generation (spontaneous activity unprovoked by peripheral

stimulation) in damaged peripheral nerve fibres; abnormal chemical sensitivities of damaged fibres; electrical cross-talk between damaged nerve fibres; hyperexcitability of second order receiving neurons situated in the dorsal horn of the spinal cord; and regenerative nerve fibre sprouting. This may lead to aberrant and potentially irreversible reconnection, causing peripheral nerve fibres normally signalling information provoked by non-painful stimuli to lead to painful sensations. In addition, the normal descending inhibitory pathways for pain, originating in the brain stem, that are activated by incoming painful stimuli, become less effective, increasing the perception of pain. These peripheral nervous system and spinal cord abnormalities may further induce abnormalities at higher levels in the central nervous system including the thalamus and cortical areas involved in pain perception (10),(5).

19.    This brief account of the neurophysiology of neuropathic pain provides the basis of an explanation for its poor prognosis. If irreversible changes in neural connectivity have become established, it is not surprising that standard pain treatments may have limited efficacy. In the case of nociceptive pain, hyperalgesia, allodynia and central sensitization (described in paragraph 20) are essential features, in which the nervous system responds in a normal bioprotective fashion. If the peripheral cause of the pain can be treated or recovers spontaneously, the nervous system reverts to a normal state. If this were not the case, each new injury or other cause of pain experienced would result in a gradually increasing pain state during life, which is clearly not the case. It is emphasised that all the MSK conditions discussed in Section B of this paper give rise to nociceptive pain, except where specifically noited.

## Central Sensitization

20.    In musculoskeletal pain, and more generally in patients with chronic pain of benign origin, there is often a disparity between the intensity of the reported pain and the demonstrable severity of tissue damage. One reason for this mis-match is central sensitization, that is, the amplification of central nervous system sensory signalling, an "increased responsiveness of nociceptive neurons to their normal or subthreshold input" (11). Although there is extensive experimental evidence indicating likely mechanisms of Central Sensitization (CS), clinical evidence is less complete and as yet, there is no applicable agreed method or guideline for its definitive diagnosis (12). The term was first used to describe a single specific spinal cord mechanism, for clarity, referred to here as spinal CS (10).

21.    Under experimental conditions, activation of sensory unmyelinated C-fibres is needed to induce CS; the noxious stimulus has to be intense, repeated and sustained over at least tens of seconds. Peripheral tissue injury is not necessary, although noxious stimuli that produce tissue injury almost invariably produce CS. The neuropharmacology of synaptic transmission of primary afferent nociceptive nerve fibres is highly complex. However, of particular importance in the induction of CS, glutamate, the fast transmitter of primary afferent neuron terminals in the spinal cord, binds to N-Methyl-D-Aspartate (NMDA) receptors (13). The therapeutic significance of this is that drugs that antagonise this mechanism may produce analgesia, by reducing CS. Such drugs include ketamine and the gabapentinoids (gabapentin and pregabalin). A partial, though variable analgesic effect of these drugs has been reported in nociceptive as well as neuropathic pain, notably in post-operative pain, though current clinical evidence is weak (14)(15). At present, the recommended, licenced use of gabapentinoids is for neuropathic pain, in particular for patients with post-herpetic neuralgia and painful diabetic neuropathy. Whether or not neuropathic pain in other small fibre neuropathies, including non-freezing cold injury (NFCI), responds to these drugs remains to be investigated in controlled clinical trials.

22.    Numerous other neurotransmitters are now known to be involved in the mechanism of CS. It is recognised that there is no single neurotransmitter involved in producing CS in the dorsal horn of the spinal cord. The recognition of many other central nervous system knock-on effects of a persistent painful input from peripheral tissues has rather confusingly led to a wider common usage of the term

CS, which we may refer to here as supra-spinal CS. By a variety of molecular mechanisms, the core features of CS can be produced: in response to a prolonged, sustained peripheral nociceptor input there is an increase in membrane excitability, synaptic transmission can be facilitated, and inhibitory influences on dorsal horn neurons can be decreased (13). Similar mechanisms in the brain may underpin changes in neuronal responses to prolonged nociceptive inputs, producing supraspinal CS. 23. Of particular relevance to MSK disorders, there is evidence that deep somatic pathological conditions affecting joints and muscles are particularly likely to induce CS, particularly low back pain (16), (12). CS associated with pain of musculoskeletal origin is potentially completely reversible, while by contrast, there is evidence that ongoing CS can become a persistent feature of neuropathic pain (17).

# Damaged Musculoskeletal Structures that Generate Pain

## Joints

**24.** Normal joints do not give rise to conscious sensation; joint position sense is essential for postural control but is not consciously perceived. Dull aching and poorly localised pain is the major sensation from damaged and diseased joints (4). Cartilage, which is aneural, does not cause pain in health or disease (18). Joint capsules, synovium and ligaments have nociceptors, and pain can sometimes be referred from adjacent joints, muscle, ligaments and fascia (19). In osteoarthritis (OA), cartilage is initially affected, and then multiple structures in the joint are involved, inflammation and cytokine production leading to pain (20), (21), (22). In joint disease, normal afferent nerve fibres become sensitised by bradykinin, prostaglandins and other inflammatory substances, so that normally 'silent' nociceptors become sensitised to movement, causing pain. These changes powerfully induce spinal CS (23). Subchondral bone pathology causes pressure changes and microfractures, osteophytes may stretch the periosteum, and the joint capsule may undergo distension and inflammation. Inflammatory change in synovium may also contribute to pain.

## Muscles

**25.** Muscle pain (myalgia) is signalled via small diameter myelinated and unmyelinated nerve fibres. These are normally silent but are activated and sensitised by inflammatory substances and accumulation of lactic acid, becoming active at rest. The sensory input from damaged muscle induces spinal CS, together with the unmasking of normally ineffective synapses in the dorsal horn of the spinal cord (24). This is the basis of referred pain to sites remote from the damaged muscle (25). Persistent muscle pain has been shown experimentally to lead to alterations in activation in the cerebral cortex, notably the cingulate cortex. Chronic work-related myalgia (occupational muscle pain) may occur on a background of monotonous repetitive work at a low level of force (26) together with the additional factor of psychological stress (27).

## Tendons

**26.** The tensile strength of tendons is related to thickness and collagen content; a tendon with a cross-sectional area of 1cm2 is capable of supporting 500-1000kg. Loading of the Achilles tendon during running may reach 9kN, equivalent to 12.5 times the body weight (28). Thus, tendons are extraordinarily resilient structures. Pathological mechanisms other than inflammatory change are important in acute and chronic tendon injury, so the term 'tendinopathy' is generally now preferred to tendinitis or tendonitis (29). Trauma due to overload and overuse is the leading cause of tendinopathy.

In a military population, other recognised causes are rarely seen; these include gout, thyroid disease, diabetes and treatment with quinolone antibiotics. Once damaged, tendons heal slowly and are prone to re-injury. With overuse injury, the microscopic changes in tendinopathy are an absence of inflammatory cells and a poor healing response, with non-inflammatory collagen fibre degeneration and thinning, hypercellularity, neurovascular in-growth and increased intrafibrillar glycosaminoglycans or mucopolysaccharides (30),(31). An obvious inflammatory response is usually seen only in complete tendon rupture.

# Co-Morbidities of Chronic Pain

**27.** The co-morbidities of chronic pain may contribute substantially to loss of function and impaired quality of life. A summary of 17 reviews found that factors consistently associated with poor outcome after Low Back Pain (LBP) included poor general health, psychological distress, poor relations with work colleagues, physically heavy work, and worse baseline functional disability (32). Anxiety and depression are common in patients with chronic pain and have been found to predict both pain severity and disability (33). In a study of US veterans with chronic MSK pain disorders, both post-traumatic stress disorder (PTSD) and depressive illness were independently associated with worse pain, poorer quality of life, and disability (34). Depression and anxiety may also increase the prevalence of opioid misuse in patients with chronic pain (35). A systematic review of 38 studies found the prevalence of opioid misuse in patients with chronic pain was between 21% and 29% (95% confidence interval 13%-38%) (36). There is a two-way association between chronic pain and insomnia, thought to be partially mediated by not only pain intensity, but also anxiety, depression and health anxiety (37), (38).

**28.** Personality may play a role in maintaining chronic pain. A systematic review of 15 studies found that maladaptive emotional regulation (e.g. catastrophizing and negative mood) was associated with perceived pain severity (39). A meta-analysis showed significant associations between self-efficacy and disability, pain severity, and affective disturbance in 15,616 chronic pain sufferers (40). In one study of over 7,000 people with low back pain in Norway, followed up for 11 years, depression, anxiety and number of sites of pain were associated with less likelihood of recovery (41). Effective psychotherapies useful for chronic pain patients may include cognitive behavioural, meditation and acceptance and commitment therapies. Successful treatment depends on a multidisciplinary approach, often involving a variety of health professionals (42).

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# Occupational Aspects of MSK Disorders

**29.** AFCS makes full and final awards for any disorder or injury predominantly caused by military service on or after 6 April 2005. To support consistency and equity, awards reflect not specific diagnoses but rather the disabling functional restriction or limitation due to the accepted disorder and its duration, particularly in the context of suitable civilian occupation. This is assessed following an adequate course of best practice clinical treatment and rehabilitation and so when the person is in an optimal medical and functional state. Awards also take account of mental health symptoms, short of a discrete disorder. The military goal is to maximise and maintain operational capability, and so from the outset, the management of MSK disorders in the armed forces is work-orientated, with clinical management addressing symptoms, supporting improvement and natural healing, while patients are reassured about the benefits of early active participation, expectation of recovery and return to work (1).

**30.** Physical disorders including MSK conditions or injuries are almost always accompanied by a degree of anxiety or low mood, and this may be influenced by factors such as how the injury occurred, how it was initially treated and how serious or disabling the injured person perceives it might turn out to be. Psycho-social factors are important in determining prognosis. These include the attitudes and beliefs of the injured person and of his or her family and colleagues. There may be issues of financial compensation involved or legal complications, and/or work issues such as poor job satisfaction, perceived lack of support at work, or even the possibility of bullying or harassment in the background. There may of course be co-morbid discrete psychiatric disorders such as depression. Some individuals may have a tendency to catastrophize, and that can induce a fear that movement or activity (because it is painful) will cause further damage or worsening of the pain or disability. This can lead to reduced physical activity, over-reliance on aids and appliances, and eventually in some cases to a disabled lifestyle of prolonged incapacity, decline in overall fitness and failure to return to work either in the military or civilian community.

**31.** In the past, treatment was based on the biomedical model, with doctors thoroughly investigating MSK problems and explaining to the patient how their pain was linked to physical damage, ideally "visible" as abnormalities on imaging. Reflecting this, MSK disorders are still commonly referred to as "injuries" although the great majority have insidious onset with no identified initiating event. Even where a sprain or strain has occurred, that often serves to draw attention to symptoms arising from an underlying pre-existing asymptomatic pathology. Correlation between MRI scan appearances of MSK disorders and lesions, let alone symptoms, is poor.

**32.** Orthopaedic, rheumatological and pain services in the NHS and military increasingly adopt a multidisciplinary biopsychosocial approach. Over-medicalisation is avoided, and key messages include the importance of self-management and active rehabilitation, maintained activity and retention in, or early return to, work. Because of the youth and general high level of physical fitness of military personnel, a stepped care approach is adopted from the outset, beginning with simple interventions supporting natural healing and importantly, providing information concerning the likely course. This will progress to more intensive clinical treatment should there be failure to respond. Modalities of treatment include manual therapy (physiotherapy and related disciplines), exercise therapy (with emphasis on rehabilitation and restoration of function) and, sometimes, other measures such as transcutaneous electrical nerve stimulation (TENS), acupuncture, ultrasound, and laser therapy, although the evidence for these is weak. Drug treatment will include simple analgesia and sometimes non-steroidal anti-inflammatory drugs (NSAIDs), but stronger analgesics should be avoided, as adverse effects frequently outweigh any benefits. Antidepressant drug treatment of associated depression may be appropriate, but again there is a risk of adverse effects. Adjunctive drug treatments such as

gabapentinoids (gabapentin and pregabalin) are increasingly used for MSK pain, but in the absence of a secure evidence base of their efficacy. Adverse effects are frequent and may negate any therapeutic benefits. For military personnel, temporary restrictions in employability grading and graduated return to work programmes as part of a "stepped approach" to rehabilitation may be appropriate. In some cases, return to the principal service occupation may not be possible and there will first be an effort to redeploy to a more suitable role within the military before, as a last resort, medical discharge back into civilian life.

33. Reintegration into civilian life for individuals with disabling musculoskeletal conditions can be challenging and not only for reasons directly associated with physical incapacity. All those who are medically discharged, regardless of length of service, are entitled to the full package of resettlement services, including training for suitable civilian employment, CV writing etc and transition support. Help is also available on housing, health and well-being, and financial advice. Currently these are not co-ordinated in a single policy. As part of the Veterans Strategy, a new unified Defence Transition Service delivered by Veterans UK is being rolled out. This is aimed at the most vulnerable service leavers and will provide co-ordinated, tailored one-to-one support as required, again on employment, health and well-being, housing and financial advice.

34. The underlying aim of the Defence Transition Policy is to enhance personal resilience and independence. Successful transition, long term clinical prognosis and securing and sustaining employment may be influenced by societal and psychosocial factors. Having experienced the "family" aspects of military life and perhaps expectations of a longer military career, a move back into civilian job-seeking can be daunting to some. Added to this are the vagaries of the labour market in which, despite high rates of general employment, the nature of jobs is changing fast and may not on the whole be to the advantage of young men and women exiting the military, particularly with short service and having failed to complete initial or trade training. Increasingly, repetitive and/or physical civilian work is being replaced by robotics or giving way to more jobs in the knowledge economy. Local unemployment rates in the areas of the country from where military personnel originate or settle may be higher than the average. Willingness, however, to accept physically disabled people into the workforce is improving and these efforts have had government support and legislative enforcement through the Equality Act (2010) and vocational rehabilitation schemes, such as Access to Work (2).

35. Musculoskeletal pain affects up to 50% of the civilian population at any one time and work, both physical and mental, sometimes modified, can be undertaken by most of the potential workforce. Recurrent back and neck pain present the biggest challenge to employers. Ideally a functional assessment of the individual plus a consideration of exactly what the work entails will enable a good person/job fit. Not only can the work be modified: many adaptations to allow access to the work place and workstations, and flexible working arrangements, as well as aids and appliances, are now available to physically impaired workers.

36. Currently, evidence on the effectiveness, particularly long-term of UK military medical discharge policies is sparse. A recent paper on veterans and benefits may provide some insights (3). The report linked records from the King's Centre for Military Health Research (KCMHR) cohort study, which includes about 11,000 personnel entering service between 2003 and 2016, with DWP data on uptake of income replacement, unemployment and disability benefits. These service leavers were not differentiated in terms of type of discharge or in the case of those medically discharged, disorders leading to medical discharge. The maximum follow-up time since leaving service for study subjects was 12 years.

37. Information on about 8,000 veterans was studied. About 23% of them had received unemployment benefits at some point in the post service period. Most unemployment benefit (7%) was paid soon after service release while at two years post-service, only 1.5% were in receipt. On the other hand, rates of disability benefit uptake were slightly less frequent (5%) but tended to persist. The study identified

factors associated with receipt of unemployment and disability benefit. For both benefit types, being male, of lower rank, shorter service, less educated, as well as having claimed benefits before service, were relevant. The study also found that veterans with mental health disorders had a higher likelihood of claiming benefits. The study did not consider separately MSK problems or any other category of injury or disorder. Comparison with civilian benefit uptake is difficult owing to the limited comparison official statistical data and different demographics of the two groups. The researchers concluded that ".... veterans are, at the very least, not at higher risk of benefit claims than the general population".

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# MSK Disorders - Part 2 Section B - Further Clinical Summaries

# Introduction

This section of the paper follows from MSK Part 1 (2017), considering additional MSK diagnoses seen in a serving military population. Topics covered include lower limb exertional tendinopathy; iliotibial band syndrome; shin splints (or medial tibial stress syndrome); stress fracture; compartment syndrome; plantar fasciitis; Lis Franc injury; hypermobility and Ehlers-Danlos syndrome. Complex regional pain syndrome (CRPS) is also included here.

# Topic 1 - Lower Limb Tendinopathy including Damage to Achilles, Patellar and Hamstring Tendons, and Lateral Trochanteric Pain

## a) Achilles Tendinopathy

1.   DEFINITION: The Achilles tendon is formed from the tendons of the gastrocnemius and soleus muscles and inserted into the calcaneal tuberosity. Achilles tendinopathy covers the range of overuse injuries which may affect the tendon ranging from mild tendon irritation to complete rupture. The disorder is common as a sporting injury, particularly in middle-aged recreational distance runners or those who play tennis, squash or soccer, especially on an occasional basis (1).

2.   CLINICAL: The tendon is a relatively avascular structure throughout its length (2). This makes it liable to be damaged by repetitive trauma over time, leading to thinning, degeneration and ultimately, possible rupture. Tendinopathy develops insidiously. Various stages in development are described, affecting different parts of the tendon and leading to pain, fullness or rupture. Pain is usually mid-structure or at the insertion. Partial Achilles tears are very rare and, counter-intuitively, although tears only occur in

damaged tendons, few tears occur in patients with a history of tendinopathy symptoms (3). Pain tends to be present on waking or after rest or there is pain on activity which settles over time.

3.    AETIOLOGY: The precise cause of Achilles tendinopathy remains unknown. Although well studied in the sports context where it is often associated with squash, badminton or running, there are few occupational studies. Proposed risk factors include age, and a number of congenital anomalies of foot and lower limb are thought to occur more frequently with Achilles tendinopathy, e.g. Varus forefoot and foot hyper-pronation. Overuse or poor technique are possible sports-related risk factors e.g. poor conditioning, training errors, failure to warm up, over-training and training in adverse weather conditions (4). Achilles tendon fibres may be damaged by diabetes and the medical use of corticosteroids eg for asthma or auto-immune disorders.

4.    TREATMENT AND PROGNOSIS: Best practice treatment for Achilles tendinopathy remains to be fully determined but it is known that early treatment, of whatever nature, leads to a more favourable outcome. Tendinopathy without rupture is treated with avoidance of the provoking cause and further overuse. However, complete rest is not advised, but rather active physiotherapy with massage, ultrasound, eccentric lengthening of the Achilles tendon with load-bearing, and orthoses to correct abnormal foot alignment.

5.    Usually the approach is initial rest, management of tendon loading, followed by physiotherapy, even for rupture. If conservative management fails, surgical treatment may be appropriate. Both conservative and operative treatments produce reasonably successful results with, in most cases, patients being able to return to previous levels of activity (6).

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# b) Other Less Common Tendinopathy Variants

5.    These include patellar tendinopathy where pain is at the inferior pole of the patella and similar in pattern to Achilles tendinopathy ie present on waking, or activity, which settles with time. It is common in running, jumping and tabbing and may be triggered by a period of intense activity. Pain from hamstring tendinopathy occurs after a period of intense loading or activity with pain radiating from lower buttock into the back of the thigh. There may be localised tenderness at the ischial tuberosity. Lateral trochanteric pain is more common in women. This tends to have insidious onset, is localised around the greater trochanter radiating down the lateral thigh. Physiotherapy is key (1).

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# Topic 3. Exertional Lower Limb Pain e.g. Ankle Sprain - Medial Tibial Stress Syndrome - Compartment Syndrome - Stress Facture

1. Exertional or exercise induced lower limb pain is the subject of a Defence Primary Quality Standard Indicator and Best Practice Guideline whose aim is to enhance accurate diagnosis and consistent quality management with early return to duty. The guideline uses anatomical boundaries to improve injury categorization. Ankle sprain is common in UK recruits and of note because such injuries may require significant rehabilitation times.

## a) Shin Splints or Medial Tibial Stress Syndrome

1. Shin splints or medial tibial stress syndrome is a relatively common overuse injury resulting in lower limb pain on exercise, usually running or marching. It is associated with an increase in intensity or duration of strenuous exercise and affects ballet dancers, athletes and military recruits. In US and UK basic military training about 5% of recruits may be affected and shin splints account for about 10% of injuries in runners. Rates are lower where there has been pre-enlistment physical training (1). No universally agreed definition has been proposed.

2. CLINICAL: Symptoms are mainly musculotendinous pain affecting the postero-medial border of the tibia mid-leg. Pain is brought on by exertion and thought to be due to stress of the bone or attached muscle. The differential diagnosis of shin splints includes stress fracture and compartment syndrome both of which must be excluded, as well as lumbar spine disorder.

3. AETIOLOGY: There remains controversy as to the underlying pathology eg ischaemia or microfracture or soft tissue injury, but most clinicians agree that shin splints are a periostitis along the tibia caused by musculotendinous strain and inflammation. The site of tenderness to palpation is the medial origin of the soleus muscle and the pain may stretch over much of the tibia. This is in contrast to a stress fracture characterised by often exquisite but much more localised pain. MRI scans are the preferred method of evaluating and distinguishing these injuries. Shin splints occur when there is a change in a person's level of activity. Unconditioned people, or those with a previous injury are most at risk, with the most common contexts, running and military recruit training. Maximal pronation velocity and pronation, both of which result in increased stress on the lower limb musculature, correlate with shin splints. Other factors include excessive running distances especially on hard surfaces. Body build and anatomical variation such as genu valgum or pes cavus may also increase risk. There is no recognised gender difference in incidence or prevalence (2).

4. PREVENTION: A number of prevention measure have been advocated e.g. warming up, well-fitting footwear, avoidance of training in poor, especially cold and wet, conditions. A few preventative measures have been trialled in military establishments, but results have been disappointing and there have been study limitations (3). There is some evidence that shoe orthoses may prevent the development of shin splints, but any benefit needs to be weighed against cost (4).

5.  TREATMENT AND PROGNOSIS: Treatment is usually conservative, focusing on relative rest and pain free activity only, for about 10 days, and then a gradual return to full activity over 6-8 weeks. Where the problem is resistant or recurrent, despite adequate management, surgical release of the fascia surrounding the soleus insertion is the intervention of choice usually achieving high levels of pain reduction and patient satisfaction (5).

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# b) Other Less Common Tendinopathy Variants

1.  Compartment Syndrome has two forms, Acute Compartment Syndrome (ACS), which can be limb and life threatening and a medical emergency and the more benign, Exertional form (ECS) (1).

2.  DEFINITION: ACS occurs when there is increased tissue pressure within a bounded myofascial compartment. This compromises the vascular supply and so the function of the contained structures, muscles, nerves and blood vessels. Normal lower limb compartment pressure is 10-15 mmHg. Serial monitoring is the usual approach for diagnosis. Pressure above 40 mmHg diagnoses ACS while pressures in the 20-30 mm range are indicative.

3.  In ECS there is exertional limb pain during and after exercise. This may be accompanied by paraesthesiae and swelling. The underlying mechanism is thought to be ischaemia but remains to be established.

4.  AETIOLOGY: ACS is associated with increased volume within the limb compartment e.g. due to haemorrhage, haematoma or oedema and is seen most commonly in relation to high energy or penetrating trauma, especially comminuted fractures of the tibia. Other possible causes are crush injury, burns, intra-arterial injection and venous obstruction. The compartment may be reduced in size by lying on a limb or tight dressings or casts (2).

5.  The pathology of ECS is unknown but again structures in a closed myofascial compartment are compressed. Exercise leads to increased muscle bulk and the associated muscle contraction may raise pressure leading to a degree of ischaemia and reduced oxygen supply. Other experts link ECS to oedema where there is sustained high intensity training e.g. running on hard surfaces causing increased osmosis and oedema (3).

**6.** CLINICAL: (1) ACS. Limb compartments are most at risk, but any muscle mass confined by fascia can be affected. The key features are pain, apparently disproportionate to any trauma and aggravated by passive muscle stretching. This produces tightness and tenderness. Later there may be hyperaesthesia and muscle weakness with, very late on, tissue necrosis, irreversible muscle injury and contractures. ACS is a medical emergency best treated by fasciotomy within 6-12 hours of symptom onset sometimes with interval skin graft to close the incisions.

(2)  ECS most frequently involves the lower limb and often occurs in high intensity athletes, notably long-distance runners. The clinical features of pain, cramps and paraesthesia usually occur after a certain time or distance run. Symptoms are usually bilateral and remit within about an hour of stopping the activity but recur when exercise is resumed. Pain is also increased by both passive and active movement. It may be useful diagnostically to measure compartment pressure at rest and on exercise. Typical pre-exercise pressures are more than 14-15 mmHg: 1-minute post-exercise we would expect a pressure of more than 30 mmHg and at 5 minutes post-exercise, pressure should have decreased to no more than 19-20 mmHg.

**7.** TREATMENT AND PROGNOSIS: (1) ACS. The success of treatment depends on early diagnosis and surgery and the presence of complications, which are more common where there is treatment delay. Infection can be a problem, its presence increasing the likelihood of amputation. Rare problems include renal failure, disseminated intravascular coagulation and respiratory distress syndrome (4).

(2) ECS. Surgical fasciotomy is the treatment of choice with usually high patient satisfaction and up to 85% patients able to resume pre-treatment levels of activity, although owing to fascia removal, there may be some muscle weakness. The response to surgery where the posterior compartment is involved is less good than for anterior or lateral compartments (5).

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3.  Schissel, D.J. et al. Effort related chronic compartment syndrome of the lower extremity. Mil. Med.1999; 164(11):830-2.

4. Tiwari, A. et al. Acute compartment syndromes. Br. J. Surg. 2002; 89:397-412.

5. Turnipseed, W.D. et al. Diagnosis and management of chronic compartment syndrome. Surgery 2002; 132(4): 613-7.

# c) Stress Fracture

**1.** Stress Fractures, also called atraumatic/incomplete fractures are associated with bone fatigue, due in a military context to high exercise stress or bone insufficiency such that normal stress can cause damage. Stress fractures comprise 10% of all sports injuries and are often associated with running. They are seen particularly in recruits as opposed to trained strength military personnel, are more common in women and typically affect the lower limb. The mechanism is thought to be that the bone responds to muscle pull and becomes deformed. If the force exceeds the bone elasticity, microfracture occurs. Suspected stress fractures should have MRI which will show osteitis of bone. X-ray changes typically take some weeks to become visible.

**2.** Extrinsic factors increasing risk of stress fractures include marked change in level and intensity of training, sustained intensive training, worn or unsuitable, ill-fitting footwear, hard training surface, low dietary vitamin D/calcium and muscle fatigue while intrinsic factors include low bone density, low Basal Metabolic Index, anorexia and cigarette smoking.

**3.** An important aspect of management is prevention of further fracture. This is achieved by prescribing rest until symptoms subside then gradually building up to the previous level of activity. This usually takes three to twelve weeks. In some cases, surgical correction may be required. High risk sites for stress fracture include the femoral neck (supero-lateral), anterior tibia, medial malleolus, talus, proximal 5th metatarsal, navicular bone, and sesamoids. The femoral neck factures may require surgery and have a long rehabilitation period (in excess of 100 days). This makes them a very significant injury particularly in recruits. They often lead to back-coursing and ultimate medical discharge. Low risk sites include the fibula where management is conservative.

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## Miscellaneous Diagnoses

## a) Plantar Fasciopathy

**1.** Plantar fasciopathy is the commonest cause of inferior heel pain. Again, it is now known it is not an inflammatory disorder, so the term fasciopathy is preferred to fasciitis. There is high risk in middle aged women, especially if they stand at work e.g. cooks and chefs and if they have flat feet, have gained weight or have a foot biomechanical abnormality. It is also common in the recruit population e.g. young, predominantly male, runners. While usually self-limiting by 6 weeks, 10% go on to develop chronic pain. In terms of interventions the disorder may respond to plantar fascia stretching, over-the-counter orthotics or extracorporeal short-wave therapy.  There is no published randomised controlled trial, but patients report satisfactory outcomes from short wave therapy (1), (2).

## References:

1. Martinelli, N. et al. Current therapeutic approaches for plantar fasciitis. RR. 2014; 6:33-40.

2. Singh, D. et.al. Plantar fasciitis. Fortnightly review Brit. Med. J. 1997; vol 315:172-175.

## b) Iliotibial Band Syndrome (ITBS)

**1.** ITBS is considered one of the most common overuse injuries in the lower limb. It is seen in runners but also in cyclists, soccer and hockey players. It causes hip, lateral thigh and knee pain and leads to inability to participate in sport. In runners, lateral knee pain may be reported with onset around a consistent mileage which requires them to stop. The aetiology remains poorly understood with the theoretical model of friction between the iliotibial band and lateral femoral condyle when the knee is partially flexed, not borne out by cadaver studies (1), (2). Abnormal lower limb biomechanics have also been implicated but results have been conflicting with diametrically opposite results on hip internal rotation and adduction and hip abduction muscle strength in runners with a history of ITBS (3), (4).

**2.** Because of failure to identify the underlying mechanisms, there is at present no best practice treatment. Patients often report pain and limitation at adjoining areas e.g. low back and hip or abdomen. On examination there may be reduced strength in hip flexors, external rotators and abductors as well as limited low back active range of motion. These observations have led to multifaceted treatment protocols involving the lumbar spine and lower limb regional treatment as well as information and education about shoes, training surfaces, warming up and training schedules. Using these techniques there is good evidence of early response e.g. in one series response within at most eight weeks following a programme of hip abductor and external rotator strengthening with return to normal activity. This was maintained at one year (5).

# References:

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4. Noehren, B. et al. Prospective study of biomechanical factors associated with iliotibial band syndrome. Clin. Biomech. 2007; 22:951-956.

5. Khayambashi, K. et al. The effects of isolated hip abductor and external muscle strengthening on pain, health status, and hip strength in females with patellofemoral pain; a randomised controlled trial. J. Orthop. Sports. Phys. Ther. 2012; 42(1):22-29.

# c) Piriformis Syndrome

**1.** Piriformis Syndrome remains a controversial diagnosis and there is variability in the use of the term. Some reserve the diagnosis for pain associated with neurological signs indicating sciatic nerve compression by the piriformis muscle, but this is a very rare presentation. Others use the term to refer to pain in the buttock, presumed to originate in the piriformis muscle and other muscles acting as external rotators at the hip joint. Buttock pain is usually more prominent than low back pain. Characteristic features include i) tenderness in the region of the greater sciatic notch; ii) pain which is aggravated by sitting; and iii) pain increased by external rotation at the hip joint. There is no proven effective treatment (1), (2).

# References:

1. Hopayian, K. et al. The clinical features of the piriformis syndrome: a systematic review. Eur.Spine J. 2010; 19:2095-2109.

2. Cass, S. Piriformis syndrome: a cause of non-discogenic sciatica. Curr. Sports Med. reports. 2015; 14 issue 1:41-44.

# d) Groin Pain Syndrome

1. Although the term, Groin Pain Syndrome is frequently used it is not a single discrete diagnosis with defined criteria but simply refers to pain in the groin. It is a common sporting complaint, particularly in soccer. There are multiple causes eg hip pathology (particularly osteoarthritis), femoro-acetabular impingement, labral tear and reduced hip muscle strength or loss of range of movement e.g. due to osteitis pubis. In any one patient multiple causes may co-exist and contribute to the symptoms. Differential diagnoses include iliotibial band syndrome (ITBS), rectus adductor tendinopathy, i.e. stress or imbalance between adductor and abdominal muscles, groin injury e.g. stress fracture, tendon avulsion, nerve entrapment syndrome affecting the ilio-inguinal nerve, intra-abdominal pathology, and referred pain e.g. from lumbar spine, sacroiliac joint or pubic bone.

2. The disorder should be investigated by imaging and clinical evaluation. There may be difficulty in precise diagnosis and identification of aetiological factors in any one case. Multiple approaches to treatment, both physiotherapy and surgical may be required and even then, the disorder may not fully remit (1).

# Reference:

1.Bisciotti, G. et al. Groin pain syndrome: an association of different pathologies and a case presentation.   Muscle Ligt. and Tendons Journal.  2015; 5(3): e14-22.

# e) Lisfranc Injuries

1. Lisfranc injuries form a spectrum of acute, usually but not always, high energy traumatic injuries involving bony or ligamentous compromise of the tarsal, metatarsal and inter-cuneiform foot joint complex. If diagnosed early and treated appropriately they usually have a good outcome. They demonstrate a wide range of severity. They may be stable, or a partial sprain, or a grossly displaced and unstable fracture-dislocation of the midfoot.

2. Investigation is important in order to establish the diagnosis, and fractures may be missed on plain X-ray unless several views are obtained. MRI is the investigation of choice. Typical mechanisms are falls from a height or road traffic accident (RTA) but Lisfranc injuries may also be seen following relatively low energy sports-related sprains and strains in baseball, wind and kite surfing. The injury may involve ligaments only, bone fracture only, or a combination. It may be partial, and essentially a sprain, i.e. a stable injury seen where the mechanism of injury is via an axial load and plantar flexion. The plantar tarso-metatarsal ligaments remain intact. Clinically there may be pain and diffuse swelling in the midfoot and inability to weight-bear. Plantar ecchymosis at midfoot is highly suggestive of Lisfranc injury.

3. Stable variants are treated non-operatively with boot immobilization followed by weight bearing as pain permits. Often there is prolonged recovery time but generally recovery is complete with return to pre-injury activity. Unstable or displaced injuries or misdiagnosed injuries with delayed or inadequate treatment often develop persistent pain and post traumatic arthritis requiring arthrodesis. For unstable injury the treatment of choice is Open Reduction with Internal Fixation (ORIF) with trans-articular screw fixation. More recently ORIF and primary arthrodesis has become increasingly popular and effective. Where ligaments are involved this procedure has lower subsequent rates of surgery for removal of

the screws etc. Most patients return to previous levels of athleticism and sport with typical timeline of about a year. There are high rates of radiographic post traumatic arthritis and symptoms (1).

# Reference:

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# f) Hypermobility and Ehlers-Danlos Syndromes

**1.** Joint hypermobility simply means that joints have an unusual range of mobility. Most people with this condition have no problems and may benefit from the flexibility e.g. ballet dancers, gymnasts and musicians. They may also experience pain and stiffness in joints and muscles, clicking joints, joints that dislocate or fatigue. Symptoms may be recurrent and similarly joints may be prone to sprains. The related Ehlers-Danlos syndrome affects 1 in 5000 people globally. This is not a single diagnosis but group of genetically determined connective tissue disorders. Features include joint pain, stretchy abnormal skin and scar formation, usually diagnosed at birth or in early childhood (1).

**2.** Patients with Ehlers-Danlos Syndrome may also have autonomic dysfunction, aortic dissection, lens dislocation, recurrent joint dislocation, scoliosis, chronic pain and early osteoarthritis. There is no cure (2), (3). In terms of MSK problems treatment is supportive. If dislocation occurs, such as patella or elbow, and there is structural damage the treatment of choice is surgery. If there is no structural damage surgery is not indicated (3).

# References:

1. Byers, P. H. et al. Heritable collagen disorders: the paradigm of Ehlers-Danlos syndrome. J. of Investigative Derm. 2012; 132(E1): E6-11.

2. Camerato, F. et al. Heart rate conduction and ultrasound abnormalities in adults with joint hypermobility syndrome or Ehlers-Danlos syndromes. Clin. Rheumatol. 2014; 33(7):981-7.

3. Gedalia, A. et al. Joint hypermobility and fibromyalgia in school children. Ann. of the Rheum. Diseases. 1993; 52(7):494-6.

# g) Fibromyalgia and Myofascial Pain

**1.** Fibromyalgia Syndrome (FMS) and Myofascial Pain Syndrome (MPS) are enigmatic pain states, essentially diagnoses of exclusion that continue to defy clear definition (1). For research in these conditions, based on a consensus research study, the American College of Rheumatology (1990) established two essential criteria for FMS: a history of widespread pain of at least three months' duration and painful sensitivity to 4kg of digital pressure at 11 or more of 18 anatomically defined tender points (2). While these criteria meant that comparable patient groups were being studied in research on FMS, there was criticism that some other common associated features were not represented, including dysfunctional sleep, fatigue and cognitive dysfunction (3). A second criticism was that the allegedly diagnostic tender points were hard to standardise, and more related to distress than the illness itself. There have been several revisions of the diagnostic criteria (4), which have now discarded tender points and moved towards recognising chronic widespread pain (5).

**2.**    Myofascial Pain Syndrome (MPS) presents similar diagnostic difficulties and is rarely diagnosed in UK military practice. In a large survey of members of the American Pain Society, 88% of responders considered MPS to be a valid clinical disorder, and 81% that it was different from FMS. Given the uncertainties concerning diagnosis of FMS and MPS, it is not surprising that there is little consensus on pathogenesis (6) or causation. Central sensitization (see paragraphs 20-23 above) seems very likely to play a part (7), but the factors leading to the development, severity and chronicity of these occasionally extreme states of pain and disability remain elusive. Evidence for effective management is accumulating (8), particularly for non-pharmacological approaches, such as exercise therapy and cognitive behaviour therapy (9).

# References:

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2. Wolfe, F. et al. The American College of Rheumatology 1990 Criteria for the classification of fibromyalgia.  Report of the Multicentre Criteria Committee Arthritis and Rheumatism. 1990; 33:160-172.

3. Wolfe, F. et al. The relation between tender points and fibromyalgia symptom variables: evidence that fibromyalgia is not a discrete disorder in the clinic. Annals of the Rheumatic Diseases. 1997 April1; 56(4):268-71.

4. Mease, P. et al. Development of the fibromyalgia survey diagnostic criteria, a modification of the ARC (2010) preliminary diagnostic criteria for fibromyalgia. Annals of the Rheumatic Diseases 2010; 69:144.

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8. Macfarlane, G. J. et al. EULAR revised recommendations for the management of fibromyalgia. Ann. of the Rheum. Diseases 2017 Feb 1; 76(2):318-328.

9. Thieme, K. et al. Evidence based guidelines on the treatment of fibromyalgia patients: are they consistent and if not, why not?  Have effective psychological treatments been overlooked? The Journal of Pain. 2017 Jul1; 18(7):747-756.

# h) Complex Regional Pain Syndrome (CRPS)

**1.**     Complex Regional Pain Syndrome (CRPS) is the term now generally adopted to include a number of conditions previously known as reflex sympathetic dystrophy, causalgia, algodystrophy and Sudeck's atrophy. The clinical features include severe chronic pain associated with painful sensitivity of skin and deep tissues (hyperalgesia and allodynia), local disturbances of autonomic function (blood flow, temperature and sweating), swelling of the affected part (oedema) and severe loss of function, usually affecting the whole limb (1).

**2.** Exclusive definition of CRPS is difficult. CRPS describes a variety of painful conditions that usually follow injury, occur regionally, have a distal predominance of abnormal findings, exceed both in magnitude and duration the expected clinical course of the inciting event, often result in significant impairment of motor function, and show variable progression over time.

**3.** In CRPS type 1, there is an initiating noxious event. Ongoing pain and hyperalgesia occur beyond the territory of a single peripheral nerve; there is or has been clinical evidence of abnormal blood flow, temperature and sweating; and the diagnosis is excluded if there is an alternative condition that would explain the symptoms and signs. CRPS type 2 follows a clearly identifiable nerve injury, usually of a major limb nerve, and is synonymous with causalgia. It is more regionally confined than CRPS type 1, but in other respects is similar to CRPS type 1. There is a neurological deficit appropriate to the affected nerve.

**4.** Being descriptive of symptoms and signs, these definitions suffer from lack of clarity concerning the definable limits of the conditions, particularly CRPS type 1, but they do have the advantage of avoiding unjustified assumptions about pathophysiology. Confusion also results from making CRPS type 2 and causalgia synonymous, emphasizing the difficulty arising from the use of a word originally intended to refer to a single symptom (causalgia means 'burning pain'), to a clinical syndrome. However, this is the widely accepted current terminology. There are now generally accepted diagnostic criteria for CRPS (2) (3)(4).

**5.** CRPS type 2 is very rarely seen in service. CRPS type 1 is uncommon but may occur following injury including fractures, tendon and ligament injury, fasciopathy, arthritis, deep vein thrombosis and prolonged immobilization. However, it is a rare consequence of all these conditions, and the factors leading to its development are unclear.

**6.** The pathogenesis and pathophysiology of CRPS remain uncertain. Initial and possibly persistent inflammation, immune mediated, is now generally thought to be an important factor. Central sensitization undoubtedly occurs, and there is some evidence supportive of a reorganized state at several levels within the central nervous system that could potentially become irreversible (5). Treatment is always difficult and demands a coherent multidisciplinary approach, including systemic drug treatment, local physical measures, psychological management, usually cognitive behaviour therapy, and family involvement. Some evidence suggests that early intervention yields a better prognosis, but for some, recovery is limited (5)(4).

# References:

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# Topic 5 - Review of 2013 IMEG Second Report on Mental Health

## Key Points

1. Since the 2013 report, adverse comment re AFCS has continued on the IMEG recommended need for diagnosis of disorders by a consultant psychiatrist or clinical psychologist, the use of interim awards, the definition of "permanent" and the general view that awards for mental health disorders compare unfavourably with awards for physical disorders and civil general damages.

2. Revised mental health disorders classifications DSM 5 (2013) and ICD 11 and a new edition of National Institute of Health and Care Excellence (NICE) PTSD guideline have been introduced and from April 2019 a new descriptor and level 4 AFCS award for mental health disorders came into the legislation.

3. This report updates on treatment and support services since 2013 and includes sections on suicide, mild Traumatic Brain Injury (mTBI), diagnosis, differentiation from PTSD and the relevance of emerging functional neuro-imaging techniques.

4. As in the Fourth (2017) IMEG report, we conclude that, at present, mTBI and PTSD can be best differentiated by clinical history and examination, rather than any specific investigation. While accepting that research on MEG shows promise in mTBI investigation, and its possible differentiation from PTSD, we find at this date that it is premature to consider MEG a specific diagnostic test for either mTBI or PTSD.

5. As part of the ongoing ministerial tasking to maintain an overview of mTBI, it is recommended that IMEG undertakes a comprehensive review of MEG as part of the 2020/21 Forward Work Plan for publication by the end of 2020.

6. The present review of the 2013 report broadly upheld its conclusions on "permanency", interim awards, parity of esteem between physical and mental disorders, horizontal and vertical equity across the range and level of awards and the need for diagnoses to be made by a consultant level clinician as specified in AFCS legislation.

7. We may have been too optimistic about functional recovery from PTSD and revisited the evidence on its chronicity. We conclude that while in most cases there is functional improvement over time or best practice treatment, there are rare cases with persistent symptoms and disabling effects. Literature search provides inconsistent findings on early predictors of chronicity and we identify no reliable early predictors.

8. From April 2005 until 31 March 2019 there were 4395 awards for mental health disorders with 19% including a guaranteed income payment (GIP). This compares with 67930 awards for physical disorders with 6% having a GIP. At 31 March 2019, 55 full and final mental health awards were at level 6 and 75 at level 8, attracting a GIP of 50 and 75% respectively.

**9.**    We consulted the latest 14th edition of the Judicial College Guidelines on general damages awards (2017) and found no evidence that AFCS lump sum awards for mental health disorders are too small.

# Introduction and Background

**1.**    The 2013 IMEG report on mental health followed a recommendation by the Lord Boyce in his 2009 Review of the AFCS. Core issues considered were: -

> a) the differences between mental and physical disorders and whether a wholly separate approach was appropriate
>
> b) the need for a tailored interim award for mental health disorders recognising the difficulty of prognosis soon after diagnosis
>
> c) the challenges of causation and attribution in mental health disorders
>
> d) diagnosis
>
> e) assessment of mental disorders in terms of functional capacity and duration and in relation to all other types of disorder in the scheme

Following literature scrutiny and expert discussion in 2013, IMEG concluded that there was no need for separate compensation approaches to physical and mental disorders. The major focus of the scheme is functional compromise for civilian employment, paid as a guaranteed income payment and applicable to both physical and mental disorders. Similarly, the general interim award provision was considered sufficient for mental health disorders. In addition, although the epidemiological evidence does not support it, there is a risk that mental health symptoms in serving personnel and veterans will be mis-labelled as PTSD, as a less stigmatised condition than others (1). As a result, the 2013 report concluded that diagnosis should be by consultant level psychiatrist or clinical psychologist. Assessment should focus on loss of functional capacity and include information on clinical management and treatment received.

**2.**    Following interviews with stakeholders, the 2016 AFCS Quinquennial review team referred topics for further comment or action by IMEG. These included review of the 2013 report conclusions, mental health disorder awards, parity of esteem with physical disorders and equity across the Tariff tables. Other issues were the AFCS concept of "permanence" and again the role of clinicians. The IMEG response which upheld the 2013 conclusions was published in the 2017 Fourth IMEG report. In this Fifth IMEG report we have again reviewed the 2013 findings and recommendations and their ongoing applicability in the light of further recent stakeholder comment, experience of the Scheme since 2016 and wider developments in mental health.

**3.**    The media and parliamentary focus on mental health and well-being has continued since 2013 with increased investment in NHS mental health care and other support services for the wider community and for veterans and their families. In service there has been expansion of mental health care and welfare provision including at transition for those medically discharged. Both in service and in the civilian community these are based on a collaborative multidisciplinary approach with healthcare and other support services delivered by multiple agencies and increasingly aligned in the service and civilian communities.

**4.**    Published UK and international mental health research on serving personnel, partner and family aspects of service, has expanded over the period. There remains less research on UK veterans, with most veteran studies from the USA and so not always applicable to UK. Since 2013 revised National Institute of Health and Care Excellence (NICE) Guidelines on PTSD have been published (December 2018) as well as new DSM and ICD mental health disorder classifications. DSM 5 was published in 2013 and ICD 11 was introduced by the World Health Organisation (WHO) in May 2019 for implementation by January 2022. Over the period since 2013, the incidence of suicide and self-harm in civilian and armed forces communities have become increasing concerns in the UK and particularly in North America, leading to review of prevention policies. This paper begins by highlighting some of these developments.

# NHS and Wider Community Advances

**5.**    Since 1953, GB based veterans have had priority access to secondary NHS health care for attributable disorders, physical and mental, based on clinical need and at the discretion of the senior treating clinician. Many veterans are "doctor averse" and reluctant to access NHS services, particularly for mental health problems, feeling that civilian health professionals, whether in primary care or specialists, have little knowledge or affinity with military life. Culturally sensitive NHS veterans' services have now been established. Veterans' mental health services have different care and support models in the four countries of the UK, but all are based on coherent collaborative best practice provision delivered by NHS, local authority (LA) social services, and charities. A recent NHS option to encourage early engagement has been for self-referral to veterans' services rather than entry only via the GP. Campaigns promoting good mental health, reducing stigma, encouraging people to seek help early and, with the expectation of a good outcome, have been regularly run by the NHS nationwide.

**6.**    Because of the demographics and different profile of common disorders compared with the armed forces context, NHS community mental health services focus on child and adolescent services, mental health in pregnancy and the first year after childbirth, depression in older people, and crisis care particularly for people with severe and prolonged mental health disorders. This latter group is also at risk of dying, on average, some 15 years earlier than their peers due to avoidable physical illnesses, (cardiovascular disease and cancer). A precise explanation for this is not yet available but factors such as lifestyle, diet and cigarette smoking and reduced access to normal healthcare are relevant. Most common civilian mental health problems are managed in primary care.

**7.**    Work by MOD, the NHS, health departments, armed forces charities and local government has raised awareness and improved civilian GP understanding of military culture and mental health issues. The curriculum for GPs and qualifying examination for membership of the Royal College of General Practitioners (RCGP) across the UK now includes knowledge on military and veterans' health. A new option for GP practices to become "veteran aware" accredited practices has begun and will be rolled out over the next few years. Similar initiatives involve the other Royal Colleges including Psychiatry, Nursing, and Emergency Medicine. Attention has been given to service leavers and their smooth transition back to the civilian community. The individually tailored single service led Defence Recovery Capability for wounded, injured and sick personnel and those with chronic significant illness, supports personnel in return to duty or preparation for a successful return to civilian life after medical discharge. This work is non-medical, is managed by the chain of command and backed by Personnel Recovery Units (PRU). It is closely aligned with clinical treatment and rehabilitation pathways provided by Defence and the NHS. A new Defence Transition Service has been set up. This will co-ordinate, under a single policy, a range of services covering employment, health and wellbeing, welfare, housing, financial information and pastoral care. As well as providing positive support the aim is to develop personal resilience and independence in the most vulnerable leavers.

8.    Successful Implementation of new services, particularly if delivered by multiple agencies with different models and at risk of duplication, depends on effective communication. In the veterans' community there are very varied levels of digital awareness. The Veterans' Gateway, 24-hour seven days a week telephone line and interactive website, was set up in 2017, funded by the Armed Forces Covenant Fund and run by a consortium of armed forces' charities, led by the Royal British Legion. It provides a single point of contact for veterans and families unsure of where to access the services they need. Over 24800 contacts have been made from its launch to February 2019 and 73,000 self-referrals through the on-line self help guide hyperlinks. The Gateway is supplemented by the University of Northumbria Map of Need project, which has helped build a detailed picture of the needs of the armed forces community based on analysis of what services are being requested and where.

# In Service Changes

9.    As expected in selected, fitter than average military populations, rates of severe and enduring mental health disorders, such as schizophrenia, are lower in the UK military and veterans' population than in the general community. Such conditions are unlikely to be caused by service. High alcohol consumption is commoner overall in the UK military community than in the general population, although the level of alcohol consumption has been reducing in the UK military in recent years. Otherwise rates of common mental health illnesses (i.e. anxiety and depressive disorders) are similar in the civilian and military communities and more common in the UK military population than PTSD. As with PTSD, rates in the general US community, and US military rates of PTSD are higher than in the UK (2)(3). In the early years of the Iraq and Afghanistan conflicts, UK rates of military PTSD were similar to that of the general UK population, at about 4%, but by the end of the British involvement in the Iraq and Afghanistan conflicts overall prevalence of "probable" PTSD in the military was 6.2% with an increase particularly notable in ex-serving personnel who had had a combat role (4). ("Probable "PTSD refers to PTSD diagnosed by psychometric screening test rather than expert clinician examination). This legacy pattern is reminiscent of the post-Vietnam US experience.

10.   Military PTSD usually responds to the same best practice interventions as civilian trauma. A longer course of treatment may be required especially where there are multiple traumatic events, comprising both unexplored pre-service events, non- military in service events, as well as military events, which may be repeated on re-exposure and not all of which are combat-related. It is of note that while the updated (December 2018) NICE PTSD guideline continues to recommend trauma based cognitive behavioural therapy (TCBT) as first line treatment for PTSD, the guideline is now more reticent about Eye Movement Desensitisation Reprocessing (EMDR) for combat related trauma. This may be because of absence of sufficient evidence of efficacy in the military, rather than evidence of harmful or absent therapeutic effect (4). Stress, in particular work-related stress, with symptoms rather than a discrete diagnosis, attributed to workload, time pressure, management demands, bullying and harassment mainly by peers, is increasingly mentioned in AFCS claims.

11.   The Defence People Mental Health and Well-being Strategy 2017-2022 aims to promote positive mental health and wellbeing, prevent and detect early onset of mental illnesses and treat such illnesses when diagnosed (6). Defence has close ties with the NHS and third sectors to share best practice and ensure a flexible integrated through life approach over a person's military career and beyond. Defence health care aligns with the NHS national mental wellbeing agenda. Target issues are stigma reduction, occupational stress reduction, prevention of suicide and self-harm and fostering of attitudes and behaviours to maintain mental fitness. Strong leadership and unit cohesion are key elements known to prevent mental health problems following deployment.

12.   In any review of mental health symptoms and illness there is high risk of a problem orientated approach and loss of proportionality. The evidence is that most service and former service personnel, regardless of deployed or combat related service are, and remain, mentally fit at entry, through and

beyond service. To promote positive attitudes towards mental fitness and equip personnel to manage their own mental fitness, we are pleased to note that Defence is working with the Royal Foundation on training resources. The single services have their own mental fitness and resilience training, and this year (2019) has seen the introduction of senior leaders' mental fitness and resilience training for all Defence people, military and civilian.

13. Since the 2013 IMEG report, we understand that MOD has struggled with shortages of suitably qualified mental health staff. This has led in some cases to delay in assessment and access to treatment at Departments of Community Mental Health (DCMHs). This position is shared with the NHS nationwide, and with private providers, with the root cause being limited numbers of suitably experienced specialists and the long training time required to achieve that. In 2018 /2019 there was some improvement in the overall military staffing picture relative to required strength and an increase in the numbers of consultant clinical psychologists.   Because of their access to weapons, referral of serving personnel with mental health symptoms has traditionally been direct to Defence Community Mental Health services (DCMH). That policy has now been replaced by a unified care pathway with initial referral to Defence Primary Health Care (DPHC) as in the civilian community.

# Some Statistics:

14. For in service mental healthcare, Defence Statistics publish an annual bulletin of statistical information (7). The 2019 edition includes, from 1 April 2007 until 31 March 2019, all initial assessments for a new episode of outpatient care at the DCMHs as well as admission to the in-patient care contractor facilities. Rates of personnel being assessed at DCMHs increased from 1.8% of the whole force in 2007/8 to 3.2% in 2015/16 and remained at that level until 2017/18. In 2018/19 rates fell to 2.7%. This drop may relate to a higher percentage of people with low risk and uncomplicated problems being seen and managed in DPHC, where data are not collected. The increasing rates up to 2017/18 may represent a real increase in incidence of problems or may reflect more frequent presentation because of the reduction in stigma. For PTSD, the most common AFCS claim and award, the overall rate at 0.2%, i.e. 2 in 1,000 personnel, remains low.

15. Across the three services more presentations are seen in females, other ranks and those aged 20-44 years.  The most prevalent disorders are adjustment disorder, depressive episode, Generalised Anxiety Disorder (GAD), Obsessive Compulsive Disorder (OCD) and phobias, not PTSD. Initial assessments for substance misuse, including alcohol have been declining since 2007/8 and remained low in 2018/19 at 4%. 70% of those treated at DCMH return to full fitness and a productive military career. Fewer than 4% are medically discharged. Inpatient care for the armed forces has been broadly stable over the last ten years with about 300 admissions annually.

16. Published annual medical discharge rates provide time trends for the last five years. Where a medical condition or fitness issue affects a member of the armed forces, following appropriate treatment, their capacity to perform their duties is assessed. If found unable to discharge their duties and alternative employment is not available, personnel can be medically discharged. Between April 2018 and 31 March 2019 there were 391 naval service medical discharges, 12 per 1,000 personnel; for the army 1,316 discharges representing 17 per 1,000 personnel; and for the RAF, 162 medical discharges, 5 per 1,000. Groups at higher risk of discharge included women and other ranks, for all three services, while for the army untrained personnel were at higher risk. The age groups most affected were army, 20-24 years and naval service, 25-34 years. The RAF average age for medical discharge was 45-49 years. In the three services the most common cause of discharge was musculoskeletal disorder (MSK), accounting for over 50% of total medical discharges. The next most common causes in 2018/19, and increasing over recent years, were mental and behavioural disorders responsible for 21% of naval, 29% army and 33% RAF medical discharges (8).

17. All AFCS awards for descriptors from any Table include an element for psychological symptoms such as worry, anxiety, low mood etc. Where a mental health disorder claim meets ICD or DSM criteria, and so is a discrete diagnosable disorder, an additional award from Table 3 (mental health disorders) may be appropriate. 4395 awards have been made from Table 3, mental health disorders, from April 2005 until 31 March 2019. Of the total mental health awards, 19% had a Guaranteed Income Payment (GIP). That represents 825 awards of which 680 were for PTSD. Over the same time period there were a total of 67,930 awards for physical disorders with 3,750 (6%) receiving a GIP (9). This suggests that claimants with mental health disorders are assessed appropriately, with consideration of likely civilian employability.

## Tariff Level 4 Awards for Mental Health

18. At the 2013 review of mental health, for reasons fully discussed in the report, the recommended highest level of award was level 6 and 75% GIP. In 2017 the evidence from literature scrutiny and discussion with senior clinical colleagues in military and civilian traumatic psychological injury supported inclusion in Table 3 of an award at level 4, attracting a 100% GIP. This was not simply a revalorisation of an existing descriptor, but a new disorder category which applies exceptionally to the very 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, is judged by the senior treating consultant psychiatrist to remain incompatible with any paid employment until state pension age. The legislative amendment to introduce this descriptor was enacted from April 2019. To date fewer than 5 such awards have been made.

19. The present review of the 2013 report has considered its discussion, conclusions and recommendations on the various topics and considered points raised by stakeholders since 2013, the 2016 Quinquennial AFCS Review (QQR) report and the 2017 IMEG report. We also considered the new literature, the 2018 NICE guidelines and the DSM V and proposed ICD 11 classifications.

## 2013 IMEG Mental Health Report Headings

## a) Difference between Mental and Physical Disorders and Separate Approaches

20. We remain content with the 2013 conclusions and recommendations that the AFCS should retain the present structure and direct relation between lump sum tariff awards and GIP for all injuries and disorders whether they are mental or physical, supporting parity of esteem between mental and physical conditions. This conclusion is well supported by the official statistics on AFCS final awards for physical and mental disorders from the start of the scheme to 31 March 2019. In particular "lump sum only" awards account for 94% of physical disorder awards made, with 6% receiving an additional Guaranteed Income Payment (GIP), while for mental health disorders there were 81% "lump sum only" awards and 19% with an additional GIP.

21. Just as civil damages comprise a one-off lump sum as general damages and, as appropriate, additional heads of damages for loss of employability, care, disabled living adaptations etc, the core element of the AFCS award is a tariff based lump sum. This addresses pain and suffering and for more serious injuries and disorders there is also a Guaranteed Income Payment (GIP), paid for the functional impact particularly on civilian employability. The inadequacy of the AFCS lump sum awards for mental health disorders compared with civil general damages has been raised.  Apart from the different basis of

civil damages (the need to prove negligence) compared with the no fault AFCS, and the fact that the Judicial College Guidelines (JCG) for the assessment of general damages in personal injury cases express the value of general damages as a range, rather than a single tariff value, as in AFCS, we find no basis for the suggestion that mental health awards are too small, following careful scrutiny of the latest edition of the Guidelines (10). This conclusion applied even before the uprating of the AFCS lump sum values on 9 April 2018. The JCG include sections on "PTSD as a sole diagnostic category" and separately "Psychiatric disorders generally". The latter may include several diagnoses, including PTSD assessed together. The language describing the functional effects to be taken into account in assessment is similar to that used in the AFCS.

# Conclusions:

- We remain content that the AFCS should retain the present structure and direct relation between lump sum tariff awards and GIP for all injuries, physical and mental disorders.

- We find that there is no basis for the suggestion that AFCS lump sum awards for mental health disorders are too low, following scrutiny of the latest (14th edition,2017) edition of the Judicial College Guidelines for the Assessment of General Damages in Personal Injury cases.

# b) Specific Interim Award Provision for Mental Health Disorders

**22.**  This issue and, more commonly, interim awards in general for all disorders, continues to be raised occasionally. For the reasons discussed in the 2013 report we continue to find there is no need for a tailored interim award provision for mental health disorders. For the general interim award provision, we understand some of the concerns, but are hopeful that discussion which has been held with the financial industry on the provision, as well as ongoing advice to claimants and supporters on timing of claims relative to treatment, may be helpful. The numbers of interim awards made since 2013/14 and in 2018/9 do not appear to be rising. When an interim award is finalised, the interim lump sum paid is not reduced even if the functionally disabling effects have improved.

**23.**  As part of this review we have explored the literature on chronicity of disorders, notably PTSD, and conclude that while most cases of PTSD do achieve functional improvement, there are cases with long term chronic symptoms and disabling functional effects (11), (12). Literature search for possible robust early signs or predictors of potential chronicity and/or treatment resistance, which might lead to fewer interim awards has to date produced a range of papers with different types and context of stressor (13), (14), (15), (16), (17), (18). Some studies were cross-sectional or had short follow-up from initial diagnosis and some did not adjust for confounders. It is also of note that where persistent PTSD was diagnosed this was not always defined adequately. In most cases multiple possible predictors were suggested, related to the trauma itself, the presence of co-morbidities, social support in the aftermath of the trauma and previous trauma in childhood, but findings were inconsistent and there was also evidence of development of similar persistence following a single traumatic event. We have therefore concluded that to date no reliable predictor of chronicity has been identified.

**24.**  We recognise that previous IMEG reports may have been too optimistic regarding progress and prognosis in PTSD. The aim is for full and final awards to be made as early as possible, reflecting the optimal functional state likely over the person's lifetime and following an adequate course of best practice treatment. We note that at 31 March 2019, 55 full and final mental health awards had been

made at level 6 and a further 75 at level 8, all attracting a GIP at 50% or more, and payment of Armed Forces Independent Payment (AFIP) to address the extra costs of disabled living.

# Conclusion and Recommendations:

We make three findings:

- There is no need for a tailored interim award provision specifically for mental health disorders, but in general interim awards continue to have a place in the scheme as a payment on account where full steady state functional state has not been reached. Should the disorder improve by award finalisation, no reduction or repayment of the initial interim award will be made.

- We will continue to monitor the literature for early predictors of chronicity or other insights into the likely course and duration of disabling PTSD.

- We recommend, by 31 December 2020, a paper following scrutiny of the level 4 and 6 awards for PTSD made from the start of the scheme to 31 March 2020, noting whether there were common features such as stressor type and context, pre-service factors, social support in the aftermath, treatments undertaken, and co-morbidities. Other questions include whether awards were full and final from the outset and the supporting evidence for such decisions, whether they were made by a First Tier Tribunal decision (FTT) and reasons, and whether interim awards were paid ahead of finalisation, and, if so, for how long.

# c) Diagnosis - Should there be a Mandatory Diagnostic Classification and who should make the Diagnosis

25.    The issue of a consultant level diagnosis for mental health disorders remains controversial and we have again considered the issue carefully. Both the American Psychiatric Association's Diagnostic and Statistical Manual and the World Health Organisation's International Classification of Disease classifications provide published criteria for diagnoses of discrete mental health disorders, including PTSD. Criteria in the two classifications for the same diagnosis are sometimes different and may also differ from one edition of the same classification to the next.  Although in broad agreement on types of PTSD etc, the diagnostic criteria for PTSD have differed in the classifications since 1980, when PTSD first appeared in DSM III.  It is however only now with DSM 5 and the proposed ICD 11 that the two classifications markedly differ.  DSM 5 reclassified PTSD as a "trauma and stressor related disorder" rather than an anxiety disorder. The approach of DSM 5 is to lower the level of threat inherent in traumatic incidents and expand the symptom criteria to include symptoms of co-morbid disorders. The ICD 11 criteria, introduced by WHO in May 2019 for adoption by January 2022, continue to focus on catastrophic traumatic events and the central role of re-experiencing symptoms and behavioural avoidance. DSM 5 no longer recognises complex PTSD as a discrete disorder while ICD11 proposes to differentiate the two types of disorder. PTSD is therefore becoming an increasingly heterogeneous condition.

26.    Because ICD11 is not yet in clinical use, the complexities and uncertainties noted above and the need for rigour and consistency in diagnosis, both in clinical and compensation terms, we continue to recommend clinical diagnosis at consultant level. The consultant should preferably have experience in trauma and if possible military cultural awareness. We also recommend that face to face interview with claimants follows scrutiny of all pertinent medical notes. Similarly, and as in 2013, we cannot currently recommend a mandatory diagnostic classification. Given UK specialist practice and the complexities

of DSM 5, diagnosis according to ICD10 would seem most appropriate at present. Consultant reports should record their preferred diagnosis with full reasons for the opinion. In some cases, consultant reports to inform claims come from treating clinicians. Factual evidence from treating clinicians is invaluable both for diagnosis and assessment. However, all causal factors should be documented rather than an opinion on attribution given without supporting evidence. Attribution is a matter for DBS administrative and medical staff based on the case specific medical and service evidence, the AFCS legislation and contemporary medical understanding of cause and course of the disorder.

27. As recommended in 2013, but not yet enacted, medical reports should also routinely include information on treatment received. This might be a simple form completed by the treating clinician with treatment dates, intervention type and duration and outcome. The experience and expertise of the clinician should also be documented. As indicated in the 2013 report, setting up a robust treatment protocol will require consultation and input from a range of experts and stakeholders, and piloting. To date the various challenges of both NHS and Defence health care have prevented implementation.

## Conclusion and Recommendations:

- Because of the classification complexities and uncertainties discussed above and the need for rigour and consistency in diagnosis, both in clinical and compensation terms, we continue to recommend clinical diagnosis at consultant level.

- As in 2013, we do not recommend a mandatory diagnostic classification at this date. Given UK specialist practice and the complexities of DSM 5, diagnosis according to ICD10 would seem most appropriate at present. Consultant reports should record their preferred diagnosis with full reasons for the opinion.

- The 2013 recommendation to develop an agreed treatment protocol as soon as resources permit, remains.

- For similar resource reasons, and because the scheme aim is full and final awards, made as early as possible after the claim, we do not, in this review, uphold the 2013 recommendation to develop a specific battery of standardized psychometric tests. Psychometric tests provide opportunity to monitor clinical progress and functional capacity over time and are likely to be most useful in compensation schemes where awards are made for finite periods followed by review.

## Mild Traumatic Brain Injury (mTBI) and PTSD

28. The 2013 review included a short section on mTBI. We continue to keep developments in mTBI research under routine scrutiny (19). We are aware of current concern and work on concurrent mTBI and PTSD, their definitive diagnosis and differentiation. This includes research on new imaging techniques particularly magnetoencephalography (MEG). There remains no internationally agreed definition of mTBI.  It is clinically heterogeneous in both presentation and outcome, and the diagnosis remains clinical, by history and examination, with exclusion of severe and moderate traumatic brain injury. In the military context, mTBI occurs as result of sport (in the UK usually called concussion) and combat, particularly due to blast.  In that context it has been much less frequently diagnosed in UK personnel compared with US personnel.

29. Most patients with mTBI recover completely within months to a year post-incident and achieve overall return to pre-injury function and employability. There remain a minority of patients with persistent symptoms and functional disability.  Outcomes in published peer-reviewed mTBI studies, with different patient characteristics, definitions of mTBI and short follow-up times, vary widely. The

studies are unable to clarify whether outcomes relate to brain damage, psychosocial factors or both. Evidence does suggest that patient education and specific intervention (e.g. for headaches) can reduce symptoms and disabling effects.

30. No current imaging technique infallibly detects mTBI. Standard CT and MRI scans do not demonstrate the diffuse axonal injury and vascular structural changes sometimes present in mTBI. These can be demonstrated by a range of more advanced, but not yet clinically routine, imaging techniques. These include functional and metabolic imaging modalities such as positron emission tomography (PET), single photon emission computed tomography (SPECT), functional magnetic resonance imaging (FMRI), diffusion tensor imaging (DTI) and magnetoencephalography (MEG). These techniques detect cellular, metabolic and connectivity change but there is to date no simple robust method of identification of mTBI or PTSD beyond a proficient clinical assessment. For MEG there are both specificity and sensitivity issues. While providing insights into localisation and the pathophysiology of mTBI, there remains uncertainty concerning optimal data processing, reflected in the current MEG publications in the scientific literature. Similarly, for PTSD, MEG findings are not at present entirely consistent. We conclude that at this date and accepting that MEG shows promise in investigation of mTBI, further research is required before it finds a place as a potentially specific diagnostic test for either mTBI or PTSD (20).

31. For AFCS compensation, awards are based on functional effects and duration, and brain imaging studies are not required for diagnosis of either mTBI or PTSD. Differentiating co-existing mTBI and PTSD is not a new challenge. Ten percent of British casualties in the First World War were diagnosed with shell shock, accounting for about a third of medical discharges, if physical injury was excluded. In the period after the war there was much debate about whether shell shock was physiological or psychological. By 1939, the matter was unresolved, with most clinicians favouring a psychological explanation. In the recent conflicts and within the limits of current knowledge, where mTBI and a psychiatric diagnosis co-exist, a challenge for compensation (and clinical management) is separation of overlapping symptoms. Where there is a documented episode of mTBI and a preponderance of physical and neurological symptoms, such as headache, balance problems and cognitive impairment, the balance will favour mTBI as the primary diagnosis, while emotional and behavioural symptoms, including nightmares and hyperarousal avoidance will suggest PTSD as the main diagnosis.

# Conclusion:

- The 2013 report on mental health included a section on mTBI, a diagnosis which covers a wide range of neurological severity. Most individuals with mTBI are at the milder end, recovering rapidly and fully, but for others, symptoms can be persistent with increased rates of psychological problems, especially PTSD. New neuroimaging techniques, notably Magnetic Resonance Imaging (MRI) which detects axonal injury were emerging at the time of the 2013 IMEG report and IMEG concluded that in time these might provide early identification and differentiation of diagnoses, and guide treatment.

- At the request of Ministers, we have maintained an overview of mTBI. A section in the 2017 Fourth IMEG reported further mTBI neuro-imaging techniques, including positron emission tomography, PET, single photon emission computed tomography, SPECT and magnetoencephalography (MEG).

- As in the Fourth IMEG report, in this current review we conclude that, at present, mTBI and PTSD can be best differentiated by clinical history and examination, rather than any specific investigation. While accepting that research on MEG shows promise in mTBI investigation, and its possible differentiation from PTSD, we find at this date that it is premature to consider MEG a specific diagnostic test for either mTBI or PTSD.

- As part of the ongoing ministerial tasking, it is recommended that IMEG undertakes a comprehensive review of MEG as part of the 2020/21 Forward Work Plan for publication by the end of 2020.

# Suicide

32.  UK National statistics define suicides as all deaths from intentional self-harm in people aged 10 and over and deaths from injury or poisoning where the intention was undetermined in those aged 5 or over. Open verdict is an option available to a coroner's jury at an inquest in England and Wales. In that case the jury concludes that death is suspicious but is unable to determine a cause or reach any other verdict open to them. Open verdict deaths are included under suicide statistics. In England and Wales and Northern Ireland when someone dies unexpectedly a coroner investigates the circumstances to establish the cause of death. The subsequent inquest can take months or even years. This leads to registration delay so that around half the suicides registered in a given year will have occurred the previous year. Until July 2018 all deaths by suicide in England and Wales were determined using the criminal standard of proof "beyond all reasonable doubt". From that date "balance of probabilities", the lower standard of proof became applicable.

33.  In 2018 there were 6,507 suicides registered in the UK i.e. age standardised rate of 11.2 deaths per 100,000 population. This is higher than in 2017 and the first increase since 2013. Three quarters of deaths were in males with a rate of 17.2 deaths per 100,000 compared with female rates of 5.4 deaths per 100,000. In males the highest age specific death rate was in ages 45-49 years (27 deaths per 100,000) while rates in the under 25s in the general population have generally been increasing in recent years (21).

34.  Since 1984 MOD has published annual statistics on coroner confirmed suicide, including open death verdicts (in line with Office of National Statistics (ONS) practice), in the regular armed forces (22). This includes numbers and rates for the latest 20-year period. From 1999-2018, 310 suicides occurred among regular personnel. Of these 292 were among males and 18 females. The UK regular armed forces have seen declining rates of suicide since the 1990s and suicide remains a rare event. Rates for the three services are 8 per 100,000 naval service, 10 per 100,000 army and 5 per 100,000 RAF. Until 2018 the rates were consistently lower than in the UK general population. The only age group with a statistically raised risk of suicide was males under 20 years.

35.  Information on UK veterans is presently limited but two studies by the MOD on veterans of the 1982 Falklands campaign and 1990/91 Gulf conflict found suicide rates below that of the comparable general population (23), (24). A new study is planned to investigate all causes of death including suicide in those who served between 2001 and 2014 and deployed to Iraq and Afghanistan. This will include personnel remaining in service and those who have returned to civilian life. It will give a comprehensive picture of suicides amongst recent veterans, explore any relationship between deployment to Iraq and Afghanistan and allow comparison of suicide rates with rates in Falklands and Gulf 1990/91 conflict veterans as well as with the UK general population.

36.  Research suggests the most significant risk factor in suicide is mental health disorder of almost any type, notably the severe and enduring disorders, schizophrenia and bipolar disorder. In a military context, PTSD is associated with suicide risk and with anger and aggression, themselves risk factors. Personality disorder, especially if co-morbid with another psychiatric disorder, is a specific significant risk factor both for self-harm and suicide. Common mental health problems, anxiety and depressive disorder, are also linked to heightened suicide risk. Childhood adversity predisposes to both mental health disorders and suicide. Interpersonal and sexual violence as well as transgender status, particularly if there is victimisation, are also risk factors (25), (26). Similarly, intimate partnership abuse can be a risk. In a

military context because of employment status, debt (a significant factor in civilian life), is less commonly a risk factor for suicide. Protective factors include a sense of purpose in life, personal growth, and general optimism. The evidence suggests cognitive behavioural therapy is effective in changing attitudes and thinking. In a military context, unit cohesion and strong leadership are shown to be protective especially after deployment.

37. Suicide is also an issue in North America. Suicide rates have increased by 25% in the US general population between 1999 and 2016 and the same period has seen suicide among veterans' double from 11 per 100,000 to 22 per 100,000. US veterans have a 21% higher suicide rates than age and sex matched civilian cohorts (27). In response, US DVA and DoD have recently issued new guidelines for the assessment and management of patients at risk of suicide (28). 66% of US veterans' suicide involved a firearm and in the civilian community of 35,658 deaths by firearm in 2017, 23,854 (67%) were registered as suicide.

38. The effects of suicide on family, friends, work colleagues as well as the economic and military operational costs are high. A Defence Safety Agency focused review of suicides in August 2018 acknowledged work already being done to prevent suicide and included recommendations on enhanced and further measures , promotion of mental fitness, prevention, detection and early treatment of mental symptoms and illness with additional funding for DCMHs, unified care pathways for mental health, the 24 hour crisis Helpline and work with the Samaritans to develop resources for those contemplating suicide (29). The Samaritans project, funded by Libor, is a handy pocket guide providing guidance and sources of help for anyone contemplating suicide. The review recommended a Suicide Prevention working group and development of a suicide prevention plan. That work is now under way

# Conclusion:

- Suicide is a major issue in UK society in general and in the armed forces. We will continue to maintain contact with the emerging literature, including international armed forces community studies, with suicide rates in the UK armed forces and veterans, and the Defence Safety Agency, August 2018 recommendations on an updated suicide prevention plan.

# Overall Conclusions on the 2013 and Subsequent IMEG Mental Health Reviews

- Overall on review of the IMEG conclusions on mental health in previous reports, we remain content that the evidence examined in the current review supports the 2011 and 2013 Report recommendations on Tariff values for Table 3 mental health disorders, the 2013 report conclusions on "permanency", interim awards, parity of esteem between physical and mental disorders, and horizontal and vertical equity across the range of awards and level of awards. We also confirm the 2017 report conclusions and recommendations on the 2016 AFCS Quinquennial Review (QQR) issues.

- As part of this Fifth report we explored the literature on chronicity of disorders, notably PTSD, and conclude that while most cases of PTSD do achieve functional improvement with treatment, there are cases with persistent symptoms and disabling functional effects. Literature search for possible robust early signs or predictors of potential chronicity and/ or treatment resistance, which might lead to fewer interim awards has to date produced a range of studies but with inconsistent findings. We have therefore concluded that no reliable predictor of chronicity has yet been identified.

- We note that the new level 4 tariff and Band A GIP was introduced into legislation in April 2019.

- We will continue to: -

  i) review the emerging literature on predictors of PTSD chronicity and

  ii) investigate level 6 and 4 awards as described at para 21 above

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# Topic 6 - Cutaneous Malignant Melanoma (CMM) in Air Crew

## Key Points

1.   The 2017 IMEG report considered skin melanoma as a recognised disease and concluded that the evidence available then did not support a doubling of risk from any service exposure or factor and so the criterion for presumption of service causal connection was not met.

2.   Attention has recently been drawn to the significant literature concerning the risk of Cutaneous Malignant Melanoma (CMM) in commercial air crew. While mortality and incidence of most common cancers is lower in this group than in the general community, the evidence suggests overall that incidence and mortality for CMM is higher than in the age and sex adjusted general population.

3.   Risk factor studies have focused on occupational Ultraviolet Radiation (UVR) and cosmic radiation. On this topic many of the studies are small, reliant on self-report for diagnosis, and work conditions such as aircraft types, flight durations, shift patterns etc are very different from today. Controls are often matched only for age and sex, not skin colour and type, presence of naevi and family history.

4.   A 2005 study looked at UVR transmittance through aircraft windshields. This study found raised CMM incidence both in pilots and cabin crew and also in Air Traffic Controllers (ATCOs). Neither cabin crew nor ATCOs are at risk of occupational UVR exposure, suggesting other factors must be involved. The study did not measure cosmic radiation dose but from other studies, average annual exposure of cabin crew is low, in the range 2-6 mSv. Most international expert bodies do not consider CMM radiogenic.

5.   Considering the literature, findings are often inconsistent, and studies are almost entirely based in the Northern hemisphere. The one Southern hemisphere (Australia) 2019 study of commercial pilots followed-up from 2001-2016 for a total of 91370 person-years found 114 CMM tumours, 52 invasive and 63 in situ. When age-specific incidence rates (SIR) were compared with the corresponding general population rates there was a slightly increased rate of melanoma in situ but no increase in invasive melanoma compared with the general population.

6.   Studies of military aircrew are limited. One 2017 US study showed an increase in CMM diagnoses over time, but diagnoses were clinical, not all histologically proven. Principal service occupations were assessed only at a single point in time and despite average short service duration, follow-up finished at service termination. Overall, the evidence in commercial aircrew, with some heterogeneity, does suggest a raised risk of CMM in pilots and aircrew but does not identify mechanisms.

7.   This review had to conclude that UVR exposure might well be non-occupational and even pre-date employment. We also recognise the very different aircraft, flight duties, speeds and heights, work patterns and flight durations for military aircrew compared with commercial flying.

8.   We will continue to monitor the literature and recommend that claim determinations for CMM from pilots and flight crew should routinely have medical input and be based on individual case facts.

# Introduction and Background

**1.** The 2017 Fourth IMEG report contained a section considering Ultraviolet Light and Skin cancers, including Cutaneous Malignant Melanoma (CMM), as recognised diseases. Based on the published peer-reviewed evidence, IMEG concluded that CMM could not at that date be considered a recognised disease i.e. presumed to have service causal connection, but that each claim to AFCS should be considered on its facts.

**2.** Since publication of the Fourth report, attention has been drawn to the significant body of evidence, spanning many years, on the risk of CMM in airline pilots and aircrew. With high socioeconomic status and regular medical examinations, commercial airline pilots, the subject of most studies, are a selected population, fitter physically and mentally than the age and sex adjusted general population. Overall mortality and incidence rates of most common cancers and cardiovascular disorders in these groups are low (1). An apparent exception is CMM. The published literature on overall mortality, cancer incidence and mortality include case studies, meta-analyses and systematic reviews, and provides the strong impression that the rate of skin cancers, particularly CMM incidence, is significantly higher in pilots and aircrew than in the age and sex adjusted general population (2). CMM mortality rates have been less studied, with inconsistent results, but in some studies, death rates are increased in both pilots and aircrew, men more than women (3).

# Findings:

**3.** Studies have considered risk factors, most frequently occupation-related solar Ultraviolet Radiation (UVR) exposure. UVR is part of the continuous spectrum of electromagnetic radiation that is sunlight. This is divided arbitrarily into UVA (315-400nm), UVB (280-315nm) and UVC (315-400nm). In terms of CMM, 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 of which 90-99% might reach the skin are important. UVA can penetrate deep into the skin. Once thought to be innocuous, UVA is now considered key in carcinogenesis, where 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, skin ageing and skin cancer much more effectively through direct damage to DNA. UVA and UVB are classified by the International Agency for Research into Cancer (IARC) as group 1 carcinogens (4). An issue for occupation-related personal injury schemes, as discussed in the 2017 IMEG report, is that occupational UVR exposure is inevitably accompanied by recreational exposure, and there is no robust basis on which to apportion the two. It is also relevant in CMM that many experts believe sunburn in late childhood or adolescence to be the key aetiological factor in melanoma.

**4.** Occupational UVR exposure for pilots and aircrew is mainly through aircraft windshields. The evidence confirms that transmittance of UVB by both glass and plastic windscreens is low (less than 1%) while for the higher wavelength UVA (320-380 nm) a more varied transmittance pattern is seen, ranging from less than 1% to over 50%, with plastic attenuating UVA more effectively than glass. As well as for pilots, the incidence of melanoma is raised in cabin crew and air traffic controllers (ATCOs) (5). Neither cabin crew nor ATCOs are at risk of occupational UVR exposure and so other risk factors are likely to be implicated. The overall evidence acknowledges that despite limitations in individual study size, cancer risks e.g. breast, prostate and acute myeloid leukaemia, have been reported as raised in flight and cabin crew (6)(7)(8). Most consistent is CMM, with a large pooled study confirming the risk for CMM, but not for the other sites (9). Additional occupational hazards listed for flight crew are cosmic ionising radiation and potentially relevant personal characteristics, skin type and susceptibility to sunburn, ethnicity, cigarette smoking and recreational UVR exposure. The dos Santos study (5) referenced above,

attempted to distinguish occupational and lifestyle exposures and compared site specific cancer risk between in flight crew and air traffic control officers (ATCOs). Overall cancer incidence was lower in both sets of occupations compared to the general population, mainly owing to low rates of smoking and so smoking-related cancers, but CMM incidence was raised in both flight crew and ATCOS. In flight crew, rates increased with hours flying, suggesting a connection with occupational exposure. However, the CMM incidence rates were similar in both occupational groups suggesting that the risk is not driven by occupation-related UV or cosmic radiation (neutron and gamma), neither of which is a potential hazard for ATCOs. The strongest risk predictors in both groups were personal and lifestyle factors, skin that burns easily and sunbathing to get a tan. Both groups have access to discounted air travel. The study had some limitations including lack of cosmic radiation dose estimates.

5. Other studies of commercial aircrew have looked at cosmic radiation with dose estimates for cabin crew of 2-6 mSv per year (10) i.e. about twice UK average annual dose from background or background and medical sources. This exposure is much lower than annual background in some UK locations, dependent on underlying geology and, based on current understanding, even over many years would be associated with low risk of adverse health effects including cancers, cataract, cardiovascular disease and importantly, CMM which is not accepted by international authorities e.g. United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) as radiogenic (11). Pilot and aircrew cosmic radiation dose was estimated in the studies, using a variety of approaches, information on flying hours, employment duration, types of flight undertaken and job exposure matrices of year specific aircraft type annual dose rates. Recent and contemporary dose rates are likely to be lower reflecting time directives and industry standards on flying hours. The relation between hours worked or estimated dose in the various studies of pilots and flight attendants to CMM incidence is inconsistent with some studies suggesting raised incidence of CMM (12) but not others (13). Other issues include whether there was flying was long or short haul, or a mixture, whether it included return trips and number of daylight hours flying.

6. Most studies are retrospective cohort. Limitations in the published evidence include small study size, with only a few cases of melanoma, often identified by self-report. Particularly in respect of AFCS compensation, relevance to contemporary conditions are important. Some publications date from the 1970s and include data from the 1940s with the majority of studies analysing data now 30-40 years old. Controls are commonly matched only for age and sex but not for other potential confounders such as skin colour, type and presence of naevi or multiple naevi and family history. Few studies are based on histologically confirmed melanoma with subsequent risk of misclassification and ascertainment bias. Three mortality studies, with analyses based on national registers, found a rise in male pilots, (3)(7)(14), but this was not correlated with any assessment of cosmic radiation dose (15). By contrast no such rise in mortality from CMM was found in cabin crew (3) and as before there was no link to cosmic radiation dose (16). No study took account of recreational UVR exposure, the changing societal habits of sun exposure with inexpensive available recreational flying, use of sun beds, holidays in the sun etc., over the last fifty years; i.e. when the incidence of documented melanoma in the general community rose rapidly. Most studies finding raised incidence of melanoma are from the northern hemisphere, often Scandinavia or US.

7. A contemporary 2019 Australian cohort study of commercial pilots followed up histologically confirmed malignant melanoma from 2001-2016 (17). Observed for 91370 person-years (PYs), 114 tumours were detected, 51 invasive and 63 in situ. When age specific incidence rates (SIR) were compared with corresponding general population rates, SIR was 1.20 (0.9-1.78) for invasive melanoma and 1.39 (1.08-1.78) for melanoma in situ; i.e. there is slightly raised risk of melanoma in situ, but no elevation of invasive melanoma compared with the general population. The highest proportion of cases came from Queensland, which also has the highest average UVR exposure of all Australian states and territories. As in the rest of Australia and in many of the studies considered in this short paper, the body site distribution of melanoma showed no excess in head and neck or upper limb, as might be

expected if UVR exposure was causal. A factor may be the strong public health messages that Australia has run about prevention of sun exposure for now almost 50 years.

8.  Studies of military aircrew are limited. A 2017 study of malignant melanoma rates in different US occupational military groups over 2001-2015 found 2333 incident diagnoses of malignant melanoma (18). Rates were highest in fixed wing pilot aircrew, lowest in the infantry, special operations and combat engineers and intermediate in health care providers. Overall rates increased exponentially over the time period. Rates tended to be low during the first years of service and then increased rapidly. At least some of these findings are likely to reflect different ages in the groups (e.g. health care workers tend to be on average older than infantry soldiers), and ascertainment bias may be an issue, especially with healthcare staffs. There are some obvious limitations. Diagnoses were clinical not histological and may have included "suspected "or "rule out" diagnoses. Principal service occupations were assessed at a single point in time. Exposure to UVR and other potential risk factors are likely to have varied over time with perhaps change in role /speciality and reflecting the very different shape and variety of tasks of military employment compared with most civilian employment, e.g. outdoor activities such as training, field operations, deployments interspersed with spells of indoor work, classroom-based training etc. No account was taken in the study of off-duty exposures. In military studies the long latent period for clinical presentation of many disorders compared with the relatively short average service duration means that for completeness there should be ongoing post-service follow-up. We are unaware of any such published study in the international literature.

# Conclusion:

i. Strength of association: Those exposed to the relevant agent as compared to those not exposed (risk ratio); e.g. lung cancer in asbestos workers (20).

ii. Consistency: The finding has been repeatedly observed by different researchers at different times in different populations.

iii. Specificity: The association is limited to specific people and types and sites of disease.

iv. Temporality: The cause should always come before the effect.

v. Biological gradient: There is an exposure response; i.e. the greater the level of exposure the greater the risk of the disease.

vi. Plausibility: The finding accords with the current understanding of pathophysiology.

vii. Coherence: The finding is coherent with contemporary understanding of the natural history and biology of the disease.

viii. Experiment: There is a reduction in the incidence of the disorder when the factor is reduced or limited; e.g. by reduction or elimination of the exposure.

10.  From his initial lecture at the Royal Society of Medicine, Bradford Hill made it clear that the listed factors were not rigid or a checklist but were guidelines to inform epidemiological investigation. Of the nine viewpoints, temporality is the only one which is inarguable. Bradford Hill also reminded us of the play of chance and the utility of a test of statistical significance to prevent hasty conclusions on the generalisability of a finding in a single study. Over fifty years on, the Bradford Hill viewpoints remain the foundation of causal inference in medicine and are relevant to this paper (21).

**11.** Overall the evidence, with some heterogeneity, suggests a raised risk (in some studies doubling) of CMM in pilots and aircrew, but does not identify mechanism or causal factors. We have discussed some study limitations and now consider the evidence against the Bradford Hill viewpoints. Some of the viewpoints are met; e.g. temporality, strength of association, dose response, but others not so e.g. specificity, and raised incidence are also seen in the general population. This means in the occupational personal injury context that exposure to the causal exposure may be non-occupational and pre-date employment. Most importantly the underlying casual connection and its basis remain elusive.

**12.** Present evidence does not allow recognition of a general presumed occupational causal connection between military aircrew duties and raised risk of CMM. In the AFCS context almost all the evidence reflects circumstances long pre-dating 2005 and the introduction of the AFCS, and relates to commercial flying, which is very different in terms of aircraft types, height, speed and duration of flights, terms and conditions of flight crew service and working pattern**s.**

# Recommendation:

**13.** We will continue to monitor the literature and recommend that claim determinations for CMM from pilots and flight crew should routinely have medical input and be based on individual case facts

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# Topic 7 - Can Tinnitus be Regarded as a Stand-alone Condition under the AFCS?

## Key Points

1. Tinnitus remains a scientific and clinical enigma. It is the perception of sound in the absence of actual external sound and is a manifestation of an underlying pathology rather than a single disease. It may relate to ear pathology or to head and neck trauma, neurological, vascular, endocrine and psychiatric disorders or medication side effects and co-morbidities, particularly psychological, psychosomatic and psychiatric disorder.

2. The paper provides a summary of evidence on the present understanding of tinnitus, its characteristics, epidemiology, risk factors and correlates, as well as its clinical management, based on multidisciplinary approaches. There is also a section looking at current thinking on mechanism and pathology.

3. IMEG reviewed UK and international public compensation tinnitus approaches and the restraints imposed by the many gaps in understanding and concluded that tinnitus is heterogeneous and may or not be associated with noise exposure or hearing loss. The underlying pathogenesis and mechanism are unknown and there is no standard test for its existence, agreed scale or method of severity assessment.

4. We recommend no change to present UK no fault compensation for tinnitus and conclude that awards should not be made for tinnitus alone. We consider the AFCS approach generous and will continue to monitor the literature.

## Introduction and Background

1. Tinnitus remains a scientific and clinical enigma (1). Derived from the Latin, tinnire to ring, and defined as the perception of sound in the absence of actual external sound, tinnitus is a manifestation of an underlying pathology rather than a single disease. Although most commonly associated with ear pathologies, tinnitus can also occur in relation to head or neck trauma, neurological, vascular, endocrine, psychiatric disorders or medication side-effects and comorbidities are common with tinnitus, particularly, psychological, psychosomatic and psychiatric disorders. (2). Traditionally, tinnitus has been considered an otological disorder, but advances in neuroimaging methods and development of animal models have increasingly led to an understanding of the role of central auditory neuronal pathways and connections in tinnitus generation. It is common both in adults and children and may or may not be distressing, with variable impact on activities, lifestyle and quality of life. There is no standard test for the existence of tinnitus nor method of assessment of its severity, although subjective durations of impairment, such as none, occasional, repeated and constant intrusion have been suggested as a grading mechanism (2).

2. In recent months, the question has been raised as to whether tinnitus can be accepted as a discrete compensable disorder under the AFCS. To our knowledge, the present AFCS approach to tinnitus compensation is unique in public schemes. The AFCS makes awards for injury or disorder, on balance of probabilities, predominantly due to service-related incidents or exposures on or after 6 April 2005.

Health and Safety legislation and MOD policy at that date and subsequently, mean that claims for chronic noise induced sensorineural hearing loss are rarely awarded under the AFCS, but where hearing loss, sensorineural or other is accepted under the AFCS, the level of the award includes an element which recognises the presence of severe disruptive tinnitus, paid regardless of whether the claimant suffers troublesome tinnitus or not. A fuller discussion of the treatment of tinnitus under the current UK benefit system and other public compensation schemes is included later in this paper.

# Characteristics of Tinnitus

**3.** Tinnitus is a heterogeneous symptom in terms of causation, quality, intensity, intrusiveness and comorbidities. Most commonly it is subjective (heard only by the person), but can be objective, meaning it can be heard by others, unilateral or bilateral, pulsatile or non-pulsatile. In many cases, there is associated hearing loss. The patient may associate it with one or both ears or may report its origin within the head or even external to the body. Tinnitus may be constant or intermittent with an abrupt or, more commonly, insidious onset. Intermittent tinnitus is an almost universal experience and is generally considered non-pathological. The quality of tinnitus is variable and where there is also hearing loss, there is often no direct relation between its quality or volume /amplitude and the degree of hearing loss (3). The distress of tinnitus is not associated with acoustic characteristics but correlates with psychological symptoms (2). Significant tinnitus is also associated with concentration and sleep difficulties (1).

# Epidemiology

**4.** Because of methodological issues such as the definition of tinnitus and assessment of its severity, prevalence estimates of tinnitus are wide (4)(5). A large and reliable study of troubling tinnitus was the UK National Survey of Hearing, which included over 48,000 adults and found a prevalence of 10.1% with 2.8% describing the tinnitus as "moderately annoying", 1.6% as "severely annoying" and 0.5% as causing "marked impairment of everyday life "(6). The prevalence of tinnitus increases with age up to 70 years, after which some studies suggest it may reduce. There are few incidence studies, but a recent UK general practice study of 109,783 adults with a first-time diagnosis of tinnitus between 2000 and 2016, reported an overall age-standardized incidence rate of 25.0 new tinnitus cases per 10,000 person-years (7). In another large observational UK study, an incidence rate of 5.4 cases of clinically significant tinnitus per 10,000 person-years was reported (8) while, in the Beaver Dam study of a population aged 48-92 years, a baseline prevalence of 8.2% was recorded. Over time the tinnitus improved in the main with cumulative incidence of new cases, over 5 years, 5.7% (9) and at 10 years, 12.7% (10). A recent report of the incidence of tinnitus diagnoses, based on the International Classification of Diseases, in military electronic health records of 85,438 US active duty service members between 2001 and 2015 recorded the incidence rate of tinnitus (per 1,000) rising consistently from 1.84 in 2001 to 6.33 in 2015 (11).

# Risk Factors and Correlates of Tinnitus

**5.** The main risk factor is hearing loss, notably age-related sensorineural loss, noise induced sensorineural hearing loss, otosclerosis, Meniere's disease, noise exposure and impacted cerumen, while all inner ear disorders are associated with increased prevalence of tinnitus (1). A 2010 Health and Safety Executive (HSE) review of the published peer-reviewed English language literature on tinnitus and its relation to noise exposure at work and noise induced hearing loss, reviewed 23 studies (12). A wide range of tinnitus prevalence was noted (5.9% to 87.5%). This was not unexpected given the different contexts of the studies, which included surveillance surveys and compensation claimants. Other issues included

different definitions of tinnitus and types and levels of noise exposure. The prevalence of tinnitus was higher in those exposed to noise, compared with non-noise exposed, and varied with the noise level and exposure duration. Most studies were cross-sectional but one longitudinal study with 15 years of follow-up suggested that tinnitus may be an early indicator of noise induced hearing loss. In that study tinnitus fluctuated over the study duration, with 16% reporting complete resolution. Where patients also reported anxiety or depression the tinnitus was more troublesome (13).

6. Neurological disorders associated with tinnitus include traumatic head injury, multiple sclerosis, acoustic neuroma and other cerebellopontine angle tumours. In addition, 10% of tinnitus sufferers have normal pure tone audiometry, which has been demonstrated electrophysiologically to be associated with reduced cochlear output, hypothesised to lead to an altered response of neurons in the central auditory system, producing tinnitus (14). Tinnitus may also be associated with infections such as otitis externa and media, meningitis and neurosyphilis and with mechanical causes which include temporomandibular joint problems and neck injury. Other factors include recreational and occupational noise exposure, the latter regarded as the second most common association (1).

7. Causes of objective tinnitus are very rare and relate to conditions that produce sound within or near the ear. Possible vascular disorders include arteriovenous malformations, vascular tumours, carotid or vertebral artery stenosis, aortic stenosis and mitral regurgitation. There are also rare mechanical causes, such as patulous eustachian tube, palatal myoclonus and myoclonus of middle ear muscles (15), while in about 40% of patients no cause is identified (16). Oral medications which may cause tinnitus include aspirin and non-steroidal anti-inflammatory agents, which can also cause reversible hearing loss, anti-malarials, including quinine and chloroquine, loop diuretics, frusemide and bumetanide, antibiotics, such as tetracyclines, doxycycline and minocycline, and macrolides such as erythromycin and aminoglycosides, where hearing loss may be permanent. There may also be risk from cytotoxic drugs such as cisplatin. The risk of medication related tinnitus can be reduced by minimising the dose and duration of treatment and use of only one drug type, although inter-subject variability in the prevalence and severity of ototoxicity among patients receiving similar treatment suggests genetic susceptibility as a risk factor (17)(18). Factors including obesity, cigarette smoking and alcohol consumption (6) have also been implicated.

8. Tinnitus has frequent co-morbidities including depressive and anxiety disorders (19). Depressive illness is found in about a third of patients (20), whereas the lifetime prevalence of anxiety disorders has been calculated as 45% (21). The presence of a mood disorder with tinnitus is associated with greater disability. There is some evidence of a genetic influence. A 2019 Swedish adoptee longitudinal study, based on nation-wide case control register data collected between 1964 and 2015, separated genetic and environmental factors in 1060 adoptees, 19015 adoptive parents and 17025 biological parents. In both adoptive and biological parents about half those with tinnitus also had hearing loss, although type was not specified. The prevalence of clinically significant tinnitus was 2.2% and the Odds Ratio (OR) 2.2 for adoptees with biological parents with tinnitus as compared with OR 1.0 for those with an affected adoptive parent (22).

# Mechanism and Pathology of Tinnitus

9. Although tinnitus is a heterogeneous symptom arising in a range of different circumstances, most research on mechanism and pathogenesis has been on tinnitus with associated hearing loss or noise exposure and carried out in small animals (2). The validity of this model is questioned by some experts (23). Results are conflicting with issues such as time course of symptom onset being out of step with possible mechanisms. For example, tinnitus may have rapid onset after noise exposure, but changes in the cortical auditory system postulated as the basis of the tinnitus is established only after a much longer time course; so as yet the mechanism of tinnitus in any context remains unclear (24).

The auditory pathway is made up of the peripheral system (i.e. outer, middle and inner ear) and the central auditory pathway, involving brainstem and auditory cortex. Normal continuous spontaneous neurological activity in the cochlea may be perceived as tinnitus in a silent anechoic environment, but normal environmental sounds usually mask it and the central auditory system selectively filters it out. Tinnitus may be experienced if the cochlea is damaged, e.g. by noise injury, or the environmental sound masking is reduced by impaired hearing or a quiet environment, or the central auditory system of inhibitory activity also fails. Reasons for these events are unknown. Tinnitus can occur in people with a severed auditory nerve suggesting that tinnitus might arise in the absence of input from the ear and be caused by abnormal neural activity generated in the brain without afferent activity from the ear. One possible explanation is that cochlear hearing loss causes reduced cochlear nerve activity and so the inhibitory cortical processes are also reduced and a state of cortical hyperexcitability and downregulation of the cochlear processes results. It is this abnormal cortical neural activity which leads to tinnitus. However, this hypothesis is not proven. Tinnitus is usually experienced soon after hearing loss, but the suggested downregulation changes in the central auditory structures take hours or days to be established.

10. The sensation of tinnitus and its effects on people in many ways resemble chronic neuropathic pain in phantom limb syndrome (25)(26). Here symptoms are referred to a different part of the body from the site of pain generation. Both chronic neuropathic pain and tinnitus include strong emotional elements and discrete affective disorders may also be present (27). In both conditions, there are no essential physical signs nor an objective test of severity. In chronic tinnitus with ear abnormality, tinnitus can be maintained over time without input from the ear. It is now generally agreed by experts that this is due to neuroplasticity.

11. In most circumstances, e.g. post head injury, the results of neuroplasticity are beneficial. However, maladaptive neuroplasticity is also recognised leading to harm and disease symptoms, e.g. chronic neuropathic pain, muscle spasticity and muscle spasm. Such a mechanism is increasingly being recognised in phantom limb pain. Here, pain and other symptoms are referred to an amputated limb in a situation where the symptoms could not have been elicited from that limb but are generated by functional pathologies in the central nervous system (28). Neuroimaging suggests that brain structural anatomical changes in tinnitus are unremarkable (29), but more recent functional neuroimaging studies suggest that functional connectivity in the brainstem of people with tinnitus may be involved. Further the observed changes involve parts of the brain remote from the auditory structures notably the limbic structures, amygdala and dorsomedial thalamus (30).

# Clinical Management

12. About 6 million adults in the UK have experienced prolonged tinnitus with most managed in primary care (31). In addition to its 2017 Clinical Knowledge Summary (15), the National Institute for Health and Care Excellence and a large European consortium (2) are presently developing guidelines on assessment, investigation and management of people presenting with tinnitus, including when to refer for specialist management. Since tinnitus is a heterogeneous symptom, linked to a range of underlying or associated pathologies, no single approach to clinical management is effective for the different types, nor without potentially serious side effects. This means that for most cases of tinnitus, lacking an identified underlying condition or pathological mechanism, treatment is based on education, reassurance, conservative supportive measures and, where hearing loss is significant, hearing aids. As no standard test for the existence of tinnitus or objective measure of its disabling effects is available, the diagnosis and physical examination are guided by a detailed clinical history of tinnitus characteristics and audiological, physical and psychological medical history. In most cases it is important not to over-investigate, but all patients with tinnitus should have an audiological assessment. Further referral for MRI imaging or specialist audio-vestibular physician or otolaryngologist

opinion should be guided by the history, clinical examination, otoscopy and audiological findings. Urgent or early secondary referral indications include unilateral or pulsatile tinnitus, tinnitus associated with head injury, and with vascular or neurological signs, facial weakness or severe vertigo. Other reasons for specialist referral, include duration of six months or more, abnormal otoscopy, significant co-morbidities, unilateral non pulsatile tinnitus and bilateral sensorineural hearing loss greater than expected for age.

13. Public and occupational health and primary care have important roles in primary and secondary prevention through key messaging on recreational and occupational noise prevention and limitation. Given its likely role in early onset of age-related hearing loss the importance of healthy lifestyle, including diet, lowering cholesterol and glycaemic load should also be stressed (32). Conservative measures empowering patients to self-care, with reliable information and learning resources, and signposting to appropriate sources of support are initial best practice treatment for persistent bothersome bilateral tinnitus, without marked hearing loss. Some patients without marked audiometric hearing threshold deficit report benefit from hearing aids, acting as maskers by introducing more ambient noise. Use of hearing aids have not been the subject of robust randomised controlled trials and is not endorsed by the current European guideline for tinnitus management in the absence of audiometric hearing loss (2). In some cases, specialized tinnitus maskers are indicated. White noise or environmental devices emitting other sources of background noise, especially at bedtime, can help.

14. No medications are licensed in the UK for treatment of spontaneous tinnitus and, although many have been tried, results in the individual patient have been variable and all potentially carry some risk. Where clinical trials have been conducted, results have similarly been inconsistent. Pre-existing or co-existing anxiety and depressive disorders are common comorbidities with moderate and severe tinnitus and should be treated appropriately. The 2016 Pattyn systematic review (21) suggested that treatment of anxiety disorders may be associated with improvement in the tinnitus symptoms and effects. In persistent tinnitus cases, there is no robust evidence that drugs, neurostimulation, tinnitus masking, tinnitus training therapy, sound therapy, music therapy or dietary and alternative therapies are effective in tinnitus management. However, there is some evidence to suggest tinnitus retraining therapy, may help reduce both symptoms and associated disability and encourage habituation to the tinnitus, particularly in severely affected cases (33), while a randomised controlled trial (RCT) found that acceptance and commitment therapy was beneficial in normal hearing tinnitus sufferers (34). However, cognitive behaviour therapy (CBT) has the strongest evidence base for efficacy in the management of tinnitus (35).

15. Reflecting overall contemporary evidence, best practice management of tinnitus can be summarised as providing tinnitus specific counselling and advice, validated tinnitus-specific, cognitive behavioural therapy and auditory therapeutic measures for the treatment of concomitant hearing loss and comorbidities. Depression and anxiety should be appropriately treated, with pharmacological support if necessary. Psychiatric treatment should also be given on a case-by-case basis as required. With profound hearing loss, cochlear implantation may be appropriate (36).

# Public Compensation and Tinnitus

16. Where tinnitus is associated with a primary disorder or injury, e.g. traumatic brain injury, which is accepted for AFCS compensation, the assessment and award will take account of the tinnitus as part of the primary disorder. In the more common situation, where tinnitus is related to noise exposure or hearing loss different arrangements apply in different schemes. There is presently no standard test for the existence of tinnitus or measure of its severity and disabling effects. Attempts at matching and masking techniques and sound synthesizers to assess pitch band with loudness and mask ability

have produced only inconsistent results. Validated standardized grading measure scales for tinnitus severity (37), (38), for clinical management, compensation or disability benefits, have been proposed but none has been generally accepted or adopted. This means that the various schemes lack common approaches to definitions and approaches which reflect expert adviser opinion not generally accepted scientific understanding. Issues affected include scheme definitions of the various degrees of tinnitus severity and its assessment.

17. In international military and occupational injury compensation schemes, tinnitus claims arise most commonly in relation to noise exposure, acoustic trauma or chronic industrial noise hearing damage. Severe tinnitus is often accepted as present where onset has been within a year of noise exposure, has lasted for more than two years, is audible at least 50% of the time, interferes with sleep and concentration and the claimant have sought specialist medical help prior to making the claim. Compensation and benefit systems generally address a wide spectrum of disorders and award outcomes aim to be fair, consistent, equitable and in line with the legislation across the injuries and disorders. Inevitably, there is a degree of arbitrariness in both diagnosis of tinnitus and assessment of severity. In the UK compensation and disability benefits systems, including the War Pensions Scheme and the related Industrial Injuries Disablement Benefit Scheme, where there is a compensable type and level of hearing loss, an addition for tinnitus may be made to the assessment and hence award.

18. There is no international consensus on the size of the addition for tinnitus severity. Some schemes, for example Workers' Compensation schemes in some US states and Canada simply decline to compensate tinnitus. In other countries, e.g. Australia, a flat rate of 5% is added to compensation payable for a noise induced hearing deficit. In yet other schemes, the addition is variable, usually a low addition, e.g. Germany where 2.5-10% is permissible. In the US military scheme, the Department of Veterans Affairs guidelines set out criteria to be met for tinnitus recognition in awards as follows: -

   - the claim must be unsolicited

   - there must be a compensable level of hearing loss

   - the claimant must have sought and engaged with treatment of medication, counselling or hearing devices

   - there must be evidence of evidence of personality change or sleep disturbance

   - there must be no other explanation of the symptoms e.g. substance misuse, therapeutic drugs etc.

   - any claim based on self-reported history must be substantiated by family member or significant other

19. One of the most recent military compensation schemes (1998) has been set up in Ireland (39). The scheme was advised by an Expert Group following extensive literature review and discussion with national and international audiological scientists and otolaryngologists with an interest in hearing loss and tinnitus. The subsequent report grades tinnitus as slight, mild, moderate and severe and sets out the published peer-reviewed evidence underlying their recommendations but no definitive criteria for each severity category. Because of the many evidence gaps, inevitably there is much reliance on group members' expert opinion. Compensation is paid for tinnitus only where evidence confirms that it has existed for two years and occurs for 50% of the time. It should have had close time onset to the hearing loss and the complaint should be medically documented ahead of any claim. Assessment additions suggested by the Expert Group are: - mild tinnitus Nil %, moderate 2% and severe 6%.

# Conclusion:

**20.** Tinnitus is a heterogeneous symptom and may or may not be associated with noise injury or hearing loss. When claimed in a civilian or military occupational context there is usually contention of a connection to noise exposure or noise related hearing loss. While this circumstance is most researched, the underlying pathogenesis and mechanism of tinnitus remains unknown. The advent of new brain functional imaging techniques may bring progress. There is no standard test of its existence nor objective method of tinnitus assessment. Most countries' public schemes either do not compensate tinnitus or do so only in a very limited way.

# Recommendations:

- In the UK War Pensions Scheme (WPS) we recommend maintenance of the present approach. Where tinnitus accompanies a compensable level of accepted hearing loss, a small addition for tinnitus may be made. This will be less than 20% added to the hearing loss assessment.

- For the AFCS, we recommend retention of the present approach. Lump sum tariff awards for hearing loss will take account of severe tinnitus, regardless of whether the claimant suffers this.

- Based on present limited understanding, as discussed above, we recommend no change in the present AFCS approach to tinnitus compensation.

- The evidence does not support AFCS awards for tinnitus arising in the absence of a compensable level of service-related hearing loss. We will continue to monitor the literature.

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# Topic 8 - Recognised Diseases: Radiation and Ocular Melanoma

## Key Points

1. For completeness, and despite its rarity and our being unaware of any claims under the AFCS, we include a short section on Ocular Melanoma (OM) as a recognised disease.

2. Literature scrutiny provided information on definition and epidemiology. There are two types of OM, the more common Uveal Melanoma (UM) arising from the iris, choroid, ciliary body and the much rarer conjunctival melanoma. Age standardised rate is 0.4-1.2 cases per 100,000 and OM occurs most commonly in Caucasians and presents in the sixth or seventh decade of life.

3. The review covers diagnosis, clinical management, treatments and prognosis. If UM metastasises, spread is mainly blood-borne to lung, bone or subcutaneous tissues. Spread may occur early or only 10 plus years after initial treatment. When the tumour spreads, survival is limited to about 10-15% at one year.

4. The aetiology of OM or its sub-types is unknown. Risk factors include age, sex, ethnicity, socio-economic group, smoking, light eyes, fair skin, poor tanning, ocular melanosis, dysplastic naevi, family history as well as certain mutations in the tumours.

5. A role for UVR has been investigated with conflicting results. The 2003 US Survivor Epidemiological and End Results (SEER) study found no population increase in OM over the period 1974-98 in contrast to the position with skin melanoma. International Agency for Research on Cancer (IARC) investigated the relation between OM site and sites deemed accessible by sun exposure. Two studies suggested that tumours occurred in areas exposed to sunlight but the third did not. In a further ten studies of different design, findings on the OM link with UVR exposure were inconsistent. Other studies suggest that personal factors such as light eyes, fair skin and burning easily were predictors.

6. We conclude that at present neither OM nor its sub-types can be accepted as recognised diseases in the AFCS. More research, which we will keep under routine review, is awaited. Where AFCS scheme members make a claim, the determination will be based on the individual case facts, including full occupational history, contemporary medical understanding of causation and progress, and the relevant legislation.
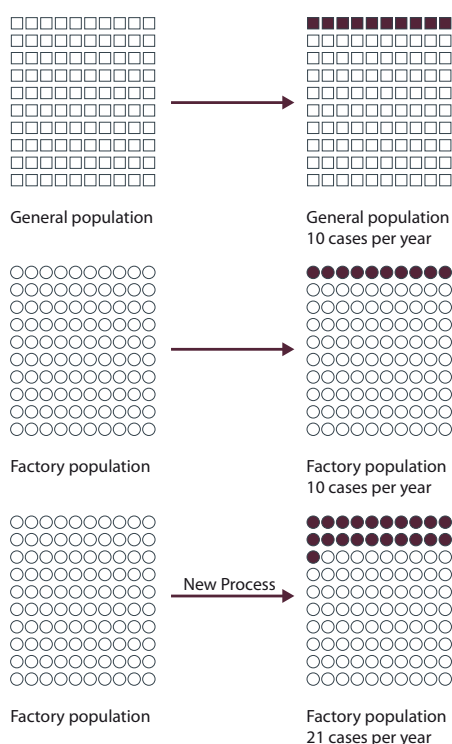
## Introduction

1. IMEG has previously reviewed the evidence on causation and possible service causes, particularly ultraviolet radiation exposure, for skin tumours, including Cutaneous Malignant Melanoma (CMM) (1), and in this Fifth report there is a section on CMM in aircrew. We are unaware of any claims for ocular melanoma under the AFCS but for completeness this paper briefly considers ocular melanoma as a recognised disease in the armed forces population. Ahead of detailed consideration of the topic we have reproduced the introduction to Recognised Diseases first set out in the Second 2013 IMEG report.

# Recognised Diseases

Ahead of the paper on Ocular Melanoma 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 10 each year, i.e. no different



General population

General population
10 cases per year

Factory population

Factory population
10 cases per year

New Process

Factory population

Factory population
21 cases per year

**Fig 1. Increased incidence of disease from ten percent 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.

# Definition and Epidemiology

13.　Ocular melanoma (OM) is the most common adult intraocular tumour. It is much less common than Cutaneous Melanoma (CMM), accounting for fewer than 5% total melanoma cases. There are two sub-types, Uveal Melanoma (UM) arising from the iris, choroid and ciliary body and, Conjunctival Melanoma (CM). UM accounts for over 85% of cases of OM, while CM constitutes an estimated 5% OM cases. OM is most common in Caucasians and then Hispanics, with age standardised rates of about 0.4-1.2 cases per 100,000 within Europe and usually presenting in the sixth or seventh decade of life (2). While overall rates of OM have been fairly steady over the last 35 years, in US Caucasians, the incidence rates of CM in males, as with CMM, appears to have been rising (3), and a Danish study showed an increase in rates of OM in Caucasian men of about 300% over the period 1943-1997 (4).

14.　The uvea is made up of the iris, choroid and ciliary body. Some tumours are large and involve several parts of the uvea. True iris melanomas arise in, and are restricted to, the iris as opposed to spread from other structures and are distinct in their aetiology and prognosis, compared with the other UM types, collectively referred to as posterior uveal melanomas. Iris melanomas make up about 10% of total OM and usually have low grade histology, and a good prognosis. Benign pigmented iris lesions, iris freckles and naevi, are common in Caucasians occurring in 5-10% and rarely becoming malignant. These benign lesions provide no disabling effects. Iris melanomas are less likely to metastasize than choroidal melanomas and, if detected and treated early, are unlikely to lead to impaired vision. Like skin melanomas, iris melanomas may contain BRAF mutations classically associated with UV exposure (5).

15.　Posterior uveal tumours, including malignant choroidal tumours, may also arise in benign pigmented lesions. They are not associated with BRAF mutations but, similar to blue naevi and ocular melanosis,

may contain GNAQ/GNA 11 or BAP1 mutations (6)(7). GNAQ and GNA 11 mutations occur early in tumorigenesis and do not predict prognosis (8), while BAP1 are strong predictors of metastatic spread and prognosis (9).

# Diagnosis and Clinical Management

**16.** OM of all types usually presents as a visual problem or is detected as an incidental finding (2). Confirmation of diagnosis is usually by fundoscopic examination by an expert clinician followed, as clinically appropriate, by ancillary tests such as angiography, ultrasonography, tomography, autofluorescense and, for prognosis, cytogenetic analysis (10).

# Treatment

**17.** Because OM is a rare tumour, meaningful randomised clinical trials evaluating treatment efficacy and effectiveness are limited and different interventions are often sponsored as best practice at different institutions. Especially for larger or symptomatic pigmented lesions, early detection and assessment of malignancy, followed by active treatment, are important in prevention of metastases, preservation of vision and disease survival. Since the 1980s, the current main treatment options are surgical or radiotherapy (RT), usually with charged particles or by brachytherapy. Newer less invasive protocols, including both surgical and RT and later chemotherapy, have been introduced, but in some cases have been reported as associated with subsequent visual loss and recurrence (11).

# Prognosis

**18.** Uveal melanoma metastasizes in about half the patients by blood borne spread or local extension and in 80-90% cases spread is to the liver (13). Lung, bone and subcutaneous tissues may also be involved. When melanoma spreads, the current five-year survival rate is about 15% (14). Spread may develop early or late; i.e.10 or more years after treatment of the primary tumour (15). Current treatment of metastatic spread is limited with median survival, where there is liver involvement, of four or five months and a 1-year survival of 10-15% (16). Indicators of poor prognosis include older age, large tumour size, extra-scleral direct extension, ciliary body involvement and histological type (17).

# Aetiology and Risk Factors

**19.** The aetiology of OM remains unknown. Published peer reviewed studies remain rare and are mainly case control in design with few longitudinal studies. Numerous risk factors, genetic and environmental have been identified or proposed but results are inconsistent (12). Work on causation of OM is hampered by its rarity and the different sub-types, the poor prognosis of OM, and so small study size. Studies do not always define caseness by objective criteria (eg histopathological confirmation) and issues such as suitable and adequately matched controls further limit studies. The sub-types of OM demonstrate different characteristics suggesting that different risk factors may apply. Suggested risk factors to date include age, sex, ethnicity, socioeconomic group, smoking cigarettes, light eyes, fair skin, poor tanning, ocular melanosis, dysplastic naevi, family history as well as the presence of certain mutations in the tumours.

**20.** The emerging understanding of a role for ultraviolet radiation in skin melanoma - cutaneous malignant melanoma, CMM - has led to expanded investigation of UVR and other radiation in OM. World Health Organisation (WHO)  International Agency for Research on Cancer (IARC) Monograph

55, dated 1992 (18), and more recent update in 2012 (19) looked at solar and UVR radiation with commentary on the evidence of its connection to OM. It was noted that the 2003 study, based on US Survivor Epidemiological and End Results (SEER) data, found no increase in OM over the period 1974-98 in contrast to the position on CMM (20). Three further studies examined by IARC, considered the distribution of choroidal melanomas in relation to ocular sites deemed accessible by sun exposure. Results in two studies suggested that tumours occurred in areas exposed to sunlight (21), (22) while the third, a much smaller study, found no preferential allocation of tumours related to likely sun penetration (23).

21. Nine case control studies and one cohort study reported on associations of sun exposure with OM. Four studies found increased risk for iris melanoma (IM) in people with light skin, eye or hair colour (24-27) and there was a link to outdoor activities in one of these (27). Four studies found an association between some measure of sun exposure and OM (26-29). In one (26) this was with sun exposure assessed by birth in a US southern latitude state compared with birth in a northern state. There was a further independent link of OM to dose of sun exposure based on duration of residence in the south or occupational exposure (26), (28). There were two meta-analyses. The 2005 meta-analysis of Shah (30) included both case control and cohort studies and found no association with latitude of birth or outside leisure activity with OM, but weak evidence that the highest occupational exposures might increase OM risk; the relative risk was 1.4 (95% CI 0.9-1.5). The Weis 2006 meta- analysis (31) found strong evidence that having light eyes, fair skin and burning easily were associated with increased risk of OM. The IARC review also looked at artificial tanning, finding some evidence of a relation between that and OM, and where considered, an increased risk of OM with duration of use and use of artificial tanning from an early age (pre 20 years).

22. The IARC also considered occupation studies on cancer causation and the IARC report of 1990 focussed on welding (32). Six case control studies examined arc welding and OM, finding a positive association and dose response relationship based on job duration. In their evaluation of the two sets of reviews, IARC concluded there was: -

    i) sufficient evidence in humans to accept the carcinogenicity of solar radiation and for a positive association between solar radiation and OM.

    ii) sufficient evidence in humans to accept the carcinogenicity of UVR emitted from tanning devices including a dose associated causal association with OM.

    iii) sufficient evidence to accept the carcinogenicity of welding and that current evidence establishes arc-welding as a cause of OM but with low risk and at present the underlying mechanisms are not clear; e.g. fumes, UVR or blue light

23. There have also been occupational studies on cooking and "working more than six months as a cook" has been proposed as a risk factor for OM. Again, the literature is restricted to small case control studies with often non-significant relative risk values. The first study to suggest a link had only two cases and six controls (33). Further, no possible basis for the link has been proposed or tested. The studies which have considered duration of employment as a cook have been conflicting (34) (35).

# Conclusion:

24. Based on available evidence we cannot at this date recommend recognition of ocular melanoma (OM) or its sub-types, uveal melanoma (UM) and conjunctival melanoma (CM), as a recognised disease. More research, which we will keep under routine review, is awaited. Where AFCS scheme members make a

claim, the determination will be based on the individual case facts, including full occupational history, contemporary medical understanding of causation and progress, and the relevant legislation.

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# IMEG STAKEHOLDER MEETING

## 28 October 2019

1. Professor Sir Anthony Newman Taylor, Chair, welcomed the guests and the opportunity of the meeting to increase the 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. Following introductions, Professor Newman Taylor outlined some key features of AFCS. A no-fault scheme, where claims can be made while serving, the standard of proof is balance of probabilities, with awards made where service on or after 6 April 2005 is the predominant cause of the injury or disorder. AFCS has normal time limits but includes a provision for late onset disorders. Awards are tariff based and the aim is to make the highest awards for those most seriously disabled due to service. Awards comprise a lump sum for pain and suffering and, for the more serious injuries, which reduce capacity for future suitable civilian employment, there is an additional Guaranteed Income Payment (GIP), paid from service termination for life. To give financial certainty and allow people to move on with their lives, awards are made final as early as possible after claim, and when the injury or disorder is in optimal steady state following an adequate course of best practice treatment.

2. Professor Newman Taylor reminded the audience of the background to IMEG. It was set up following a recommendation by Lord Boyce's 2010 review of AFCS. IMEG is a non- departmental body with members appointed according to Cabinet Office rules. The role of the group is to advise Minister on the medical and scientific aspects of AFCS. IMEG advice is evidence based, expert, independent and transparent. Suggestions for topics come from individual claimants, representative bodies, clinicians, the chain of command service personnel, welfare and support staff, veterans and members of the public. IMEG is then tasked by Minister. To date four reports have been published, January 2011, May 2013, March 2015 and December 2017. The Fifth report will be published in early 2020.

3. Professor Newman Taylor spoke on key concepts in the Scheme including the standard of proof, balance of probabilities, causation, prognosis and functional capacity for civilian work and how that might be impacted by injury or disorder. He then summarised topics covered in reports to date. In the 2011 First Report there was a section on external injury to genitalia in men and women, brain and spinal cord injury, loss of the use of a limb and a preliminary look at mental health and hearing loss disorders. For the 2013 Second Report Lord Boyce requested a more in-depth review of mental health, hearing loss and facial disfigurement. The concept of a "recognised" disease, that is, a disorder whose causal link to service can be presumed on balance of probabilities was discussed, and the report considered multiple sclerosis, epilepsy, meningitis, encephalitis and asthma against the criteria. The 2015 report included Q fever and its sequelae, especially fatiguing illness, mesothelioma, and non-freezing cold injury (NFCI). There were sections on the long- term effects of lower limb amputations, covering non-cardiovascular and cardiovascular effects, as well as comment on retained complex lower limb injuries. Also included were some more potential recognised diseases including diabetes mellitus, testicular cancer and the leukaemias. The December 2017 Fourth report included part 1 of the scrutiny of musculoskeletal (MSK) disorders, traumatic brain injury, validation of the Departmental Policy Statement on Ionising Radiation and related adverse health effects and ultraviolet light and skin cancer, as a recognised disease. There was also discussion of spanning and worsening cases and the IMEG response to issues raised in the 2016 AFCS Quinquennial Review (QQR). For the Fifth report, topics include the hazards, risks and adverse health effects of remotely piloted aircraft systems, aircraft cabin air quality, mental health symptoms, diagnoses and cardiovascular diseases, musculoskeletal (MSK) disorders part 2, a review of the 2013 IMEG report and recommendations on mental health, and papers on skin melanoma in aircrew, tinnitus as a stand-alone disorder and ocular melanoma as a recognised disease.

**4.** Professor Newman Taylor ended with a short update on the Advance Study. This collaboration between MOD, Imperial College and King's College, London is a 20-year prospective study to investigate long term physical and psychosocial outcomes of battle field trauma casualties from Afghanistan. It involves 1,200 Afghanistan veterans 2003-2014 divided into an injured group of 600, who were aero-medically evacuated and directly admitted to a UK hospital during or after 2003. The comparison group is 600 uninjured personnel matched for age, sex, rank, deployment and combat role. The study is investigating long-term cardiovascular, musculoskeletal and psychosocial outcomes.

**5.** Professor Newman Taylor then introduced Professor David Snashall to speak on Civilian employment of ex-military personnel. As indicated when outlining the scheme and its aims, a striking feature of military personnel, including those injured or who become sick during, or as a result of, service is their youth. A major aim of service treatment and rehabilitation and AFCS is to support people into a fulfilling future life of which paid work, wherever possible, is a key factor. Where transfer to another service or principle service occupation is not feasible, the injured person will be medically discharged and supported to undertake suitable civilian work in an environment to which the Equality Act applies.

**6.** Professor Snashall spoke first about the medical discharge rates for the three services and the most vulnerable groups, women, the untrained, other ranks and, except in the RAF, younger personnel. Medical discharge rates were generally decreasing, and the most common reasons are first Musculoskeletal (MSK) disorders, most frequently back and knee pain. MSK disorders accounted for about 50% medical discharges and for about 30%, and second most common group, mental health disorders.

**7.** A general overview of UK civilian employment revealed that more people are presently employed than ever before. In 2019 the figure was about 33 million, up from 27 million in 2006 and 24 million in 1978. Reference was also made to the changes in the sectors providing employment from the mid-19th until early 21st century with a decline in agriculture, manufacturing and mining, but very significant expansion in service industries, particularly public sector, finance, leisure and hospitality and distribution. Transport (except the docks) and construction tended to remain steady over the period. Professor Snashall confirmed government commitment to supporting people with disability into work. Currently about 48% of the UK's 8.5 million people with disability are employed and government is emphasising future further reduction of numbers on benefits.

**8.** Dr John Scadding then gave a presentation on Pain in Musculoskeletal (MSK) Disorders. He began by outlining some of the limitations in precise diagnosis of MSK disorders, so that frequently specific diagnoses are not reached for knee, low back or groin pain. Dr Scadding considered that imaging, including MRI scanning could be unhelpful in some circumstances. A normal MRI scan does not preclude pathology, and abnormalities demonstrated may not be the source of the pain, usually the most commanding symptom in MSK disorders. Pain often resolves over time with natural healing, but fear of worsening the problem may lead to avoidance of mobility or activity, including remaining in or returning to work. This in turn may increase the disabling effects. Co-morbidities are common, including anxiety, low mood, insomnia, adverse effects of therapeutic drugs, substance misuse, debt, relationship difficulty and family dysfunction.

**9.** Dr Scadding discussed features and current understanding of the mechanism of nociceptive pain, which is "normal " pain with a clear bioprotective function. In 1983 spinal central sensitization (CS) was discovered. This leads to pain amplification, expanding duration and the area affected, but is a normal response to prolonged superficial or deep tissue injury. The short-term function of CS is to allow rest to promote healing. CS is reversible with tissue repair and healing. Dr Scadding next introduced neuropathic pain, defined as pain arising as a direct consequence of a lesion or disease affecting the somatosensory system. Neuropathic pain responds poorly to simple analgesia and anti-inflammatories. There may be associated sensory symptoms such as numbness, and it is frequently accompanied by co-morbidities. It is now understood that mechanisms in neuropathic pain are quite different from

those in nociceptive pain involving disruption of normal neuronal activity and probable structural reorganisation. While nociceptive pain and central sensitisation (CS) are potentially reversible as the injury heals, that is not always the case with neuropathic pain.

10.     In most patients with MSK disorders, the pain is nociceptive but in a small minority where there is low back or neck pain with a disc prolapse or vertebral fracture there may be spinal nerve root or spinal cord irritation or compression, with associated neurological deficit. In this situation surgical decompression is likely to resolve the neuropathic pain. Neuropathic pain may also arise with long bone fractures that damage major peripheral nerves. Dr Scadding then briefly discussed Complex Regional Pain Syndrome (CRPS) types 1 and 2, confirming that presently the pathogenesis is uncertain. CRPS type 1 is more common in the military population following fracture or soft tissue injuries, while CRPS 2 results from injuries to peripheral nerves. It is uncommon in military populations.

11.     Dr Scadding ended with discussion of the principles of clinical management of pain in MSK disorders. Surgery has little place in management. He stressed the use of simple analgesia and non-steroidal anti-inflammatories in the early stages, avoiding opioids and polypharmacy. Anti-depressants and gabapentinoids might be relevant but doses should be titrated accurately, bearing in mind potential adverse effects which might outweigh benefits.  It is important where pain becomes chronic, to adopt a multidisciplinary approach, addressing physical inactivity, avoidance of catastrophising, and negative beliefs and attitudes. Patients should be encouraged to maintain physical fitness and either remain in work or make an early return. Psychological issues should be addressed, and over-medicalisation avoided.

12.     The Fifth IMEG report contains a review of the 2013 report and recommendations on mental health. Professor Peter White began with an update on mental health matters based on findings from the Kings Centre for Military Mental Health research cohort study set up in 2003 to examine the potential impact of deployment to Iraq on the health and well-being of UK service personnel. Data have been collected so far in three waves and Professor White presented data from 2014/6 comparing it with that from the first phase of the study in 2004/6.  Alcohol misuse was down from 16% in 2004/6 to 10% in 2014/6 and common mental health disorders, such as anxiety and depression were stable at both dates, around 20%. In this combined sample of veterans and still serving personnel, PTSD was detected in 4% in 2004/6 and 6% in 2014/16. This compares with 4.4% in the civilian population.

13.     In the 2014/6 survey, PTSD in serving regular combat personnel was 6%, compared with those in a combat support role (4%).  Among non-deployed ex-service regulars, it was 5%, for those who had deployed 9.4%.  Another study of personnel whose last deployment before leaving service was in a combat role, found a PTSD rate of 17% compared with 6%, for those deployed in a service support role.

14.     Professor White then turned to some myths. He confirmed that for since at least the mid-1980s and continuing, overall male suicide rates in the armed forces are lower than in the general population. The exception is young men under 20 years. Young veterans and early service leavers aged 16-24 years are also at increased risk. This seems to relate to pre-service vulnerabilities, such as childhood adversity. The longer a person remains in service the lower the risk of suicide. Neither Falklands nor First Gulf War veterans have higher suicide rates than service controls who did not deploy, or the UK general population. Veterans make up 5% of the adult population in England and Scotland but account for only 3.5% of the prison population. They are however over-represented in violent and sexual crimes rates.

15.     In phase 3 of the King's cohort study, around 1,500 members of the cohort who reported a mental health problem in the previous three years were asked about help-seeking. 55% had accessed medical help from a GP or mental health specialist, 46% had received non-medical welfare support and 86%, informal support. Only 7% had not sought any help at all. Rates of usage, awareness and willingness to engage were similar in both still serving personnel and veterans.

16. On parity of esteem, Professor White said that contrary to the widely held view that AFCS awards for mental health disorders are inadequate compared with those for physical disorders, from 6 April 2005 until 31 March 2019, there were 67,930 awards for physical disorders of which 6% also had a GIP. For mental health disorders the corresponding figures were 4,395 total awards with 19% having a GIP.

17. Mental health disorders in military personnel and veterans are generally treatable to a level of improved function. In terms of PTSD prognosis Professor White quoted a 2012 Australian civilian study which suggested that 75% of the civilian population suffers a significant trauma in life with 7% going on to develop lifetime prevalence PTSD. The study suggested that a significant minority remain ill for many years with worse prognosis if there was childhood trauma /violence, severe symptoms or co-morbid mood disorder.

18. The evidence in UK military populations also suggests that there is a small group of military personnel and veterans in which response to treatment is poor, and the disorder can become chronic and functionally disabling. Against that background the 2017 IMEG report recommended addition of a new highest AFCS award for treatment resistant disorders. In April 2019, a new descriptor at level 4 with a 100% GIP was added to Table 3. This was: "Permanent mental disorder causing very severe functional limitation or restriction."

    A footnote added: "Functional limitation or restriction is very severe where the claimant's residual functional impairment after undertaking adequate courses of best practice treatment, including specialist tertiary interventions, is judged by the senior treating consultant psychiatrist to remain incompatible with any paid employment until state pension age". So far fewer than five awards have been made.

19. Since the 2013 IMEG report there have been new editions of the diagnostic classifications of Psychiatric Disease, from the American Psychiatric Association, DSM 5 in 2013 and now being trialled for adoption in 2022; from the World Health Organisation, ICD 11; and in December 2018, the National Institute of Health and Care Excellence (NICE) published updated guidelines on PTSD. The NICE advice on PTSD clinical management is broadly similar to the previous edition but it specifically no longer endorses Eye Movement Desensitisation Reprocessing (EMDR) for military PTSD. That seems to reflect a lack of evidence of effectiveness in military PTSD rather than evidence of harm.

20. The diagnostic classifications, as in previous editions, differ quite markedly both from their own earlier editions and from each other. ICD 11, but not DSM 5, proposes a PTSD sub-group, complex PTSD. This refers to a disorder linked to a repeated stressor of horrific or extremely threatening nature, or one from which escape is impossible. Symptoms include guilt and shame, lack of emotional control and dissociation. There is often comorbid mood and substance misuse, self-harm and risk-taking. Complex PTSD has a poor prognosis.

21. Finally, Professor White spoke about mental health and mortality, noting that people with severe and enduring mental illness, particularly schizophrenia and major depression, die about 10 years prematurely mainly owing to cardiovascular and cerebrovascular diseases. As part of the Fifth report, IMEG has scrutinised the extensive evidence on the issue. Summing up, Professor White reminded the audience that mental ill health affects a minority of service personnel and veterans. Anxiety and mood disorders and alcohol misuse are more common than PTSD. Permanent and severe functional disability can occur but is rare.

22. Following a short discussion, audience questions and comments, Professor Newman Taylor closed the meeting, confirming the forthcoming publication of the Fifth report, whose topics included some of those discussed today. He thanked Admiral of the Fleet, the Lord Boyce, members of the Tribunal service and all other members of the audience for their attendance and contribution to the meeting.

    Attendees included: Admiral of the Fleet, the Lord Boyce, representatives from Defence Primary Health Care, HQ Surgeon General, Defence Business Services, Armed Forces Policy Support, Veterans' Welfare Service, Defence Military Rehabilitation Centre, Stanford Hall, service welfare and Recovery staff, members of the Tribunal service and service veterans' charities.