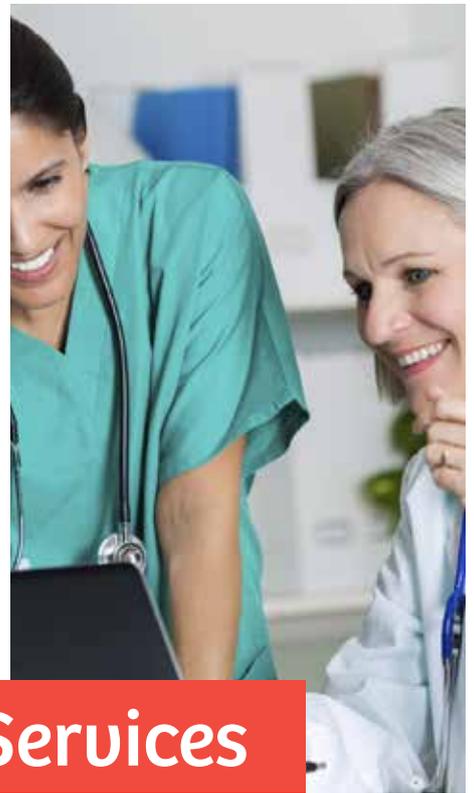




- The Australian Army Malaria Institute and the Mefloquine Controversy
- Paramedics in the Australian Defence Force – A Time for Change?
- Concussion within the Military

The Journal of the Australasian Military Medicine Association





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STATEMENT OF OBJECTIVES

The Australasian Military Medicine Association is an independent, professional scientific organisation of health professionals with the objectives of:

- Promoting the study of military medicine
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- Disseminating knowledge of military medicine
- Publishing and distributing a journal in military medicine
- Promoting research in military medicine

Membership of the Association is open to doctors, dentists, nurses, pharmacists, paramedics and anyone with a professional interest in any of the disciplines of military medicine. The Association is totally independent of the Australian Defence Force.

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Editorial

On 19 June 2018, the Australian Senate referred “The use of the Quinoline anti-malarial drugs Mefloquine and Tafenoquine in the Australian Defence Force” to the Foreign Affairs, Defence and Trade References Committee for inquiry and report by 17 September 2018. Submissions closed on 31 July 2018. This is a controversial issue, which has had some debate within the Journal. Dr Howie-Willis’s paper, on the history of Australian military malariology¹, has received comment in a recent Letter to the Editor². Dr Howie-Willis has responded to that letter in this Issue.

Sixty-five years ago, on 27 July 1953, an armistice was signed that ended the Korean War. No peace treaty was signed at the time and only in April 2018 have the leaders of North and South Korea agreed to sign a treaty to formally end the Korean War by December 2018. 17,000 Australians served in the Korean War between 1950 and 1953, with 339 killed and 1200 wounded. Australian forces were involved in a number of key battles, including the battles of Yongju, Kapyong and Maryang San and the air battle of Suchon in December 1951. Despite these numbers and Australia’s continual involvement over the 4 years, the Korean War often seems to be the forgotten war when it comes to histories or reflections on lessons learned. As a Journal, we would be very interested in any papers look at any military medical aspects of the Korean War.

Our third issue of 2018 addresses a range of diverse areas. Clinical reviews look at concussion in the military, sepsis in gunshot wounds, analgesic use in musculoskeletal pain, and the role of paramedics in the Australian Defence Force (ADF). An article on the use of reflective practice in training and a reproduced article on assessment of medical suitability for employment and deployment in the ADF complement these. Finally, there is the second part of an interesting historical perspective on Naval uniforms.

We continue to get a good range of articles, but other military and veterans’ health articles are always very welcome and we would encourage all our readers to consider writing on their areas of military or veterans’ health interest. Our themes are now available for 2019 to allow for authors to research and develop their articles – we certainly welcome articles in these areas but welcome any articles across the broader spectrum of military health. I look forward to catching up with authors, reviewers, Editorial Board members and, of course, readers at the October AMMA Conference. We would also encourage authors who are preparing to present at the AMMA Conference in October to consider writing up their presentations early for publication in the Journal.

Dr Andy Robertson, CSC, PSM

Editor-in-Chief

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Dear Editor,

THE AUSTRALIAN ARMY MALARIA INSTITUTE AND THE MEFLOQUINE CONTROVERSY

In JMVH 26(1), January 2018, you published a letter from Dr Remington L. Nevin, Executive Director of the Quinism Foundation in Vermont, USA. Dr Nevin's letter commented on aspects of an article of mine, 'Australian military malariology comes of age', which appeared in JMVH 25(3), July 2017. His comments focused on the final section of my article headed 'The Australian Army Malaria Institute under attack: the mefloquine controversy'.

Dr Nevin's letter contains a number of assertions which I refute.

Firstly, my article was not a 'historical review' of the debate over the use of mefloquine and tafenoquine by the Australian Defence Force (ADF) and research on these antimalarial drugs by the Australian Army Malaria Institute (AAMI). The article was the fifth and concluding instalment of a five-part series tracing the history of Australian military malariology from 1885 to 2015. The series outlined that history biographically, profiling some twenty medical specialists and malariologists whose work on malaria had contributed to the evolution of malariology in Australia.

Of necessity, my article referred to the formation and subsequent development of the AAMI. It did so only briefly as this topic was already comprehensively covered in a seven-part series titled 'Army Malaria Institute: Its Evolution and Achievements', appearing in JMVH between 2012 and 2016, the co-authors of which were present and former AAMI staff members.

My observations on the mefloquine controversy were included in a section at the end of my article. Seen in that context, they were certainly not an 'historical review' of the debate over mefloquine use. Indeed, the section made the point that a history of the mefloquine debate is not yet possible because the debate continues. As Dr Nevin will possibly be aware, at present, the Senate of the Australian Parliament is conducting an inquiry into the use of mefloquine and tafenoquine by the ADF. If he knows about that inquiry, he will also know that it was prompted by the persistent demands of particular interest groups within, what may be loosely described as, the 'Anti-Mefloquine Lobby' (AML).

Secondly, Dr Nevin seems to have inferred that I am some kind of mouthpiece of the AAMI. Such is not the case. I am an impartial and independent practising historian who wrote a book about the Australian Army's experience of malaria. (Released

under the title *An Unending War: The Australian Army's struggle against malaria, 1885–2010*, it was published in 2016 by Big Sky Publishing Pty Ltd.) A chapter of that book dealt with the AAMI, tracing its development against the background of catastrophic epidemics of malaria suffered by the Army in overseas deployments from World War I to the engagement in East Timor in 1999. While I appreciate the AAMI's historic achievement in having saved thousands of ADF personnel from potentially fatal episodes of *P. falciparum* malaria infection, I am entirely independent of the AAMI and am certainly not a spokesperson for them or the ADF.

Thirdly, Dr Nevin suggests I am conducting 'an attempted rearguard defence' of the AAMI and its mefloquine and tafenoquine research programs. Again, his inference is wrong and unequivocally denied. The AAMI does not need me to defend it against the often intemperate AML fulminations. It is quite capable of doing that itself, as it will no doubt do so before the present Senate inquiry.

Fourthly, Dr Nevin states that I have trivialised 'the concerns of antimalarial drug safety advocates' by writing that 'all antimalarial drugs have unwelcome side effects'. I reject this suggestion. Dr Nevin's letter does not acknowledge the fact that mefloquine was used because some people could not take doxycycline, the ADF's 'front-line' antimalarial drug. For some ADF personnel, doxycycline has serious side effects. Indeed, about one in eleven or nine per cent of people cannot tolerate doxycycline. For those people, using mefloquine as a 'second-choice' antimalarial drug may well have been lifesaving.

This brings me to another issue which Dr Nevin's letter conveniently ignores. A reality that some former ADF personnel within the AML do not acknowledge is that mefloquine, tafenoquine and doxycycline might actually have saved their lives. By not acknowledging this, they nullify their own arguments against the AAMI.

Here I draw Dr Nevin's attention to the highly malarious places in which these former soldiers served—Timor Leste, Bougainville and the Solomons. They are regions of malaria endemicity where the often fatal *P. falciparum* form of the disease is common and still causes mortality. Without the AAMI-devised malaria treatment and prophylaxis regimens, multiple deaths of ADF personnel from *P. falciparum* malaria could well have occurred. The

point here is that for the 'consumers', in this case ADF members serving in a malarious region, the choice is stark: either take an antimalarial drug and accept the risk of side effects or not take it and risk dying from *P. falciparum* malaria.

Yet another reality avoided by Dr Nevin and the AML is the widespread use of mefloquine by Australian civilians travelling overseas to malarious areas. As my article pointed out, between 2010 and 2015 almost 85 000 prescriptions for the drug were filled in Australia. Are any of those consumers clamouring for compensation because of the 'psychoneurosis' they might allegedly have suffered? Is it only people associated with the AML who have purportedly suffered from mefloquine toxicity? If so, why? These are questions that Dr Nevin and his supporters might care to answer honestly in submissions to the present Senate inquiry.

I wish to conclude with one final point, one made in my article relating to the deaths and near-deaths from malaria among ADF personnel. As my article pointed out, the last malaria fatality among ADF personnel was in 1967 in Vietnam; however, in Timor Leste in 1999–2000, five ADF soldiers came close to death after contracting *P. falciparum* malaria. Their lives were saved by their prompt evacuation and hospitalisation in the intensive care unit of the Royal Darwin Hospital. These cases demonstrate that lethal malaria infections are not just a theoretical risk during modern military operations but remain a threat to the lives of all ADF personnel posted to malarious regions. In view of that, Dr Nevin and the AML might care to advise JMVH readers what measures they would recommend for protecting ADF personnel against malaria.

Yours sincerely,

Dr Ian Howie-Willis, OAM, PhD
Independent Professional Historian
Canberra, Australia

Dear Editor,

COMMAND VERSUS TECHNICAL AUTHORITY: LESSONS FROM THE 2ND GENERAL HEALTH BATTALION

This letter replicates my response in Issue No. 203 of the ADF Journal, regarding the article by Reade et al, 'Command versus technical authority: lessons from the 2nd General Health Battalion', in Issue No. 200 of the ADF Journal (and reprinted in JVMH Vol. 25 No. 3). In short, Reade et al advocated that the command and control arrangements of the 2nd General Health Battalion (2GHB) should apply elsewhere within the ADF, which would entail health units being commanded by a nonclinical general staff officer, while health technical control would be provided by a medical officer Director of Clinical Services.

While the article contends that these arrangements replicate the management structure of every major Australian civilian hospital since the 1980s, this is not necessarily true for many rural and remote civilian hospitals of comparable size to 2GHB. Furthermore, it is understood the current arrangements for 2GHB stem from a shortfall in suitable medical officers in the late 2000s, rather than a conscious decision to reflect civilian hospital practice. It is suggested that ex post facto justification should not preclude Army clinical officers with the appropriate abilities and interest from undertaking future command roles.

The article also arguably perpetuates an ADF health care model that prioritises treatment services at the expense of other military health functions. It does not address ongoing management shortcomings, such as the ADF's environmental hazards in its base settings, or assessing medical suitability for employment and deployment, or the ADF's aviation, diving and submarine and medicine services.

Unlike Army, all Navy and RAAF health officers have a clinical background. Even so, many of these officers have successfully performed deployed and non-deployed health command roles over many

years. In so doing, they continue to demonstrate the benefits of military health officers not only having consummate clinical expertise but also a comparable understanding of the relevant operational environment. This particularly includes providing clinical advice to operational unit commanders, without filtering through a non-clinical third party.

The article correctly indicates that clinical expertise alone does not translate into the ability to command. Furthermore, many—but not all—clinical officers prefer clinical rather than management roles. Even so, the experience of all three Services validates the contention that it is easier to teach command skills to clinicians, than clinical skills to commanders.

Managing military health services requires a combination of clinical and non-clinical skills which, depending on the size and scope of the health services being provided, may be beyond the capacity of a single individual. If achieving the full range of managerial skill sets requires two people, the nature of military service implies that one will be subordinate to the other.

It is therefore contended that maximum benefits accrue to ADF operational capability, maximum flexibility accrues to career managers, and maximum benefits accrue to individual personal aspirations, if all ADF clinical officers have an opportunity to assume command roles, technical control roles or both. If these roles have to be split, selecting who performs which should be based on the best combination of the candidates available. Sometimes, the best health and operational outcomes may be achieved with a clinical commander supported by a non-clinical staff officer; otherwise, vice-versa may apply.

Dr Neil Westphalen
Commander, Royal Australian Navy Reserve

Paramedics in the Australian Defence Force – A Time for Change?

Lauren D'Arcy

Abstract

Paramedic practice is rapidly changing due to the ongoing pressures on health care systems. Paramedics are increasingly being integrated into primary health care roles, initiating interventions on scene and autonomously making clinical judgements based on operational guidelines. Evolving professional standards have resulted in the advancement of clinical skills, degree-based education and paramedic registration. This expanding professional profile of paramedics in the civilian health system is not being reflected in defence career options. New roles for paramedics in the Australian Defence Force (ADF) could be based on Physician Assistant and Emergency Care Practitioner roles implemented in the United States and United Kingdom respectively. While this would require organisational change, it does not replace the need for medics or medical and nursing officers. Ultimately, the aim is to find a best-fit role that recognises paramedic education, skill and experience to the equivalence of other health services roles.

Key Words: paramedic, defence career, education, pre-hospital care

Introduction

Reviewing the nature of modern warfare and peacekeeping operations, it is apparent that the characteristics of medical emergencies are increasing in complexity and variability, placing added demand on health services¹. Military health capability is increasingly stretched between its primary goal of providing health services to its own forces and its responsibility under the Geneva Convention, 1948, to provide care to civilian populations¹.

In 2012, recognition of the need for higher level pre-hospital care led to the development of Combat Paramedic roles within Army Reserves allowing paramedics to utilise their civilian scope of practice². Since then, the role and capabilities of civilian paramedics have changed greatly, including degree-level education, advanced interventions and clinical care roles.

The traditional understanding of paramedics as 'swoop and scoop' care providers is rapidly changing; driven by increasing pressures on existing health systems^{1,3,4}. Recognising this professionalisation of practice, new national laws are being created to protect the title of 'Paramedic', and establish standards of education, experience and scope of practice for all practicing paramedics in Australia as of 2018⁵. According to the Australian Health

Practitioner Regulation Agency (AHPRA), persons wishing to identify as paramedics must meet the approved education standards, as well as a minimum period of experience for those under previous diploma-based studies. Under registration, Australian Defence Force (ADF) medics who have completed accredited courses in paramedicine can also apply for consideration for registration⁵.

With a rapidly shifting paradigm of pre-hospital care and greater professional practice within paramedicine, the question remains how will registered paramedics fit within the ADF health structure? This paper explores current standards in paramedicine and considers new options for paramedics within the ADF.

Contemporary paramedic practice

Pre-hospital care is quickly evolving with a focus on rapid transport, early intervention and prevention of secondary injury. Paramedics have subsequently increased their proficiency in medication administration, complex medical procedures and rapid differential diagnosis. While paramedics still work predominantly on scene, their increasing utilisation within health care pathways has created greater opportunities to adapt their experience to clinical and in-hospital settings^{4,6,7}.

Clinically, paramedics require the ability to quickly identify patient conditions and signs of deterioration and initiate interventions, as well as determine when to commence or terminate resuscitation⁴. While variation exists between states, Australian paramedics are now qualified in diverse advanced interventions and medication administration which can include endotracheal intubation, cricothyroidotomy, needle thoracentesis, intraosseous access and blood sample collection, as well as the administration of thrombolytics and schedule 8 medications⁸. Non-clinical paramedic skills have also expanded, from extrication and transport to on-scene leadership, triage, resource coordination and management, the use of bypass protocols and team safety, referrals or treat and not transport pathways^{4,6,7}. The need for these interventions, and subsequent practice, is largely determined by paramedics who autonomously make decisions based on standard operating procedures and clinical guidelines which grant authority to practice under a physician's licence^{4,6}.

While paramedics are required to follow standard operating procedures and guidelines, it is an understanding of pathophysiology and patient conditions that determine how guidelines are utilised⁴. The need for wider understanding of pathologies, medications and interventions has also led to improved training including degree-based qualifications. Post-paramedic registration and degree-level qualifications (or higher) will now be required to practice as a paramedic within Australia. Former diploma-level studies will only be accepted under a grandparenting scheme, likely to cease after three years⁵. Beyond graduate qualifications, paramedics are also able to undertake postgraduate-accredited courses in emergency management, extended care, mass casualty incidents, aeromedical evacuation and critical care.

Paramedics in the ADF: role considerations

As paramedic practice evolves, existing roles offered to qualified paramedics in the ADF will also require consideration. Currently, only one paramedic titled option is available in Army Reserves as an other-ranks role, only open to paramedics employed by a State Ambulance Service⁹. Furthermore, there are no commissioned officer roles available to paramedics other than logistics roles⁹. Those in full-time ADF service, should they become registered paramedics, will not be eligible to be promoted to officer within their chosen specialty, unlike other degree-qualified ADF health professionals. This disparity in rank contrasts with civilian practice, where paramedics provide on-scene leadership and control, coordinate

teams and resources, make autonomous clinical decisions and work as peers with registered nurses within hospital environments^{4,5}.

When reconsidering the role and function of registered paramedics in the ADF, inspiration could be drawn from the successful integration and use of Physician Assistants (PA) by the United States (US) military. In their military capacity, PAs are commissioned officers (permanent and reserves), who provide primary health care, examination, diagnosis, investigations and treatments with limited prescribing rights¹⁰. A qualified PA's autonomy and scope of practice is similar to that of a paramedic working under the authority of a physician without direct supervision¹⁰. The use of PAs by the ADF was proposed by Forde and Pashen in 2009¹⁰, citing successful US examples and the trial of PAs in various clinical settings around Australia. It was asserted that both ambulance officers and medics could use this pathway to extend their clinical contribution; however, given the similarity in function, it is possible the US military PA example could instead be used for developing ADF paramedic roles¹⁰.

Additionally, United Kingdom (UK) paramedics have the opportunity to practice as Extended Care Practitioners (ECP). An ECP requires a nursing or paramedical background and perform non-complex patient assessment, management and referrals¹¹. A literature review by Hill, McKeen and Price (2014)¹¹ found ECPs performed highly in areas of patient and staff satisfaction and cost efficiency, delivering a benefit to the National Health Service. Similarly, in rural and remote Australia, paramedics are being successfully integrated into primary health care roles with an extended scope of practice including injuries, phlebotomy, wound care and sutures, catheterisation, supervision of difficult patients, vascular access, stabilisation and resuscitation^{7,12}. Additionally, paramedics support health promotion strategies, advocacy and liaison services, preventative services and referral pathways^{4,7,12}.

The successful integration of Paramedics into extended care roles in the US, UK and Australia, highlight the potential for the development of new officer roles encompassing pre-hospital and clinical settings. This would allow paramedics to practice with similar autonomy and skill sets to that of civilian roles, while providing a direct pathway for medics currently studying degrees in paramedicine.

Potential barriers to change

Adapting traditional ADF health care roles to encompass new standards in paramedicine will

inevitably cause debate. While there is immense potential for increased contribution to ADF health services, the deeply entrenched perception of paramedics as emergency responders with limited primary health care capabilities remains in existing organisational structures. This is not unique to the ADF, as the evolution of paramedicine blurs the boundaries of patient care, it has been highlighted as a concern for other health professionals^{6,7}. Reconceptualising paramedic practice in the ADF may result in similar concerns; however, resisting change could impact upon recruitment and retention of paramedics in the ADF due to lack of professional recognition.

Careful consideration will also be required when identifying suitable paramedic qualifications for ADF roles. While no national skill level exists, paramedics in some states are qualified to perform advanced invasive procedures, which would be limited to intensive or critical care paramedics in different states. Additionally, simply being registered professionals or having degree-level qualifications does not automatically make all paramedics suitable for military employment. Interested candidates would need to meet existing recruiting requirements including selection boards, as well as military and employment training, as expected of all ADF health professionals.

Conclusion

Over the last decade there has been significant development in the clinical scope and professional roles for qualified paramedics. In response to continually increasing pressure on the health care system, paramedic clinical and non-clinical skills are frequently being utilised in new roles in both

pre-hospital and in-hospital or clinic environments. While the pressures faced by health systems are reflected in the ADF, the changing professional standards for paramedic practice are not. This directly impacts career options for paramedics in the ADF. In other health systems, PAs and ECPs have been successfully filling roles in pre-hospital and in-hospital care with similar qualification levels and skill sets held by paramedics within Australia. While there will be debate on the professional boundaries and scope of practice, there is definite potential for the ADF to utilise these models as a framework for paramedics. By acknowledging the modernisation of paramedic practice, the ADF will be able to proactively adapt to upcoming reform of the profession.

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Conflict of interest:

The author is employed by St John Ambulance WA Inc, working as a Paramedic for Metro Operations. No grants or financial incentives were received for publication of this article.

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'Military Superbug' *Acinetobacter Baumannii* Induced Sepsis in Craniofacial Gunshot Injuries

I Danish Khan, Associate Professor, Army College of Medical Sciences and Base Hospital, New Delhi, India

Abstract

Background Craniofacial gunshot injuries encountered during counter-insurgency/counter-terrorism operations are involved in a situational complexity requiring astute battlefield care, evacuation, operative management and critical life support. Secondary infections by 'military superbug' *Acinetobacter baumannii* complicating to sepsis can jeopardize survival.

Cases Two combatants sustained craniofacial gunshot injuries during counter-insurgency/counter-terrorism operations in hilly jungle terrain of South-Asia. Having survived through initial assault of the gunshot and resuscitation, they were tactically evacuated on ventilator support to tertiary care. In the backdrop of tissue devitalization, hemodynamic and renal compromise, extensive surgical and critical care interventions, secondary infection by multidrug resistant *Acinetobacter baumannii* led to sepsis and demise.

Conclusions Craniofacial gunshot wounds in the battlefield can initiate a domino effect leading to physiological complications which can predispose to secondary infections, leading to sepsis and demise. *Acinetobacter baumannii* known to survive in environmental reservoirs, can cause bacteremia and sepsis in gunshot, warfare injuries and natural disasters. A prudent emphasis on secondary and opportunistic infections in battlefield and hospital care is mandated to optimize outcome in gunshot injuries.

Key Words gunshot, ballistic trauma, *Acinetobacter baumannii*, military superbug, sepsis

Introduction

Guns and assault rifles have been indispensable weaponry from medieval to modern era. Gunshot injuries cause gunpowder propelled projectile-induced penetrating ballistic polytrauma. Gunshots comprise 50-90% of injuries encountered during low-intensity conflicts, civil wars and counter-insurgency/counter-terrorism (CI/CT) operations.¹ High velocity (1500 m/sec) rifled gunshots are commonly encountered among soldiers fighting belligerent guerillas in CI/CT operations in contrast with low velocity (350-500 m/sec) pistols used commonly in civil wars. High velocity rifled gunshots produce heavy craniofacial damage to vital neuromuscular structures from passage of missile, secondary shock wave and cavitation, despite smaller entry wound. In addition, they pose a higher risk of infection.^{2,3}

The incidence of gunshot injuries in US and Indian Armed Forces is 0.34-0.68/1000 person-years and 1.07/1000 troops respectively.^{3,4} The incidence of gunshot injuries was 53.5% during terrorist attacks,

armed banditry and communal clashes in Nigeria, 91.8% during Boko Haram insurgency and 72.2% during Libyan Civil War insurgency.^{5,6} US and UK military data reveal significantly higher mortality secondary to gunshot compared to explosions.^{7,8}

Craniofacial gunshot injuries encountered during CI/CT operations are involved in a situational complexity requiring astute battlefield care, streamlined evacuation logistics, and operative and critical life support capabilities at various echelons along the chain of evacuation. Secondary infections by 'military superbug' *Acinetobacter baumannii* complicating to sepsis can jeopardize survival. The discussion is focused on two combatants who sustained craniofacial gunshot injuries during CI/CT operations in hilly jungle terrain of South-Asia. Having survived through initial assault of the gunshot and initial resuscitation, they were tactically evacuated on ventilator support to tertiary care facility located more than 1800 km from site of injury in South-Asia. In the backdrop of tissue devitalization, hemodynamic and renal compromise, extensive surgical and critical care interventions,

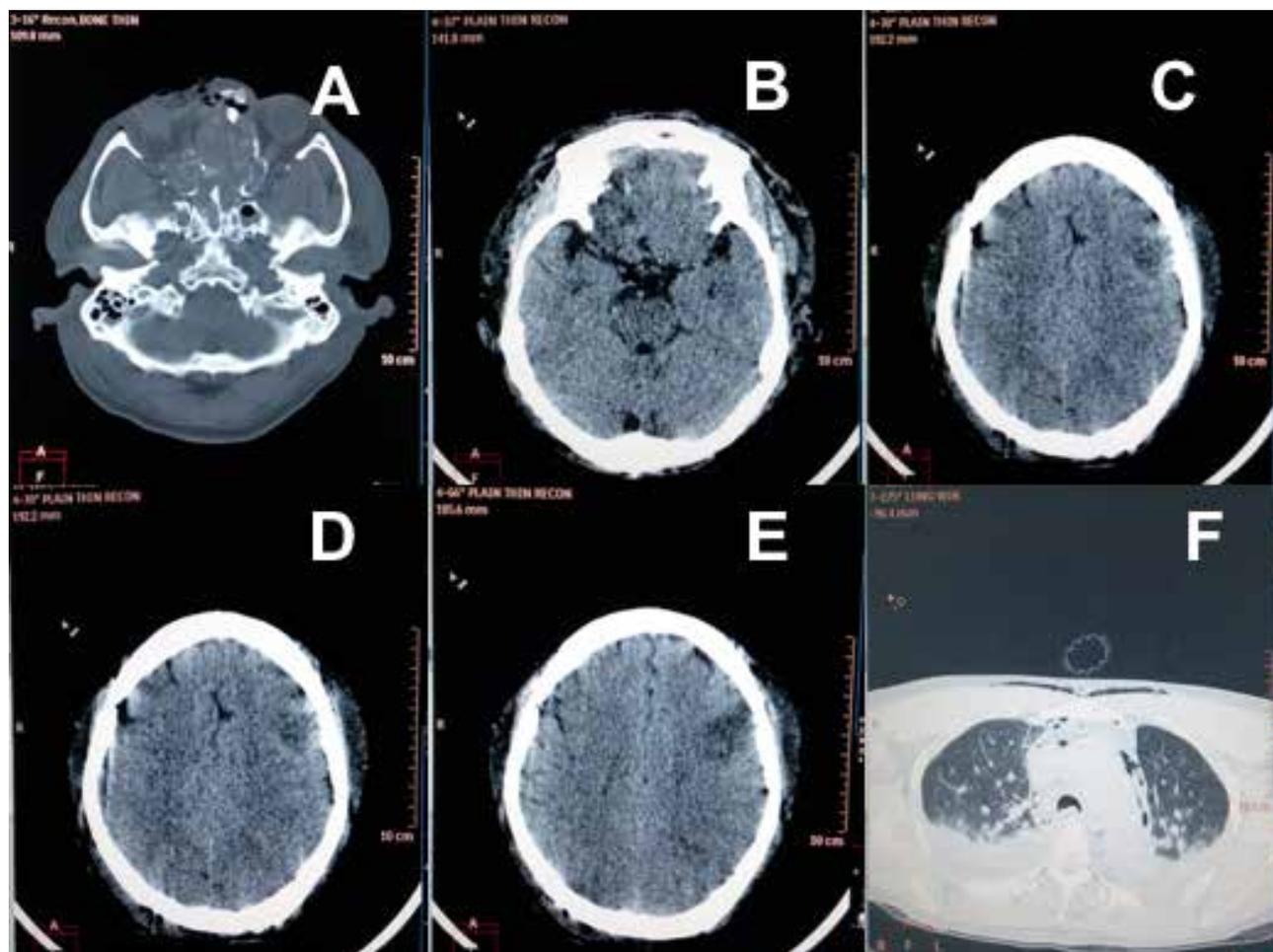


Fig 1 (Case 1: Gunshot wound Face): Non-contrast Computed tomography (NCCT) head revealing (A) Multiple skull fractures including fractures of maxillary antrum, nasal bone, ethmoid and sphenoid; (B and C) Cerebral contusions in bilateral basi-frontal, right anterior and high frontal lobes; (D and E) Contusion in left temporal and occipital lobes; (F) NCCT chest revealing bilateral pleural effusion, basal consolidation and pneumomediastinum.

there was secondary infection by multidrug resistant (MDR) *Acinetobacter baumannii* leading to sepsis and demise.

Case 1

A 52-year-old combatant sustained craniofacial gunshot injury over face and right eye during a CI/CT operation. He was air evacuated to secondary care, where emergency tracheostomy, emergency repair of perforated posterior pharyngeal wall, lacerated tongue, evisceration of lacerated right eye, debridement of right open-globe injury, with packing of pharynx and primary repair of facial wounds was done. Continuous haemorrhage from oral cavity led to massive transfusion with 22 units whole blood within 48 hours of injury.

He was air evacuated on ventilator support to a tertiary care facility on the third day post injury for definitive management of fractured maxilla and

palate, right open-globe injury, pharyngeal wall injury and a suspected splinter induced vascular injury on left side of neck. The Glasgow Coma Scale (GCS) was 7/15 with improving revised trauma scores. Noncontrast Computed Tomography (NCCT) of head revealed multiple fractures of skull, maxillary antrum, nasal bone, ethmoid and sphenoid, and cerebral contusions in bilateral basi-frontal, right anterior, high frontal, left temporal and occipital lobes. NCCT of chest revealed bilateral pleural effusion, basal consolidation and pneumomediastinum (Figure 1). NCCT of the cervical spine revealed multiple metallic foreign bodies in the neck with a large hematoma in the left parapharyngeal space. Computed tomography angiography revealed normal carotids. On the fourth day post injury, evacuation of the neck hematoma, re-packing of the oronasal and orbital cavity were performed followed by feeding via tube gastrostomy and jejunostomy. His left eye revealed optic disc hemorrhage.

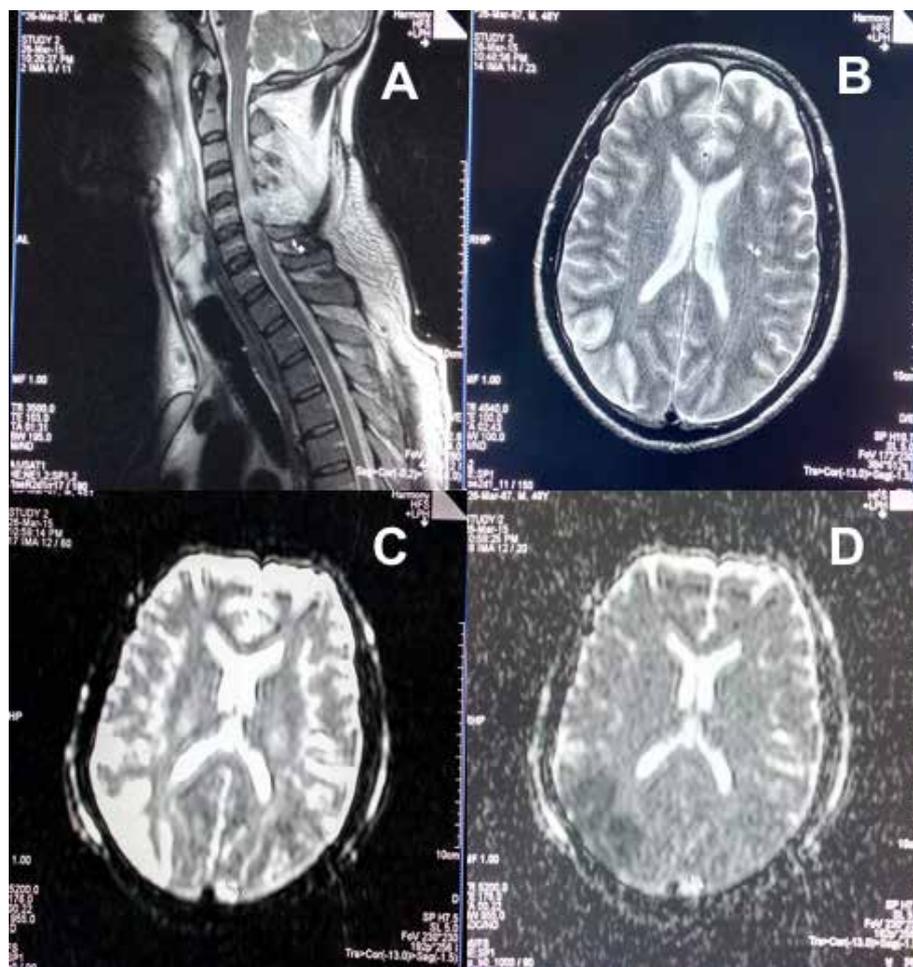


Fig 2 (Case 2: Gunshot wound Neck): Magnetic resonance revealing (A) Comminuted posterior fracture of C4 and C5, cord compression and edema extending from C3 to C6 vertebrae (B-D) Watershed infarct of right middle and posterior cerebral arteries, and occlusion of internal carotid artery.

Blood culture revealed multidrug resistant *Acinetobacter baumannii* on the sixth day post injury for which colistin was initiated. On 12th day post injury, he developed hypotension, bilateral basal crepitations, decreased breath sounds due to pleural effusion with basal lung atelectasis, as revealed on contrast-enhanced computed tomography (CECT) of the chest. Features of sepsis with toxic granules, serum procalcitonin 40 ng/ml and sepsis induced delirium were noted. On day 16 post injury, he developed 104°F fever with respiratory distress. Right lower lobe consolidation and bilateral pleural effusion were seen on a chest X-ray. His condition continued to deteriorate with deranged renal parameters, reduced urine output and increased dependence on inotropes. Urea and creatinine increased to 154 and 3.7 mg/dl respectively, and serum sodium and potassium reached 4.6 and 9.5 mmol/L while other hematology and clinical chemistry parameters were within normal limits. He succumbed to cardiac arrest on day 24 of injury. The cause of death was

pneumonia and sepsis with multiorgan dysfunction.

Case 2

A 48-year-old combatant sustained gunshot injury at the angle of right mandible involving the face and neck in a CI/CT operation. He was resuscitated from hypovolemic shock, cardiac arrest and initiated on mechanical ventilation. Evaluation of the head and neck through NCCT and magnetic resonance imaging revealed cerebral oedema, watershed infarct of right middle and posterior cerebral arteries, occlusion of the internal carotid artery, cord compression and cord oedema, comminuted displaced fracture of right mandible and comminuted fracture of C4 and C5 vertebrae. (Figure 2) He was air evacuated on ventilator support under sedation to a tertiary care facility the same day where his GCS was E1VETM1 (sedated) with bilaterally sluggish pupils and quadriplegia.

Exploration revealed a laceration of the cord at C5 with large dural cord oedema. While he was being managed with inotropes, mannitol, dexamethasone, cefotaxime, amikacin and blood transfusion, he developed left lung consolidation and left pleural effusion. Intercostal drainage of 700 ml sanguineous pleural fluid revealed 250 leucocytes/mm³, lymphocyte predominance, 4 mg/dl proteins, 20 mg/dl albumin, 134 mg/dl sugar and 200 U/LDH. Tube feeding via gastrostomy and jejunostomy was initiated. Initially discouraging Trauma and APACHE II scores improved in intensive care.

During the course of his illness, leucocytes varied from 7000-25000/mm³, alkaline phosphatase 48-311 U/l, urea 39-98 mg/dl and creatinine 1.4-1.9 mg/dl. Other parameters were within normal limits. His condition continued to deteriorate further with a low GCS, persistent fever, gasping respiration, hypotension requiring inotropes, decreased air entry bilaterally, neutrophilic leukocytosis with left shift, and high urea and creatinine levels. Tracheal cultures and blood cultures revealing MDR *Acinetobacter baumannii*. Serum procalcitonin levels reached 28 ng/ml despite the initiation of colistin. He succumbed to cardiac arrest on the 26th day post injury. The cause of death was sepsis due to MDR *Acinetobacter baumannii*.

Discussion

Gunshot wounds in the battlefield/operational scenario are severely damaging and lethal. Only 10% of patients survive to reach a medical facility.¹ Battlefield healthcare principle of Tactical Combat Casualty Care is enmeshed in a situational complexity demanding overlapping operational parallels between medical and combat commands. Evacuation logistics affected by host conditions, terrain features, inclemency of weather, air capability, communication support and infrastructural limitations act as a caveat to the concepts of 'Platinum half hour and Golden Hour'. Trauma scoring and stabilisation of the patient to cater for long periods of evacuation is critical. Mountainous and forested/jungle terrain restricts evacuation on foot by stretcher bearers till road-head or landing ground can be reached. Air effort for casualty evacuation is restricted by visibility, weather phenomenon and enemy action.^{9,10,11} It takes many hours for the patient to reach a facility where Damage Control Surgery and Damage Control Resuscitation can be offered as seen in these patients who had to travel hundreds of kilometers on ventilator support for definitive management.^{2,12,13}

Gunshot projectiles crushing through tissues in ballistic penetrating trauma cause massive tissue

devitalization, ischemia, anoxia and coagulopathy, and increased susceptibility to infections. Craniofacial gunshot injuries lead to an immediate deterioration of trauma scores, yet the benefit of doubt and/or opportunity should be given to the soldier. Given the high lethality of craniofacial gunshot injury, both patients survived for more than 23 days due to vigorous resource-intensive efforts, although they succumbed to secondary infection by the 'military superbug' *Acinetobacter baumannii*. Pharyngeal injury and neck hematoma, seen in the first patient, can lead to airway compromise and demise, which is a common complication of complex craniofacial injuries. During Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF), craniofacial gunshot injuries led to 67% fatal airway and vascular injuries, multiple facial fractures and airway haemorrhage.¹⁴ The second patient developed infection, respiratory distress and acidosis, which is known to occur in 3-10% of trauma patients.¹⁵ The incidence of infection in ballistic polytrauma remains at 35-40% despite surgical debridement and empirical antimicrobials.¹⁴ Uncontrolled haemorrhage even after surgery is attributable for 30-40% trauma related deaths. Massive transfusion is required in approximately 8% military casualties compared to 3% civilian casualties. The 'Golden Hour Container' utilizing phase-change materials can maintain temperatures for transportation of blood components without using electricity, batteries or even ice.^{8,11,16}

Infections complicating to sepsis are considered potentially survivable.^{1,3,7,9} During the Soviet-Afghanistan War, the incidence of wound sepsis was 5.4% with 9.3% survival.¹⁷ Sepsis lead to 15.51% and 37.7% deaths respectively from gunshot injuries in the Syrian Civil War and the Philippines.^{3,18} Tactical situation has played an important role vis-à-vis sepsis in predicting the survival from gunshot wounds throughout history.^{1,2,19}

Both patients developed *Acinetobacter baumannii* infection despite being on empirical antimicrobials initiated at primary care. *Acinetobacter baumannii* emanates alarm at three axes. One, it is a robust pathogen found in soil and water at varied temperatures and thus can grow in land/water sources present in battlefields. Two, *Acinetobacter baumannii* being an emerging pathogen in battlefield injuries, may not be covered under clinical suspicion. Three, most *Acinetobacter baumannii* are MDR requiring aggressive reserve antimicrobials such as colistin or tigecycline, which may not be available at primary care. *Acinetobacter* can also exist in an immunocompromised host along with coinfecting pathogens.^{20,21,22}

MDR *Acinetobacter baumannii* is known to cause bacteraemia and sepsis in gunshot and warfare injuries. The infection can be acquired in the battlefield or nosocomially in any echelon of care, given the ubiquity of the nonfastidious pathogen. Extensive tissue devitalization and systemic deterioration leads to an immunocompromised state furthering *Acinetobacter* induced sepsis which has a negative prognosis with 20-60% mortality.²³ While susceptible *Acinetobacter* strains were isolated from Vietnam War injuries, 100 cases of MDR and two panresistant *Acinetobacter* blood stream infections meeting the CDC's National Nosocomial Infection Surveillance criteria, were seen during OEF and OIF. *Acinetobacter*, quoted as the 'military superbug' and 'Iraqibacter', has now been included under the US Military 'Global Emerging Infections Surveillance' program.^{24,25,26} The risks of infection remains several weeks post-craniofacial ballistic trauma. MDR *Acinetobacter* entail aggressive empirical management and warrant usage of reserve antimicrobials such as tigecycline and colistin ab initio, which is against the existing guidelines of empirical antimicrobial therapy.^{27,28,29} Both tigecycline and colistin need to be given in sepsis dosage which renders patients prone to nephrotoxicity, neurotoxicity and gastrointestinal disturbances.

While the future of craniofacial trauma management may encompass haemostatic devices, lyophilized plasma³⁰, walking blood banks³¹, and battlefield surgical robots³², a high index of suspicion is warranted toward emerging infectious diseases caused by *Acinetobacter* which can adversely affect patients improving from polytrauma. Advances such as tissue factor pathway inhibitor, tumour necrosis factor antibody fragment, platelet-activating factor acetylhydrolase, antithrombin III, pyridoxylated haemoglobin polyoxyethylene, mass spectrometry, MicroRNAs, proteomics and inflammationomics

can facilitate early diagnosis and intervention in infections and sepsis.^{33,34} An impetus toward damage control must include infection control in the conundrum of trigger-triggered complication cascade.

Conclusion

Craniofacial gunshot wounds in the battlefield can initiate a domino effect leading to pathophysiological complications from battlefield to tertiary care, such as projectile-induced penetrating ballistic polytrauma, haemodynamic and renal compromise, delayed evacuation, multiple critical care and surgical interventions, massive transfusions and tissue devitalization, which can predispose to secondary infections leading to sepsis and demise. *Acinetobacter baumannii* known to survive in environmental reservoirs, can cause bacteraemia and sepsis in gunshot, warfare injuries and natural disasters. A prudent emphasis on secondary and opportunistic infections in battlefield and tertiary care is mandated to optimize outcome in gunshot injuries.

Conflicts Of Interest

None

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Concussion within the Military

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Abstract

Concussion or mild traumatic brain injury (mTBI) is associated with long-term impairments in military personnel. Diagnosis of the condition remains clinically challenging. Neurological examination and cognitive symptoms may not accurately map the nature and severity of underlying brain injury. Neuroimaging techniques, such as diffusion tensor imaging (DTI), show promise as an effective tool in delineating the microstructural neural changes and corresponding clinical consequences following mTBI. This paper discusses the diagnosis and management of concussion, in the military context, using two cases of veterans who suffered blast-related mTBI. Insights on an integrated approach to concussion in the military, incorporating thorough neurological and neuropsychological examination and application of advanced neuroimaging are presented.

Key Words: Concussion, Military, Traumatic Brain Injury (TBI), Imaging, Simoa, Chronic traumatic encephalopathy (CTE)

Introduction

Concussion is a traumatic brain injury (TBI) which results in altered brain function¹. The expression thereof, is determined by the extent and region of the brain that is affected² and is amplified by repeated exposure to such insults. The effects are usually temporary³ but can include short-lived acute clinical symptoms that mostly resolve without intervention⁴. These symptoms may manifest as cognitive symptoms (impaired memory and concentration), affective symptoms (anxiety, depression, irritability, impulsivity, insomnia, ideation) and symptoms in the somatic domain (fatigue, headache, dizziness)⁵. Signs and symptoms of concussion may not appear until hours or days after the injury.

Blast-related mild traumatic brain injury (mTBI) has been called the 'signature injury' of the wars in Iraq and Afghanistan due to the significantly high prevalence in veterans previously deployed in these regions⁶. Over 300 000 United States (US) Armed Forces veterans have sustained a brain injury since 2003⁶. One in every 10 Australian Defence Force (ADF) personnel who have served in the Middle East reported post-concussive symptoms as per the criteria for a new mTBI^{5,6}. Repetitive mTBI is also a significant risk factor for neurodegenerative tauopathies including dementia and chronic traumatic encephalopathy (CTE)^{7,8}.

The US government has acknowledged the significance of concussion and established the Defense and Veterans Brain Injury Center (DVBIC), which is now part of the US Military Health System⁹. It is the TBI operational component of the Defense Centers of Excellence for Psychological Health and

Traumatic Brain Injury⁹. The mission of the DVBIC is to serve the active-duty military, the beneficiaries and veterans with TBI, adopting state-of-the-science clinical care, innovative clinical research initiatives and educational programs, and support for health protection of the target population¹⁰.

Post-traumatic stress disorder (PTSD) is an issue of major concern for the ADF and often overlaps with concussion and mTBI¹¹. In many cases, the cause of PTSD is ill-defined and requires further consideration¹². Symptoms of concussion and PTSD may overlap and be confused by those not linking the two¹³. Considerable research efforts, currently being undertaken in the US⁹, are modelled on a multidisciplinary approach to understand and address the effects of mTBI on military veterans returning from the overseas deployment. It considers the association of mTBI incidence, severity of post-concussive symptoms, comorbidities, social support, family functioning and community reintegration on long-term outcomes and the efficacy of rehabilitation interventions¹¹. Various treatment pathways targeted at mTBI in the military health system are also being studied, especially on veterans returning from Iraq and Afghanistan.

The cases that follow highlight both the needs and difficulties associated with the diagnosis and management of TBI. They identify areas of concern, new developments which may enhance diagnostic acumen and amplify issues for future research.

Case #1

A 35-year-old male soldier of Caucasian background was first seen in August 2017, and reported being

exposed to innumerable blasts while working with demolitions for the ADF. He reported at least 10 blast injuries while on deployment, being within 20–50 metres from explosions including an estimated 5 metres from an exploding projected grenade. He denied any loss of consciousness from any of these blasts.

In 2011, he reported being within 5–10 metres of a 'controlled detonation' of an explosive device, estimated to be equivalent to 5 kg of TNT, while inside the base compound. He reported feeling rattled but denied loss of consciousness. He described feeling shockwaves through his body when exposed to the explosion. In 2009, he reported firing a 66-mm rocket launcher, which he also described as a 'shoulder-fired concussion weapon', 60 times within a day, claiming 10 times per day is the upper limit. He had four deployments to the Middle East, all of which were associated with explosions and shockwaves. In addition, he reported five episodes of concussion while playing rugby.

On being examined during neurological consultation, he complained of 5 years of deteriorating memory. In 2013, he described an incident in which he failed to recognise his friend's partner whom he had known for at least 2 years. He also reported a loss of memory of a fellow soldier with whom he had been deployed for 6 months. He identified problems with retrieving information unless that memory had been actively 'jogged'. He claimed that newly acquired information was lost within 2 weeks if it was not repeatedly accessed and reinforced. He further reported difficulty retaining fine detail and specific information.

Using office administered clinical tools to evaluate cognitive function¹⁴, his scores were above average for the overall assessment, suggestive of no cerebral deficit. His remaining neurological examination was normal, as was standard brain imaging using magnetic resonance imaging (MRI) and electroencephalography (EEG). Advanced imaging including diffusion tensor imaging (DTI) was also performed to investigate the damage to the white matter tract.

He underwent detailed neuropsychological psychometric evaluation, which showed normal performance in the domains of: attention; concentration; processing speed; visuospatial processing; language; higher level skills; abstract reasoning; verbal fluency; planning; and problem-solving. Concurrently, psychometric testing demonstrated difficulties in: learning and memory measures; poor initial encoding for lengthy and

detailed verbal information; and mild reduction in learning recall of auditory information.

Case #2

A 39-year-old Caucasian male soldier was first assessed in July, 2016, stating that in 1999, while on deployment, he fell down a 100-metre ravine dressed in full battle rig and experienced loss of consciousness. He identified 1–2 hours of retrograde amnesia and 2 days of pro-grade amnesia. He was told that he walked out of the ravine and rejoined his patrol but he had no recall of this. He advised that he completed the exercise without further incident. In 2000, he presented and was treated for back symptoms, which he attributed to the fall but did not seek intervention for concussion.

Between 1998 and 2000, he stated that he undertook approximately 25 parachute jumps, in conjunction with his duties in the army. On two occasions, he reported a loss of consciousness in association with such jumps. He stated that they occurred in winds of more than 30 knots and reported loss of consciousness for 5–6 seconds before landing. He had no recall of grounding nor of 30 seconds to 1 minute after landing. He also stated that on one occasion he jumped at 700 feet, which was below safety standards and on impact claimed to have lost approximately 5 minutes. He did not report the incident.

Upon leaving the ADF in 2002, he joined the Police Force where he worked in riot control. He described an incident in which he was 'king hit', which resulted in 1–2 seconds of retrograde amnesia. He reported waking in the police sick bay approximately 5–10 minutes after the insult. He further reported numerous hits to the head between 2002 and 2005.

In 2005, he joined the US Department of Defense as a civilian contractor. He was deployed to the Middle East where he was exposed to an estimated 13 improvised explosive device blasts. He recorded four episodes of loss of consciousness and, while the incidents were reported to the authorities, he never sought medical attention in sick bay for consequences.

In 2006, he rejoined the ADF and experienced two episodes of loss of consciousness while playing rugby. He reported being sent off the field but returned to play within 30 minutes. The last of these incidents was in 2010.

In 2009, while serving with Special Forces, he reported being within 100 metres of an explosion which occurred behind him. He stated that the

blast was of such force as to blow him over. When he regained consciousness he was lying on his back, which he interpreted as the force being of sufficient intensity to both knock him down and roll him over.

His current complaints included: problems with anger control; episodes of altered consciousness, which he claimed to be epileptic seizures; gait disturbance with bradykinesia, freezing and bizarre movements; impaired cognition; sleep apnoea requiring continuous positive airway pressure (CPAP); and various tics and tremors.

Clinical examination revealed a very strange 'robotic-like' gait, which had features of psychiatric manifestations and was associated with slow movements, pill-rolling tremor and freezing. He had a speech disorder with stuttering and, at times, speech arrest. Testing higher-order cognitive function with in-house tools¹⁴ revealed impaired memory but did not identify any specific abnormality. Back examination was normal. Evidence of bradykinesia, pill-rolling tremor and lead-pipe rigidity were suggestive of extrapyramidal involvement with superimposing psychiatric features.

Standard imaging with MRI and a 48-hour sleep deprived EEG were both normal. In addition, he underwent advanced imaging including DTI. He responded well to anti-Parkinsonian medication including L-dopa, selegiline and pramipexole.

This case drew media attention as a special report on the Australian Broadcasting Commission (ABC) free-to-air television station. The presentation went to air with the approval and participation of the patient in August 2017¹⁵.

Discussion

Concussion remains the 'signature diagnosis' within military medicine, given its high prevalence in veterans especially with regards to the wars in Iraq and Afghanistan¹⁵⁻¹⁸, though TBI is gaining traction as a condition requiring additional research and understanding^{19,20}. It is essential to appreciate that, in the ADF, PTSD is acknowledged as of major importance¹² but the relationship between mTBI or concussion, and PTSD is not as well recognised.

Current management of concussion involves diagnosis, based on patient history and neurological evaluation in the clinic, exclusion of other pathologies, particularly structural head injury, for a differential diagnosis of concussion as well as careful consideration of potentially influencing factors²¹. Modifying factors that are crucial in mapping treatment plans include: current or future

engagement in high-risk activity or deployment; co- and pre-morbidity such as, migraine, depression and sleep disorders; use of psychoactive drugs; severity; sequelae (evidence of impact seizures or prolonged convulsive convulsions); and temporal features including frequency, timing and recency of concussions²¹.

The two cases presented in this paper, identify important features of TBI that deserve further consideration. Post-concussive symptoms are non-specific to mTBI/concussion. There is a large variability in severity, timeline and appearance of these symptoms, which make it diagnostically challenging. When combined as a 'cluster', these symptoms may be indicative of the condition. Given the nature of comorbidities, objective assessment of post-concussive symptoms is difficult^{16,22,23}, demonstrating a compelling need for further research to better understand the clinical implications of mTBI and to detect and quantify its prevalence and severity²⁴. In the two cases presented, DTI was able to capture alterations in white matter microstructural changes, even when the traditional diagnostic imaging modalities didn't find any abnormality.

Case #1 presented with repeated concussive episodes in whom office evaluation was normal, as were routine investigations. On more intensive formal neuropsychological psychometric assessment, he was shown to have defined areas of cognitive dysfunction. This emphasises the need to progress beyond routine clinical evaluation in patients with TBI who present as reliable witnesses and who offer a good history of ongoing problems. In most areas of psychometric testing, the patient scored within the average to above average range, thereby supporting the office evaluation. However, in specific tasks, there were confirmed areas of deficit requiring further attention.

Case #2 presented with repeated TBI in various situations in whom there were features of both neurological and psychiatric manifestations. Office evaluation confirmed problems with memory and physical examination showed evidence of extrapyramidal involvement with Parkinsonian features, which responded well to treatment and resulted in improved quality of life. There remained symptoms of a psychiatric nature which did not respond to such treatment and reinforced the concept that elements of both neurological and psychiatric manifestations can coexist in patients following TBI.

Further Considerations

It can be seen, from the above examples, that

routine clinical evaluation may be insufficient to adequately define the full nature and extent of the potential damage consequent to TBI. There is a need for further investigative tools of which there are a number of techniques, such as: enzyme-linked immunosorbent assay (ELISA); chemiluminescence; electrochemiluminescence; surface-enhanced Raman spectroscopy (SERS); induction coupled plasma mass spectrometry; immuno-PCR; and bio-barcode assay²⁵.

It has been argued that none of these are sufficiently robust to address recent experience of TBI and to consider the context of ongoing care²⁵. Advanced investigative techniques, such as single-molecule arrays with the simultaneous counting of singulated captured microbeads (Simoa™), a novel approach to determine peripheral concentrations of related compounds, may be of potential value in measuring concentrations of compounds such as tau, neurofilaments and Apo E protein in the peripheral blood and corresponding clinical consequences following mTBI²⁵. It is argued that Simoa™ uses an ultrasensitive sandwich array able to detect multiple micro-RNA's without pre-amplification and can detect these at femtomolar (fM) concentration ranging from 1–3 fM with high specificity²⁶. This technique may be of potential use to identify those who's TBI has probable negative prognostic values; however, for the present, it remains a tool in the research domain that warrants further investigation to determine its clinical value. It needs to be confirmed that Simoa™ will live up to expectation for reliability, validity and specificity, and that the correct peripheral compound is being appropriately measured in the right circumstances. Achieving this outcome will require ongoing studies and a commitment by all those involved. It represents a potentially exciting frontier, which may have wide application if the research supports the projected enthusiasm and expectation of its relevance.

A further consideration for investigation of TBI is reflected in more sophisticated imaging which is more sensitive in detecting alterations in neural micro-architecture. This may include DTI, which is a much more sensitive tool than conventional MRI^{8,24,27-30}. It must be acknowledged that both cases presented in this report were investigated with DTI but both initial reports, as provided by the radiologist, were 'normal'. This reflects the need for specialised and committed neurovascular, cerebral neuro-imaging skills to evaluate the relevance and applicability of DTI and the need to understand appropriate post-processing of the raw data to provide relevant diagnostic/radiologic results, especially in the military population who have experienced combat-related

blast/impact trauma^{23,24,27,29,31}. DTI pre-processing, post-processing, data visualisation, including tractography and radiological interpretation with clinical correlation, needs advanced, committed neuroimaging/neurovascular skills. Since advanced neuroimaging analyses is not routinely performed, customised platforms/programming are required to analyse DTI datasets.

A number of studies on veteran and civilian populations with mTBI/concussion indicate a role for advanced neuroimaging in objective assessment of brain injury from both diagnostic and prognostic standpoints, to better understand and predict neural and clinical consequences of the injury^{8,13,19,22-24,27-43}. It must also be acknowledged that there needs to be caution in extrapolating research, undertaken in a civilian population, to that in the military context, given the nature of source, complexity and wide heterogeneity of injuries⁵. Morphometric imaging studies, using T1-weighted, T2-weighted and fluid attenuated inversion recovery (FLAIR), have shown reduction in regional cortical thickness (as measured from the boundary of the white matter) in symptomatic military veterans who experienced mild- to moderate- TBI^{13,38,42}. Another promising imaging technique is diffusion weighted imaging (DWI), including DTI, that has been harnessed to study the neural microstructure in cases of concussion⁸. It is potentially more sensitive in detecting subtle effects of mTBI due to the axonal injury^{29,31,35}. Other studies have shown significant reductions in diffusion parameters, such as functional anisotropy (FA) values, as well as loss or variations in white matter integrity across several tracts in mTBI patients^{29-31,35,42}. Despite studies showing good sensitivity, future longitudinal studies are warranted to establish its diagnostic specificity and prognostic sensitivity before it is translated to routine clinical use.

Techniques of non-invasive measurement of regional brain metabolism, assessed as glucose uptake, measured using [¹⁸F]-fluorodeoxyglucose positron emission tomography (¹⁸F-FDG-PET) have also found significantly lower metabolism in the brain regions of the amygdala, parahippocampal gyrus and hippocampus in military veterans with history of blast-induced mTBI in comparison to the veterans without a history of blast exposure^{39,41,43}. ¹⁸F-FDG-PET can capture hypometabolism or compromised brain uptake of FDG for days to months after mTBI. This may be of value in clinical settings to stratify patients based on the stage of injury, type of injury and mechanism or to monitor the effects of medication for ongoing management of mTBI⁴⁴. Further studies (on a larger cohort) using ¹⁸F-FDG-PET, to study

the effects of trauma on metabolic activity in blast-induced mTBI war veterans, is required.

Other advanced emerging neuroimaging modalities, such as susceptibility weighted imaging (SWI)³⁷, arterial spin labelling (ASL)³², magnetoencephalography (MEG)²², electroencephalogram (EEG) phase synchronization⁴⁰ and spectroscopic imaging²⁴ have shown promise in studies of concussion-related brain injury. Their application has been limited in blast-induced mTBI in military populations. Advanced neuroimaging holds promise as a surrogate biomarker when combined with clinical and neuropsychological endpoints in early detection of mTBI, to characterise the nature and severity of injury. These techniques may assist in guiding therapeutic interventions, specifically in the context of concussion/mTBI in the military.

Amid concerns around the association of repetitive concussion/mTBI with CTE and dementia, further studies on clinicopathologic/radiologic correlation of the progression of the condition, following exposure to repeated concussion, is warranted^{7,45}. Large scale, multicentre, longitudinal studies on the effects of mTBI/concussion on veterans, using advanced imaging and monitoring techniques hold the potential to bring a paradigm shift in the care and treatment of affected individuals. It may also establish the clinical utility, sensitivity, specificity and accuracy of these techniques.

Conclusion

While TBI remains the 'signature' diagnosis for the ADF with the wars in Iraq and Afghanistan, it is insufficient to rely solely on bedside clinical skills. As with all neurological evaluation, history is the most important part of the assessment. If the subsequent clinical evaluation does not reflect expectation, based on the history provided, there is a need to progress to sophisticated investigation and potential use of

cutting-edge tools such as Simoa^{TM25} and advanced neuroimaging based characterisation of the nature and severity of the brain injury due to concussion/mTBI in the military^{22,28,31,32,38}. The cases provided reflect the lack of self-reporting of TBI by those who have experienced concussion/mTBI and this is most relevant to those within the Defence Forces where there exists a fear of the impact on a career path. As cutting-edge techniques develop and improve, there is an unequivocal need to properly subject those who have experienced TBI to further investigation, using an integrated approach²³. While there exists new and exciting technology, it is imperative to confirm the sensitivity, validity and reliability of such technology and to demonstrate that the correct test is being applied within the appropriate setting and is measuring the right variable(s). This necessitates an ongoing commitment to research in this field by people with the specialised and developed skills to demonstrate the benefit of these measures and their relevance to TBI and its clinical care.

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Analgesic use in Vietnam Veterans' with Musculoskeletal Pain

Lisa Kalisch Ellett, Nicole Pratt, Elizabeth Roughead

Abstract

Background: International studies suggest that high-dose opioid use is more common in veterans with post-traumatic stress disorder (PTSD) than those without in the treatment of musculoskeletal pain.

Purpose: This article aims to examine the use of analgesics by Australian veterans with musculoskeletal pain by conducting a drug utilisation evaluation and to examine use by PTSD status.

Methods: A cross-sectional study of Vietnam veterans with musculoskeletal pain was conducted using Australian Government Department of Veterans' Affairs (DVA) data. The study reviewed the proportion of dispensed prescription analgesics between 1 July 2015 and 30 June 2016. The volume of opioids dispensed per veteran was calculated as oral morphine equivalents (OME). Results were stratified by PTSD status.

Results: 10318 Vietnam veterans with musculoskeletal pain were included and 59% were dispensed analgesics. The most frequently dispensed analgesics were paracetamol (dispensed to 31% of veterans with PTSD and 28% without PTSD; $p < 0.01$) and paracetamol with 30 mg codeine (19% of veterans with PTSD and 16% without; $p < 0.0001$). Opioid analgesics were more likely to be dispensed to veterans with PTSD than without (35% v 32%, $p = 0.002$); however, there was no significant difference in the volume dispensed (median of 1.2 [interquartile range (IQR) 0.4–5.8] OMEs per veteran per day for those with PTSD, compared to median 1.3 OMEs [IQR 0.4–6.3] per veteran per day for those without, $p = 0.3$).

Conclusion: Many veterans with service-related musculoskeletal pain did not receive prescription analgesics. Veterans with PTSD were more likely to be dispensed analgesics than those without, but PTSD did not appear to influence the volume of opioid dispensed.

Key words: musculoskeletal pain, Vietnam veteran, opioid, analgesic, post-traumatic stress disorder

Introduction

Musculoskeletal pain is common. Systematic reviews of studies published worldwide between 1980 and 2009 for the Global Burden of Disease 2010 study found that the age-standardised point prevalence of lower back pain was 9.4%, neck pain was 4.9%, osteoarthritis was 3.8% and other musculoskeletal disorders was 8.4%.¹ Prevalence of lower back pain was highest in men, while all other types of musculoskeletal pain prevalence was highest in women. Prevalence increased with age, although the ages of peak prevalence varied by pain type (e.g. prevalence of neck pain was highest at age 45, while lower back pain prevalence was highest at age 80).¹ Within Australia, 22% of men and 27% of Australian women have a musculoskeletal condition, and prevalence increases with age: more than half of men and more than two-thirds of women aged 65 or over report having a musculoskeletal condition.²

Musculoskeletal pain is also common in veterans.

Musculoskeletal problems are the most common comorbidity treated at US veterans' health administration facilities for veterans who served in Operation Enduring Freedom (OEF) or Operation Iraqi Freedom (OIF).³ A survey of British veterans who served in the Gulf War ($n = 2735$), Bosnia ($n = 2393$) or who served in the armed forces but were not deployed to either of these conflicts ($n = 2422$), found that the prevalence of back problems was 36%, 24% and 28% in each of these cohorts respectively.⁴ Musculoskeletal pain is also common in older veterans. A 2006 report from Australia involving veterans who most commonly served in World War II or the Vietnam war, and their spouses, found that 47% reported having back pain and 51% reported having osteoarthritis or rheumatoid arthritis.⁵

Musculoskeletal pain can be managed with non-pharmacological strategies; however, in some cases analgesics are required.⁶ Paracetamol or non-steroidal anti-inflammatory drugs (NSAIDs) are recommended for mild pain and opioid analgesics

should be reserved for severe pain.⁷ Opioid analgesics should only be used short-term for musculoskeletal pain as there is limited evidence to support long-term use.⁷ In addition, only one-third of patients will benefit from opioid analgesics for musculoskeletal pain and for those who receive a benefit, maximal pain reduction is 50%, while eight in ten will report an adverse event.⁶

Although several studies have examined the use of opioid analgesics in the general Australian population, none have specifically examined opioid analgesic use among Australian veterans. International studies have shown that use of opioid analgesics for pain management is higher in veterans with post-traumatic stress disorder (PTSD) compared to those without PTSD and that high-risk use is more common in those with PTSD.⁸ A study involving 141 029 US veterans who served in Afghanistan or Iraq who had non-cancer pain found that 15 676 (11%) were dispensed opioids to manage the pain.⁸ Compared to veterans without any mental health disorder, those with PTSD were more likely to use opioids at high dose (adjusted relative risk (RR) 1.42, 95% CI 1.31–1.54), were more likely to use opioids long-term (RR 1.47, 95% CI 1.42–1.53), were more likely to use more than one opioid analgesic at the same time (RR 1.87, 95% CI 1.70–2.06), were more likely to use sedative or hypnotic drugs at the same time as the opioid analgesic (RR 5.46, 95% CI 4.91–6.07) and were more likely to have their opioid prescription re-dispensed more than one week earlier than the expected end date of their prescription (RR 1.64, 95% CI 1.53–1.75).⁸

International studies show a high prevalence of musculoskeletal pain among veterans with PTSD and that problematic use of opioid analgesics may be more common among veterans with pain and co-morbid PTSD. However, there are no published studies on the use of analgesics for chronic musculoskeletal pain in Australian veterans or the influence of PTSD status on analgesic use. Extrapolation of results from international studies may not be relevant to the Australian veteran population due to differences in age and gender, with the Australian veteran population comprising of more men and older age groups than international veteran cohorts. Additionally, differences in access to medicines and the types of analgesics available between different countries limit the usefulness of extrapolated results from international studies. Therefore, the aim of this study was to conduct a drug utilisation evaluation of analgesics by Australian veterans with musculoskeletal pain and examine use by PTSD status.

Methods

Data for this study were sourced from DVA's administrative claims database. The DVA administrative claims database contains details of all prescription medicines, medical and allied health services, and hospitalisations provided to veterans for which DVA pay a subsidy. The data file contains records for a current treatment population of 200 000 members of the veteran community. DVA maintain a client file, which includes data on gender, date of birth, date of death and family status. Medicines are coded in the dataset according to the World Health Organization (WHO) Anatomical Therapeutic Chemical (ATC) classification system⁹ and the Schedule of Pharmaceutical Benefits item codes.¹⁰ Hospitalisations are coded according to the WHO International Classification of Diseases (10th Edition), Australian Modification.¹¹

Vietnam veterans were included in the study if they were alive on 30 June 2016 and had an accepted service-related disability for chronic musculoskeletal back or knee pain, effective before 1 July 2015. For these veterans we identified analgesic use between 1 July 2015 and 30 June 2016. Analgesics were defined as paracetamol (ATC code N02BE01), paracetamol in combination with codeine (ATC code N02BE51), opioid analgesics (ATC code N02A) and NSAIDs (ATC code M01A). PTSD was identified if a Vietnam veteran had a record in the disability file for service-related PTSD and where the disability was accepted as service related before 1 July 2015.

We identified the number of Vietnam veterans with a service-related musculoskeletal pain disability who were dispensed each type of analgesic. Demographics of study participants were identified, including age at 1 July 2015, gender, type of residence at 1 July 2015 (community or residential aged care), remoteness of residence at 1 July 2015 (major city, inner regional area, outer regional area, remote area or very remote area based on the Australian Standard Geographic Classification) and socioeconomic status based on postcode of residence at 1 July 2015 (using socioeconomic indexes for areas [SEIFA]). Results were stratified by PTSD status. Chi-squared tests were conducted to determine differences in the percentage of Vietnam veterans with and without PTSD dispensed each type of analgesic.

To provide an estimate of the volume of opioid analgesic use over the 1 year study period, the volume of opioids dispensed to study participants was calculated as 'oral morphine equivalents' per veteran per day, using the conversion table developed by the Australian National Drug and

Alcohol Research Centre.¹² We calculated the oral morphine equivalents (OME) supplied at each opioid dispensing by multiplying the OME conversion factor for each opioid by the mass of analgesic in each tablet and the number of tablets supplied at the dispensing. For example, oxycodone has an OME conversion factor of 1.5, so a dispensing of 20 oxycodone 5 mg tablets contains $1.5 \times 20 \times 5 = 150$ OMEs, equivalent to 150 mg of morphine. The total OME for each opioid analgesic dispensed to each veteran over the year was calculated, then divided by the number of days in the year (365) to provide the average OME per veteran per day. Differences in the median OME per day were compared for veterans with and without PTSD using the Wilcoxon test. We also expressed the cumulative percentage of opioid OMEs dispensed, by the cumulative percentage of patients using opioids, stratified by those with and without PTSD as a Lorenz curve.¹³ All analyses were performed using SAS for Windows, V9.4 (SAS Institute, Cary, North Carolina, USA). Approval to conduct the research was obtained from the University of South Australia Human Research Ethics Committee and the Department of Veterans' Affairs Human Research Ethics Committee.

Results

The study cohort included 10 318 Vietnam veterans with service-related musculoskeletal pain disability. Ninety-nine per cent of study participants were men and lived in the community (Table 1). Over half of the cohort had PTSD (57.3%). Although all study participants had an accepted service-related musculoskeletal pain disability, 39% of those with PTSD and 44% of those without PTSD were not dispensed pain medicines during the study period (Table 2). Veterans with and without PTSD who were dispensed analgesics received a median of two different medicines to manage their pain during the 1 year study period (Table 2).

The most frequently dispensed analgesics, paracetamol (single ingredient product) and paracetamol with 30 mg codeine, were dispensed to more veterans with PTSD than to those without PTSD (Table 2). As a group, opioid analgesics were more likely to be dispensed to veterans with PTSD than those without PTSD; however, the only individual opioid analgesic more likely to be dispensed to those with PTSD compared to those without was paracetamol with 30 mg codeine (Table 2). As a group, NSAIDs were more likely to be dispensed to veterans with PTSD than those without PTSD; however, there was no difference in the proportion of veterans in either group dispensed individual NSAIDs (Table 2).

Table 1 – Vietnam veterans with service-related musculoskeletal pain disability

	Veterans with musculoskeletal pain and PTSD (n = 5 909)	Veterans with musculoskeletal pain but no PTSD (n = 4 409)
Age group:**		
55-64 years	382 (6.5%)	489 (11.1%)
65-74 years	4 954 (83.8%)	3 142 (71.3%)
75-84 years	532 (9.0%)	667 (15.1%)
85 years +	41 (0.7%)	111 (2.5%)
Male gender: n (%)	5 904 (99.9%)	4 398 (99.8%)
Resident in aged care facility	19 (0.3%)	26 (0.6%)
Location of residence:*		
Major city	2 838 (48.0%)	2 233 (50.6%)
Inner regional	2 059 (34.8%)	1 520 (34.5%)
Outer regional	841 (14.2%)	545 (12.4%)
Remote	74 (1.3%)	28 (0.6%)
Very remote	21 (0.4%)	10 (0.2%)
Missing	76 (1.3%)	73 (1.7%)
Socioeconomic status:*		
Bottom 0-25%	1532 (26.2%)	1 050 (24.2%)
26-50%	1 510 (25.8%)	1 079 (24.8%)
51-75%	1 448 (24.8%)	1 080 (24.9%)
Top 76-100%	1 353 (23.2%)	1 134 (26.1%)
Missing	66	66

*at 1 July 2015 **No study participants were aged less than 55 years

Veterans dispensed analgesics during the study period received a median of 5 (IQR 2-11) dispensings over the 1 year study period. Veterans dispensed paracetamol received a median of 4 supplies over the year. Among veterans dispensed opioid analgesics, the median number of supplies per veteran was 3, and among those dispensed NSAIDs there was a median of 3 supplies over the year. There was no significant difference in the number of dispensings to veterans with PTSD or those without (Figure 1).

Veterans with PTSD were dispensed a median of 1.2 (interquartile range (IQR) 0.4 – 5.8) OMEs per day over the 1 year study period, which was not significantly different to the volume of opioids dispensed to veterans without PTSD (median 1.3 (IR 0.4-6.3) OMEs per day, $p = 0.3$) (Figure 2). This is equivalent to the supply of just over three packs of morphine 5 mg tablets (quantity 28 tablets) over the 1 year period. Paracetamol with 30 mg codeine, oxycodone and tramadol were the most frequently dispensed opioid analgesics. The volume dispensed did not significantly differ between veterans with and without PTSD (Figure 2).

Table 2 – Analgesic medicines used by Vietnam veterans with service-related musculoskeletal pain with or without PTSD

Number of veterans dispensed:	Veterans with service-related musculoskeletal pain and PTSD		Veterans with service-related musculoskeletal pain and no PTSD	
	n	%	n	%
At least one pain medicine*	3626	61.4	2481	56.3
Paracetamol*	1813	30.7	1241	28.2
Paracetamol+ codeine 8 mg or 15 mg	47	0.8	30	0.7
Any opioid analgesic*	2065	35.0	1412	32.0
Paracetamol and codeine 30 mg*	1147	19.4	717	16.3
Buprenorphine patch	128	2.2	100	2.3
Codeine	18	0.3	11	0.3
Fentanyl	55	0.9	40	0.9
Hydromorphone	15	0.3	8	0.2
Methadone	4	0.1	5	0.1
Morphine	62	1.1	45	1.0
Oxycodone	923	15.6	651	14.8
Tramadol	433	7.3	326	7.4
Any NSAID*	1853	31.4	1283	29.1
Diclofenac	247	4.2	174	4.0
Ibuprofen	154	2.6	97	2.2
Indomethacin	150	2.5	99	2.3
Ketoprofen	22	0.4	18	0.4
Naproxen	192	3.3	148	3.4
Piroxicam	52	0.9	32	0.7
Celecoxib	545	9.2	367	8.3
Meloxicam	689	11.7	495	11.2
Median (p25, p75) different pain medicines per veteran#	2 (1-2)		2 (1-2)	

*Chi-square analysis, $df=2$ for all comparisons. Statistically significant difference in the per cent of veterans with/without PTSD dispensed these medicines: At least one pain medicine $p < 0.0001$; Paracetamol $p = 0.005$; Any opioid $p=0.002$; Paracetamol and codeine 30 mg $p < 0.0001$; Any NSAID $p = 0.01$ (no statistically significant difference for other medicines)
Wilcoxon test; $p=0.8$

The Lorenz curve (Figure 3) shows that the overall volume of use of opioids was very similar for veterans with PTSD and without PTSD. Fifty per cent of opioid users (with and without PTSD) accounted for just over 96% of the total volume of opioid use (Figure 3). This indicates that the remaining 50% of opioid users consumed approximately only 4% of the total quantity of opioids dispensed during the study period.

Discussion

The study highlights that not all veterans with chronic service-related musculoskeletal pain receive prescription analgesics. Sixty-one per cent of Vietnam veterans who had PTSD and musculoskeletal pain were dispensed analgesics on prescription during the one year period, compared to 56% of Vietnam veterans with musculoskeletal pain but no PTSD. Paracetamol, alone or in combination with codeine 30 mg, were most frequently dispensed and were more likely to be dispensed to veterans with PTSD than those without PTSD.

An earlier study of analgesic use in Australian general practice patients with chronic pain who visited their GP in April/May 2008 or July/August 2009, found that 86% used at least one medicine to manage their pain, most commonly paracetamol (used by 43% of patients who managed their pain with medicines).¹⁴ One-third of patients who used medicines used opioid analgesics (including paracetamol + codeine 30 mg) to manage their pain, while 22% used NSAIDs.¹⁴ In our study, a total of 3054 veterans were dispensed paracetamol. This is equal to 50% of the 6107 patients who were dispensed analgesics; slightly higher than the prevalence of paracetamol use in the earlier study involving general practice patients. Fifty-one per cent of the veterans dispensed analgesics during the study were dispensed NSAIDs, and 3477 (57%) were dispensed opioids (including paracetamol + 30 mg codeine), both which are considerably higher than the prevalence of use among general practice patients with chronic pain. The majority of patients in the general practice study were aged 64 years or

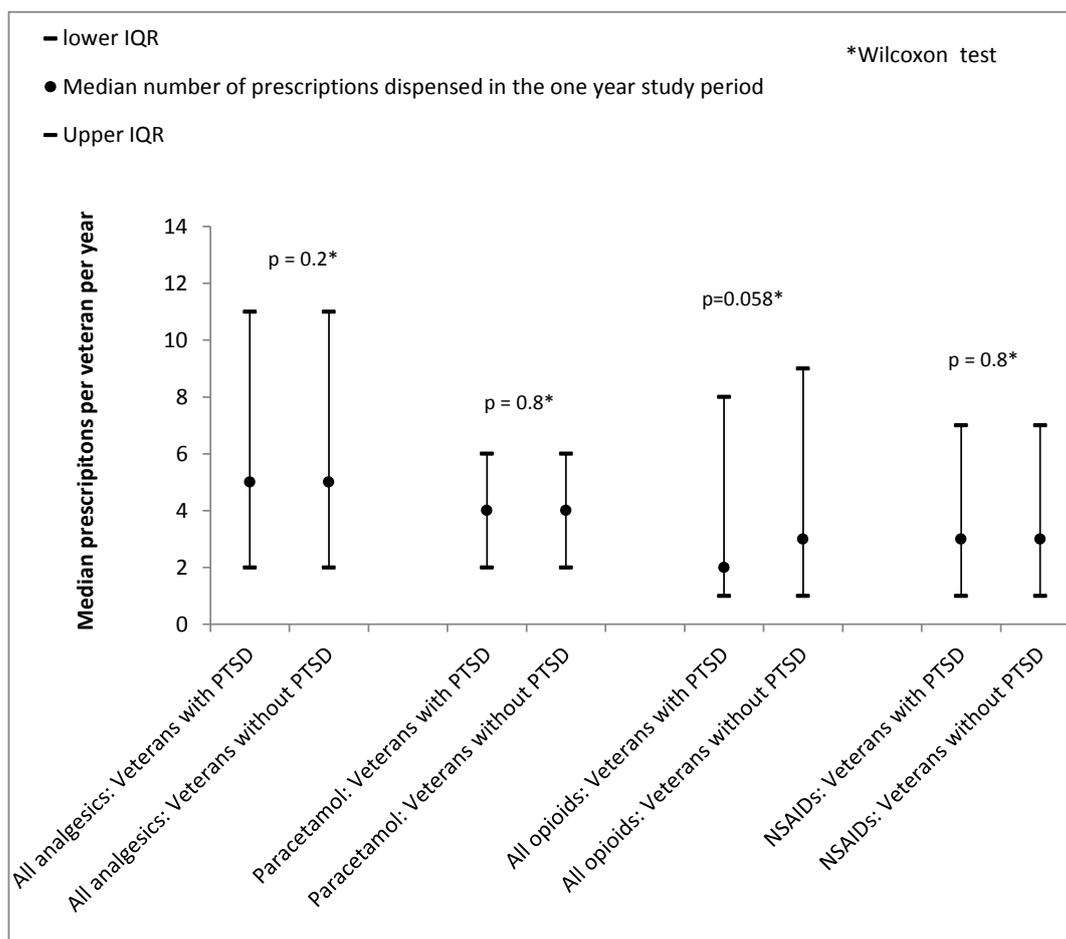


Figure 1 – Median number of analgesic prescriptions per veteran over the one year study period

under and prevalence of pain increased with age.¹⁴ The higher prevalence of use of opioid analgesics and NSAIDs in the study population may reflect the older age of the population, as a previous Australian study also showed an increase in opioid use with increasing age.¹⁵

International research has found that veterans with PTSD are more likely to use opioid analgesics, and are more likely to use them at high doses than those without PTSD.⁸ In the US study, 17.8% of veterans with PTSD were dispensed opioid analgesics compared to 11.7% of veterans with a mental health condition but not PTSD and 6.5% of veterans with no mental health diagnoses.⁸ In our study, a higher percentage of veterans with PTSD than those without PTSD were dispensed opioid analgesics (35% v 32%); largely due to greater prevalence of use of paracetamol with 30 mg codeine in the PTSD group. However, there was no significant difference in the volume or number of opioid analgesic prescriptions dispensed to veterans with or without PTSD over the study period. The veterans in the study who were dispensed opioids received a median of 1.2-1.3

OME per day for the duration of the study period. This is equivalent to enough morphine to take the minimum recommended dose for chronic non-cancer pain (5 mg twice daily)⁷ for between 6 and 7 weeks, or 3 to 4 standard packets (each containing 28 tablets) of morphine 5 mg tablets. Opioid analgesics are recommended to be used short-term for musculoskeletal pain⁷ and our results indicate that, for most Vietnam veterans with service-related musculoskeletal pain disability, short-term use of low-range doses is the norm.

The average daily dose of opioid analgesics dispensed to veterans in our study was much lower than the doses reported in an international study involving veterans. A study involving 141 029 American veterans who served in Iraq or Afghanistan who were diagnosed with pain, found that veterans in the highest quintile of opioid analgesic dose received a dose equivalent to 33 mg of morphine daily or higher.⁸ By contrast, in our study, veterans in the highest quartile of use were dispensed doses equivalent to 8 mg per day or higher. This difference may be explained, at least in part, by differences in

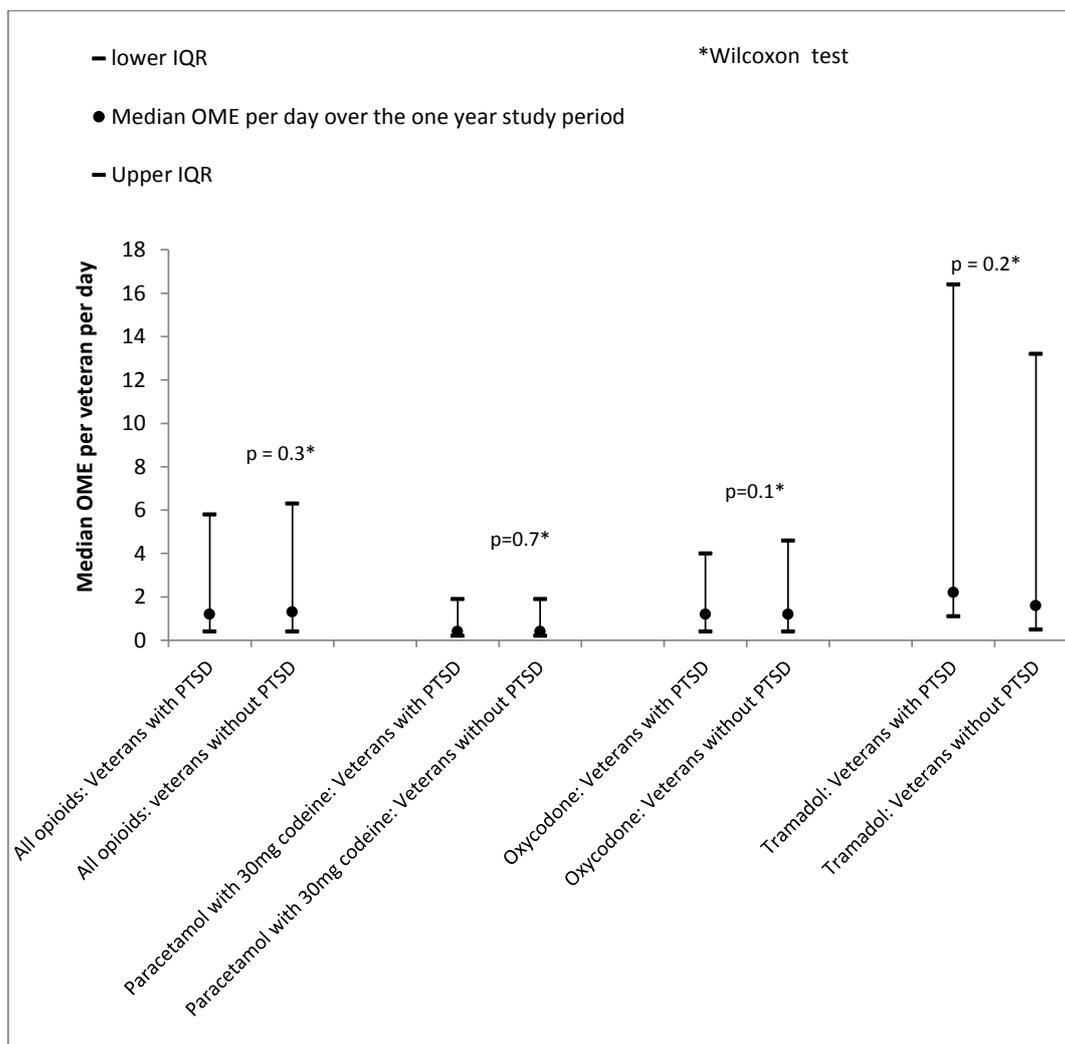
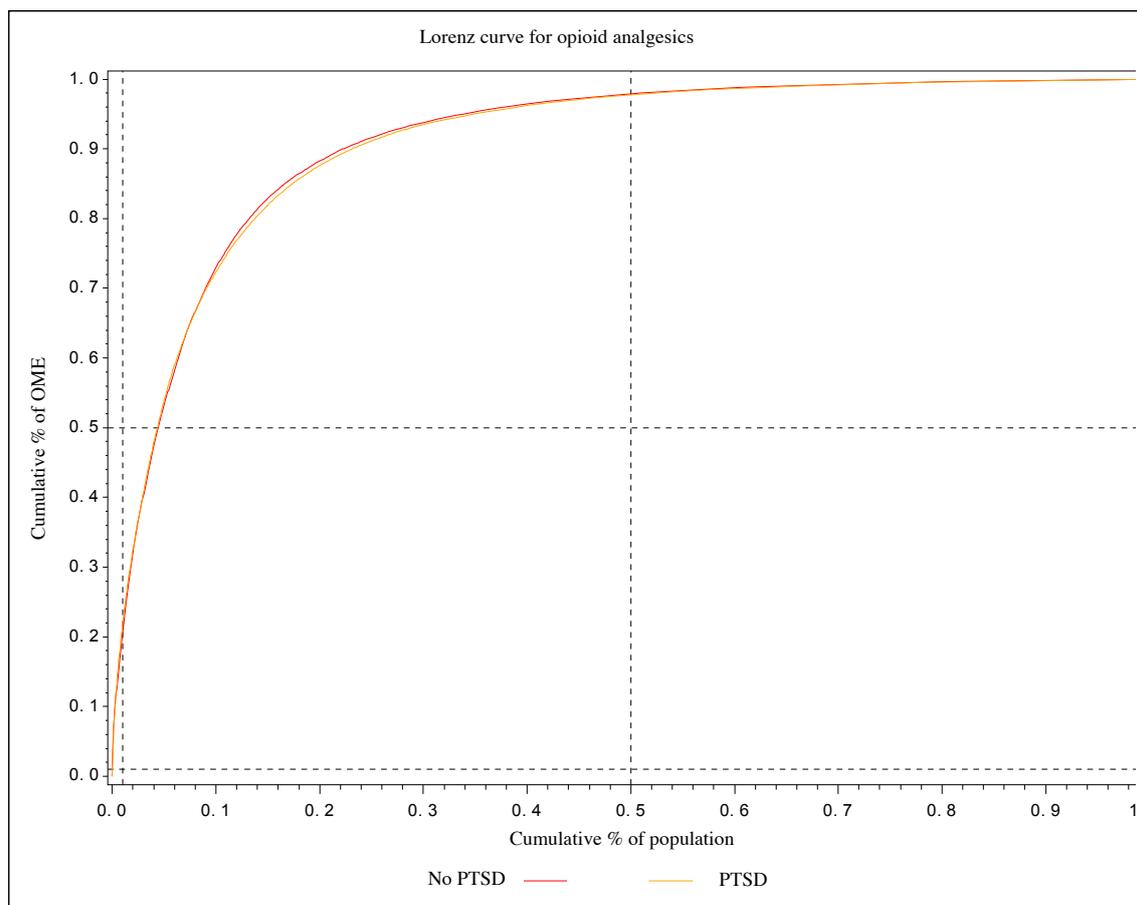


Figure 2 – Median OME per veteran per day over the one year study period

the study methodology: the American study required participants to use opioids continuously for at least 20 days,⁸ whereas there was no minimum duration of opioid use for patients in our study. In addition, the age and gender of study participants were markedly different. Eleven per cent of participants in the American study were female and 58% were aged under 30 years, compared to over 99% male and all participants aged 55 or over in our study. Other studies have shown that prevalence, dose and duration of opioid use varies by age and gender.¹⁵ A national practice improvement intervention involving Australian veterans and their prescribers, aiming to improve the use of medicines for musculoskeletal pain, may have also contributed. This intervention advocated for the use of non-medicine management options where possible, and recommended that opioid analgesics should only be prescribed short-term, at doses lower than those used for managing cancer pain and only after careful consideration

of alternative management options. Differences in severity of pain between the two study populations may also have contributed; however, information relating to pain severity is not recorded in our dataset.

Our study identified supply of prescribed analgesics; we were unable to identify the use of analgesics purchased over the counter without a prescription. It is possible that some veterans who were not dispensed prescription analgesics during the study period purchased over-the-counter paracetamol or NSAIDs to manage their pain. It may be that the prevalence of use of analgesics like paracetamol and some NSAIDs, which are available over the counter without a prescription, is higher than reported in our study. However, the prevalence of use of analgesics such as opioids or paracetamol with codeine 30 mg, which are only available via prescription, is likely to be an accurate representation of the prevalence



of use in this patient population due to complete capture of data in our dataset. In addition, the high prevalence of use of paracetamol and NSAIDs in our study compared to the general practice chronic pain population indicates that we are unlikely to have underestimated use to a large extent.¹⁴ A strength of our study is the use of OME to measure opioid doses. This allows a more accurate comparison of doses for the different opioids than other measures such as the defined daily dose (DDD), which can lead to under or over-estimation of opioid doses actually taken by patients.¹⁵ In addition, there is complete capture of prescription medicines dispensed to veterans in our dataset, with no loss to other insurance services. This means that we are more likely to have complete capture of the population of veterans with chronic musculoskeletal disability than international studies, where veterans may have received health care or medicines from other sources and so do not appear in the claims data used. A limitation of our study is our inability to adjust for pain severity because this information is not recorded in the dataset. It may be that some of the veterans in our study who had a record of a musculoskeletal pain-related disability were not dispensed analgesics because they were no longer experiencing pain.

Conclusion

Our study has highlighted that not all veterans with service-related musculoskeletal pain receive prescription analgesics. Among veterans who do receive prescription analgesics, those with PTSD are more likely to receive paracetamol alone, paracetamol with 30 mg codeine or NSAIDs than those without PTSD. For those dispensed opioid analgesics to manage their pain, there was no significant difference in the amount of opioid dispensed to veterans with PTSD compared to those without. Unlike international studies, problematic use of long-term, high-dose prescription opioids was not common in our study cohort.

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Incorporating Reflective Practice as an Assessment Tool in the Training of New Zealand Defence Force (NZDF) Medics

Wendy Maddocks

Abstract

The New Zealand Defence Health Directorate changed its strategic vision in 2016 in the way the New Zealand Defence Force (NZDF) provides medic training. This change provided an opportunity to analyse the value of using reflective practice as a summative assessment during the first primary health care (PHC) on job experience (OJE). Approval was gained from the Commanding Officer (CO) of the Defence Training Institute (DTI) and the Chief Instructor (CI) of the Defence Health School (DHS [NZ]) for the author to gain access to the learners and conduct voluntary interviews. The first cohort of Military Medical Technicians (MMTs) ($n=14$) were interviewed twice while the MMT learners were on OJE at NZDF Health Centres. A retrospective analysis was conducted on the responses received, identifying the benefits from using the selected model which required them to reflect on clinically based encounters and link their experience with the literature. Key benefits included evidence of increased confidence, skill utilisation and self-awareness.

Background

NZDF tri-service MMTs and Medics provide routine PHC to military personnel as part of a multidisciplinary team. In addition, they are trained to respond to requests from the New Zealand Government for tactical or Humanitarian and Disaster Relief. Training is provided by the DHS (NZ) who receives clinical leadership from the Defence Health Directorate. In February 2017, the first cohort ($n=14$) commenced the new syllabus of learning which had been designed to meet job specific requirements suited to all three NZDF services (Navy, Army and Airforce). Instruction over the 30 months includes residential theory and simulated practical, and extensive blocks of learning in various NZDF PHC and operational settings.

The focus of OJE is to apply the skills and knowledge already acquired into real life encounters, in addition to 'just in time' (JIT) learning where a learner is coached by senior clinical staff if they have not learnt the skills. Given the unpredictable nature of military health care this, and being able to respond appropriately in accordance with NZDF policy, is an important part of their learning. This article explores and analyses the use of reflective practice by MMT learners during their first OJE in a NZDF PHC setting.

Reflective Practice Literature Review

Reflective practice is a learning tool used in various health and education learning contexts¹ with increased uptake by pre-hospital health providers (e.g. paramedics)². This process helps formalise subconscious thoughts and actions to a more deliberate and systematic process to help inform future practice.³ Proponents argue it is of most value when it is implemented early in training when skills are not intuitive, and continue through the entire training continuum.⁴ The key premise of reflective practice, reflective journaling or critical reflections is that the learner gains insight into their clinical decision making process, away from the environment in which the learning has occurred. The reflection is then presented against a backdrop of a critical analysis of literature relating to the incident or experience.^{5,6}

While all reflective models offer an element of looking deeper into a situation, not all require looking beyond the situation and researching literature to support the reflection, thus limiting the academic value.⁷ The DHS (NZ) encourages medic learners to engage with extant and emerging literature early within their learning and to develop a 'best practice' mind-set providing evidenced based care for future patient encounters.⁸ The key point is to make the linkage

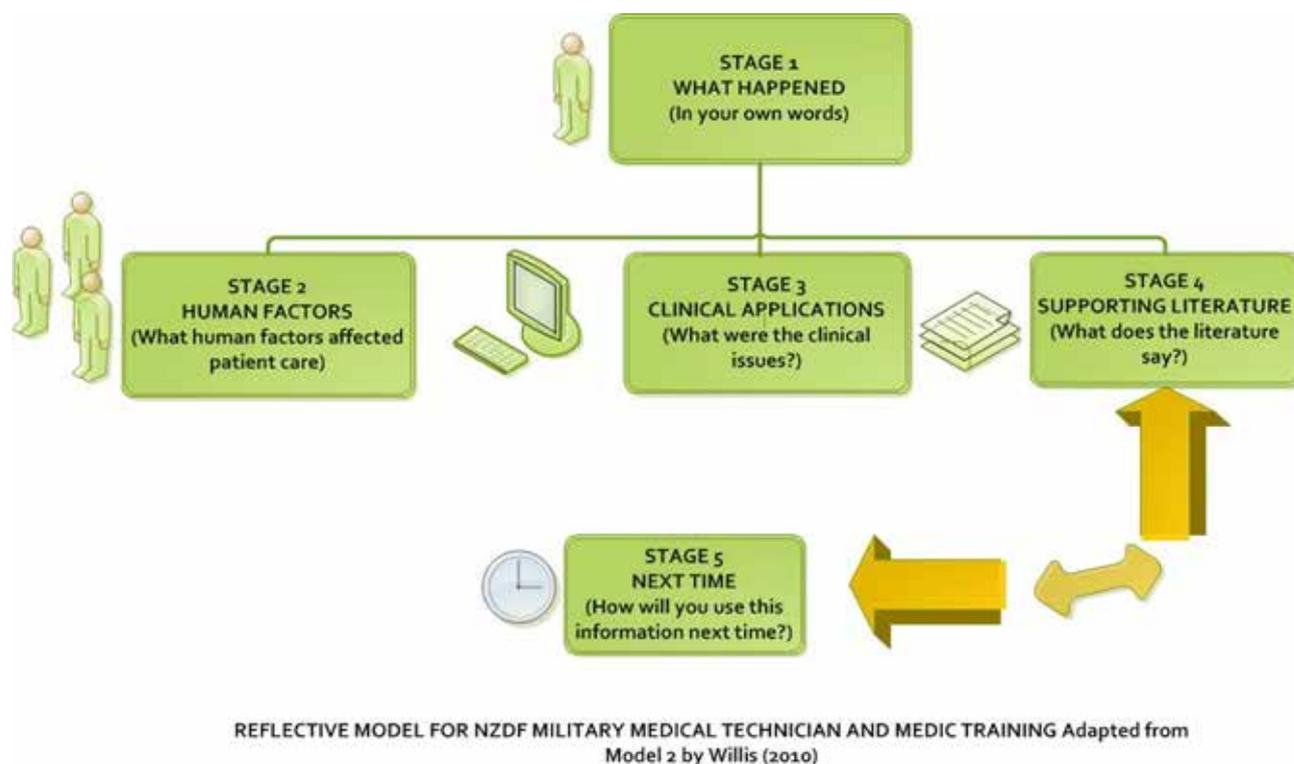


Figure 1: Reflective Practice Model as used by NZDF (Willis, 2010)⁸

between theory and the clinical experience.¹ This may start with an uncomfortable feeling or thought which the learner then questions.⁶

A model developed for paramedic use by Willis⁸ was selected as it is based on pre-hospital contextual elements which are similar to a NZDF medic,⁶ such as working in an austere or dangerous environment or working in adverse climatic conditions. The clear steps conclude with a 'what would you do next time?'⁸ which encourages continual forward thinking (See Figure 1). Employing a narrative style to describe their encounter was encouraged for learners to discover questions they may not yet know the answers to, thus helping to link knowledge and practice, which is especially valuable early in the career.⁹

Learning is enhanced through using a reflective model as 'ownership' of learning rests with the individual as they critique their practice. In addition, clinical time is more than just a race to tick off competencies without further contextual considerations.^{10,11,12} Guidance and support needs to be provided throughout the reflection process to ensure the portfolio of work is not just a timeline of events or an 'autobiography' without any deeper exploration.^{10,11}

Method

Using the reflection on action approach¹³, a cohort of 14 NZDF MMT learners were interviewed, either in person or by phone, by the author shortly after completing their first and sixth reflection while on their first OJE. All learners voluntarily participated in both interviews ($n=14$) which lasted about 10 minutes each. Due to the diverse geographic locations it was not possible for the interviewer to visit each learner in person. Consent for the author to approach and interview the learners was obtained by the CO of DTI and the CI of DHS (NZ). Support was also obtained from the Learning Support Manager who facilitated the process and enabled access to the written reflections on completion. Learners could remove themselves at any time without penalty. The author was known to the learners through delivery of a lesson on reflective practice but was not involved in assessing the work or clinical supervision. All responses were confidential and raw data was not shared with any assessors. No identifying patient data was included in the interviews or written reflections.

The author became immersed in all the raw data through repeated reading of the reflections and interviews, listing key words using a coding system similar to that used by Chirema.⁶ Further analysis

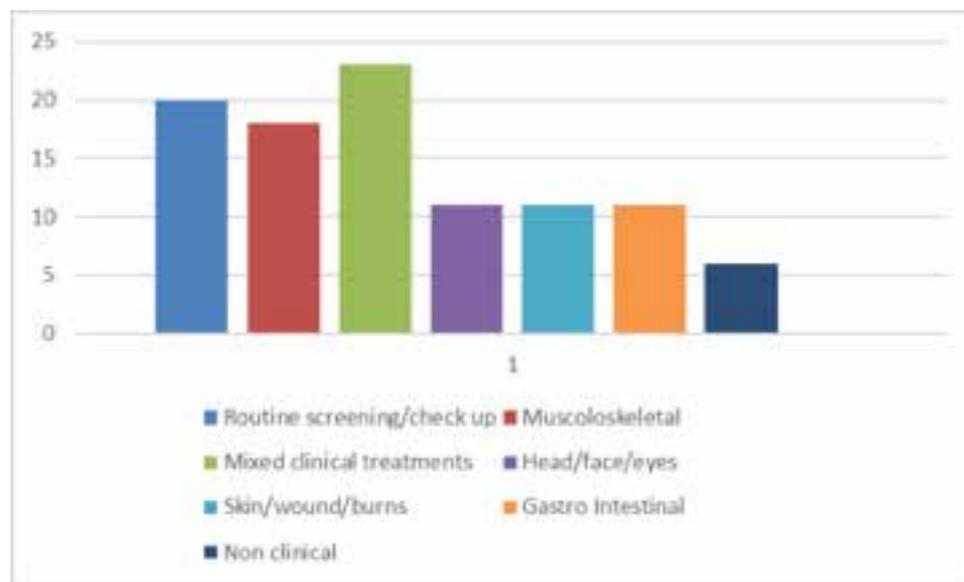


Figure 2: Reasons for MMT reflections during PHC OJE (%)

of results relating to individual services was not conducted due to the small cohort size, which means it could be possible to identify individual responses.

Results

All 14 of the first cohort of MMT learners completed both interviews, with a 50:50 split of male and female MMT learners (age range of 20-30 years). Two learners already had a prior health qualification, most were school leavers and some had prior work experience before joining the military.

A total of 84 reflections (six per learner) were completed throughout the 12-week OJE, covering 37 different types of reasons. All reflections were submitted in a written format using the supplied template. The range of reasons for all 84 reflections is summarised in Figure 2.

Routine screening covers pre-deployment vaccinations, regular check-ups and taking blood samples post deployment. The mixed clinical treatments include skills like suturing, helping the medical officer with minor operations, wound dressings and coughs and cold. The non-clinical reasons included some ethical experiences, documentation errors, and communications with senior personnel, privacy and consent. Other encounters included teaching activities.

The First Reflection

First reflection Questions

What have you learnt from doing the first reflection?

How do you think the reflection has guided your future practice?

What was the hardest thing about doing it?

Twenty broad 'themes' of data were identified. These were then further clustered together by the researcher to identify similarities and differences (as per Figure 3).

What did you learn from doing the first reflection?

All felt the reflections helped put experiences into context; however, some identified that it was hard to put their thoughts down into words and weren't sure what was expected of them. Around half of the responses related that doing the reflection helped to "slow down" thinking and highlighted areas for improvement by "learning from mistakes or errors". These are indicative snapshots:

"...take a step back...helps to learn to do better and get a different perspective..."

"...found them difficult to do...don't like talking/writing...but found that doing them helped with the process and to focus the mind"

How has it guided your future practice?

All indicated increased confidence and knowing what to do "next time" and the need to "think more" to highlight what needs "improving". Several noted they felt it gave them confidence to "stand up for the patient" or their "own knowledge". Several noted they could already see the benefit to their future study as

Table 1: Visual Rating Scale used to Self-Rate Confidence by MMT Learners after their 6th Reflection

	0 Non-change	1	2	3	4	5	6	7	8	9	10 Completely changed practice
Responses	0	0	0	0	1	4	3	4	1	1	0

it provides a summary to refer back to. One noted the reflection helped them to:

“...not be too complacent...or to have tunnel vision...”

Another noted that doing the research gave them:

“...more knowledge about what to do, more confidence to build up...”

What was the hardest thing?

Several found it hard to “put their thoughts into words” but as already stated no one chose to submit a visual or audio reflection. Three of the learners felt the process was “easy” as long as they were disciplined to complete them in the right time frame. Over half the learners found it hard to find appropriate literature to support their reflection, despite ready access to online academic databases and support from staff.

The Sixth Reflection

Sixth Reflection Questions

How do you feel you have changed from the first to the sixth reflection? (practice, confidence and knowledge)

What have you learnt about yourself through doing the reflections?

On a 0-10 scale, how much do you think doing the reflections has added to your overall confidence?

All interviews (n=14) were conducted during the last week of their 12 weeks of OJE after the sixth reflection had been completed. All learners were based in a different location to their first reflection. Three interviews were conducted in person and the remainder by phone.

How do you feel you have changed in practice, knowledge and confidence?

Eleven broad themes were identified with increased confidence reported by 71% and improved clinical knowledge reported by 64%. Other themes related to improving such as improving the efficiency of the

clinical consult and looking for correlations between the clinical situation and the literature. Continual self-improvement and ways to do better or learn more remained as general themes. This is an indicative snapshot:

“...I feel like they flowed more easily and didn't get writers block, easier to write and understand more... since able to reflect more learn from mistakes...now wanting more in depth...”

What have you learnt about yourself through doing reflections?

The responses ranged from very brief to very detailed with more than half realising in the end they still had a lot to learn, even though they were feeling more confident in their abilities. They also recognised the potential to make mistakes and to remain vigilant to this possibility. Some found the physical act of writing and researching helped them to retain information for future use. One learner intentionally made her reflections more detailed than required so they would become a form of ‘study notes’ for future use. Several noted again they needed to slow down and think these through as they realised most of their reflections were based on errors being made through rushing. Several commented on their improved ability to collaborate and communicate with other team members in a more confident way.

How much has doing the reflections added to overall confidence?

Learners were asked to self-identify how much they felt doing reflections had increased their confidence using a simple 0-10 Scale.

The mean score across all 14 learners was 6.39/10 with a range of 4-9.5. This supports the notion that the learners valued the contribution to their learning; however, a couple did note it was only part of the learning as they felt that actually seeing patients and learning from their supervisors also contributed significantly to their confidence, possibly more than doing the reflections.

Finally, as with the first reflection, learners were invited to add any comments. They all felt doing the

reflections were beneficial and they could see the value, whereas at the beginning some weren't so sure. All felt that doing six reflections in a 12-week period was just the right amount of workload. They saw them as valid learning experiences, "pulling apart" and "learning from mistakes" and "increasing self-awareness". One noted it was great to be using such a tool so early in her career so she could see how to do more research in the future.

"...they weren't as awful as first thought..."

'...At beginning couldn't see how they would help... but they haven't only increased my own confidence...I have realised others have gaps...'

Discussion

Figure 3 summarises the clusters of reasons between the first and sixth reflection. Conclusions cannot be drawn from such a small group of learners or comparisons made between services or the NZDF as a whole based on these results. Further investigation of future reflections may provide more data to draw comparisons from. The types of reasons learners completed reflections on during the first and sixth reflections compared to collectively over the whole time could be due to any number of reasons. The first and sixth reflections provide a snapshot of that time period only.

The findings of this study have certainly supported the value of including reflective practice early in the NZDF Medic's learning and continuing through their future OJE's in all settings. While it may seem

labour intensive to complete, time is available and as long as the learners are disciplined to complete within the allocated timeframe there should not be any hindrance to their completion. Others have noted similar issues and go further to state that "reflection is a prerequisite for learning in the context of real practice" ^{11(p1231)} Further analysis could have been completed through a more detailed interview process, using the 'sense making' approach as used by Teekman¹³, whereby the data is drilled further and gaps recognised where specific interactions between patient and health care professional are being explored. This approach would require face-to-face interviews lasting approximately one hour per interview.¹³

Some responses had an element of ethics such as challenging a superiors' practice, patient confidentiality and incorrect documentation being completed. While these issues are also experienced within a civilian context, the military context adds a further layer of complexity which could be explored further through the reflective practice model. This duality of conflict of ethics and confidentiality has been examined by various authors within different military contexts;^{15,16} however, further discussion is beyond the scope of this project.

Learners mentioned the value in the feedback received from clinical supervisors even though some indicated there were delays in getting feedback as part of the criteria for the reflection. This step should not be omitted as the importance of guided supervision with reflective practice, especially so early in a clinical career, cannot be emphasised

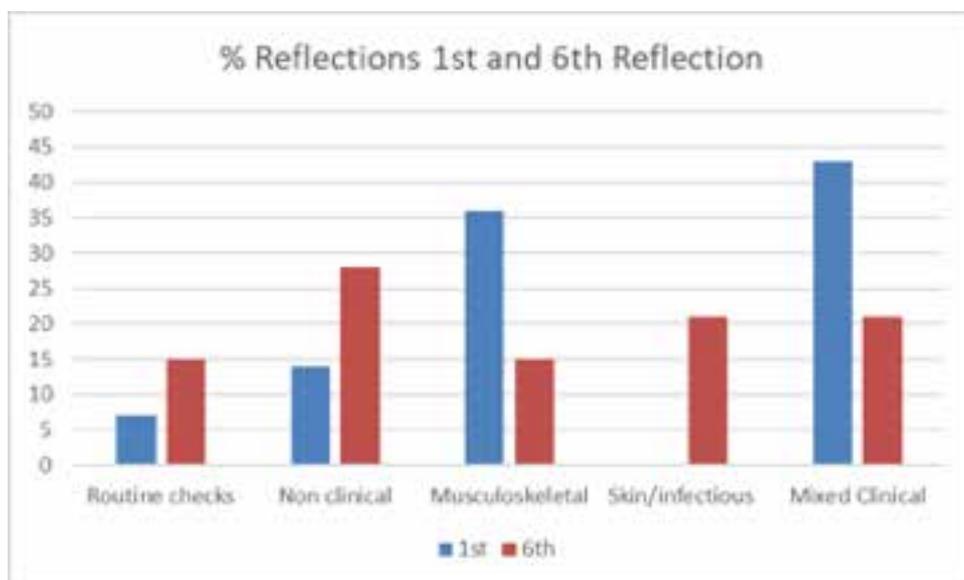


Figure 3: Types of reasons for 1st and 6th Reflections (%)

enough. They need to be conducted in an environment which legitimises and values the use of reflection as a learning strategy.¹ Brookfield¹⁰ talks about using four lenses as part of reflective practice, with the inclusions of colleague's experiences as part of the critically reflective lens process.¹⁰

Conclusion

This retrospective study explored the value of including reflective practice as a form of assessment in the new tri-service NZDF medic training which was implemented in early 2017. All on job learning is completed within military environments and for the first time the use of a reflective practice model was incorporated into the summative assessment while on OJE.

The first cohort of 14 NZDF Medic learners were interviewed after their first and their sixth reflective practice while on their first PHC OJE. They were asked to comment on how they found using the reflective practice model and what it contributed to their learning. In all cases the model and process were seen as positive experience with all learners believing they have learnt from it. The model will continue to be used in further NZDF Medic training with some minor adjustments according to the context.

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Assessing Medical Suitability for Employment and Deployment in the ADF

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Introduction

This article follows previous papers by the author, regarding occupational and environmental medicine in the ADF.¹ They asserted that high rates of workplace illness and injury indicate the need to improve the management of hazards associated with ADF workplaces, with better emphasis on prevention. They also advocated that the ADF's health services should be premised on an occupational and environmental health paradigm, which would require reassessing the fundamental inputs to capability for both Joint Health Command, and Defence's Work Health and Safety Branch.

The papers argued that such a reassessment could lead to a holistic and sustainable workforce-based health service delivery model by 2030. This timeframe is based on the current state of the ADF's occupational and environmental health services, and the small number of civilian specialist practitioners within the Australasian Faculty of Occupational and Environmental Medicine. These considerations suggest that a mature health delivery model would take 10-15 years' sustained effort with respect to occupational and environmental physicians alone.

This article expands on those papers, by addressing medical suitability assessment for the employment and deployment of ADF members.

ADF health assessments – recruiting

The need for high recruiting medical standards was first demonstrated in Australia during World War 1. Of the 589,947 men who were medically examined for the First Australian Imperial Force (AIF), 30.3 per cent were rejected on medical grounds. Thereafter, 33,800 of 421,809 AIF entrants (8.0%) were medically discharged before leaving Australia, while another 16,000 of the 331,781 personnel who served overseas (28.1% of all AIF non-battle casualties) were invalided home before seeing active service.² These militarily ineffective personnel not only wasted

resources and hampered operational capability, but also constituted a considerable post-war burden with respect to their rehabilitation and compensation entitlements.³

Substantial clinical advances since have driven major changes to recruiting medical standards. Conditions such as asthma, which were previously incompatible with military service, can often now be adequately managed without reducing operational capability. Furthermore, Navy recruiting in particular has significantly benefited from advances in shipboard habitability since the 1950s—for example relating to the prevention of certain skin conditions and the treatment of obstructive sleep apnoea.⁴

Even so, recruiting health assessments still fulfil several aims. Firstly, they facilitate operational capability by ensuring that entrants are medically suitable for the tasks they will undertake: all else being equal, infantry soldiers who are recruited to a higher medical standard have a capability edge against opponents who are not. This consideration also applies to occupations that require specific medical standards: for example, the importance of visual tasks for aircrew means that, compared with other occupational groups, they require a higher visual standard.

Secondly, recruiting health assessments ensure that operational capability is not degraded by pre-existing medical conditions that may be exacerbated by the tasks that entrants undertake during their service: for instance, entrants with pre-existing back conditions pose a capability risk for duties that entail carrying heavy packs for extended periods. Finally, recruiting health assessments 'baseline' each entrant's health status for compensation purposes, with respect to future medical conditions they may develop during their service. For example, when ascertaining compensation eligibility for a knee condition, it is essential to have adequately documented the medical status of that knee before entry.

Virtually all ADF recruiting health assessments are conducted by contracted civilian medical practitioners.⁵ A key differentiation from their Defence counterparts is that they do not provide treatment: where necessary, such cases are referred back to the candidate's civilian GP.

A key limitation of all health assessments, however, is that they cannot positively confirm that personnel are medically suitable for a particular purpose—they can only document the apparent absence, at that time, of conditions which may limit or prevent examinees from undertaking that purpose. Consequently, health assessments for recruits must always be considered only one of many ways of managing health-related employment and deployment risk.

ADF health assessments – current members

Misconceptions

A key misconception among many Defence health staff and the general ADF population, is that health assessments are primarily used to identify new medical conditions in order to facilitate treatment. In fact, the number of medically or operationally significant clinical conditions identified via this means is very small. Moreover, finding such a condition at a routine health assessment usually implies a failure in patient presentation/reporting, and/or the standard of primary health care they receive.⁶

It is therefore essential that the diagnosis and treatment of every new medical condition includes considering its impact on the affected member's ability to perform their normal duties and vice-versa, that is, considering the impact of their normal duties on their newly diagnosed medical condition. This means that Defence primary health care providers not only need to be good clinicians but also need a thorough understanding of the duties that their patients undertake.

Personnel requirements

Documenting a member's health status via a health assessment fulfils several aims, many of which relate to personnel employment requirements, such as promotions, courses, re-enlistments and career transfers. The overall intent is to limit the expenditure of resources on personnel who are not medically suitable.

Another key requirement is to ascertain health status prior to deployment. When done correctly, pre-deployment health assessments also 're-baseline' the member's medical status for subsequent

compensation purposes. This entails repeating the same health assessment on their return, to identify changes to their health status that may be ascribable to their deployment.

Post-deployment health assessments should also document the actual and potential workplace hazards encountered by each member during their deployment. As maritime workplace hazards, for example, are obviously not the same as those ashore and vice-versa, pre-and post-deployment health assessments both need to be environment-specific.

The 're-baselining' requirement also applies to non-deployed personnel, particularly regarding the current status of previously identified medical conditions they have developed since their previous health assessment. Besides validating their current medical suitability to deploy, this also facilitates compensation for non-deployed workplace-related conditions.

The health assessment workload must not be underestimated. For example, of the 144,000 US Army personnel considered 'non-deployable' for medical and dental reasons as at December 2016, 55,000 (38%) were so classified because they were out of date for their annual periodic health assessments and/or dental examinations.⁷ Even the financial and personnel cost of civilian employment assessments (where they exist) should not be underestimated.⁸

Furthermore, the author has previously noted that, anecdotally, only 20-40 per cent of ADF primary care presentations are for non-work-related conditions typically seen in an equivalent Australian civilian population—the remainder are predominantly workplace-related musculoskeletal and mental health disorders, for which 're-baselining' is required for compensation purposes. Despite these facts, the ADF's health services currently do not apply 'baselining' to their health assessments.

Occupational health requirements

ADF health assessments should also align with the legislative requirements of the *Work Health and Safety Act 2011* and its implementing regulations, and Safework Australia's supporting Guides, National Standards, and Model Codes of Practice.⁹ It is essential to understand that these occupational health assessments can only ascertain the effectiveness of the examinee's workplace hazard controls: they are not themselves control measures.¹⁰ Identifying a preventable work-related condition at an occupational health assessment usually not only occurs far too late for the affected member but may

also have a range of adverse reputational management and other organisational consequences.¹¹

At present, the responsibility for the ADF's occupational and environmental health services is divided between Joint Health Command and Defence's Work Health and Safety Branch. As a result, the ADF's overall legislative compliance with occupational and environmental health assessments is minimalist, reactive, and ad hoc.¹² The aforementioned link between workforce treatment services and workplace health assessments indicates that Joint Health Command should be responsible for both.

Health assessment content

Current ADF health assessments do not assess medical suitability for employment and deployment: they are primarily 'healthy lifestyle' checks per the Royal Australian College of General Practitioners' 'Red Book'.¹³ As previously noted by the author, the usefulness of the College's otherwise extensive preventive health guidance to the ADF is limited by its focus on the general Australian population, rather than being targeted for a young, medically fit, geographically mobile and predominantly male workforce. Furthermore, lifestyle factors such as tobacco use are irrelevant if they do not actually preclude employment or deployment.

Health assessment periodicity

ADF periodic health assessments are presently conducted every five years until members reach 40, with progressively shorter intervals thereafter. These timeframes do not reflect personnel or legislative considerations but resourcing issues based on the 'Red Book'. From an occupational and environmental health perspective, using this guidance for a young and generally fit ADF population is unduly conservative—evidence suggests their periodic health assessments can be safely performed five-yearly until individuals reach 60.¹⁴

Even so, because they can only confirm the absence of medical conditions at that time, five-year intervals are too long to accommodate additional personnel and/or legislative requirements. Health assessments for these purposes should therefore be 'triggered' when required. Balancing their demands against resourcing issues suggests that 'triggered' personnel health assessments should remain valid for all subsequent personnel management requirements for a maximum of 12 months, while 'triggered' occupational health assessments should comply with Safework Australia's guidance.

Temporarily medically unfit personnel

Defence medical practitioners who deem ADF personnel temporarily medically unfit for normal duties for less than 28 days may either recommend a period of restricted or alternative duties, or a period of excused duties, or have them admitted to a military or civilian hospital.

Except for aircrew, and apart from the need for command approval, Joint Health Command direction for managing temporarily medical unfit personnel is generally similar to that used for civilian sickness certification.¹⁵ At present, however, ADF 'medical absences' are not managed as a workforce capability management issue premised on early rehabilitation and timely return to work but as a health administrative issue that is almost solely premised on conditions-of-service considerations.

Furthermore, Joint Health Command currently does not collect or report work-related illness/injury data, or record lost time or restricted duties, or identify the ensuing health care costs (albeit some of this information is collected via a separate non-health reporting process managed by Defence's Work Health and Safety Branch). Yet this health information is essential for monitoring the effectiveness of the ADF's occupational and environmental health services, accounting for the health care costs incurred by Joint Health Command and the compensation and health care costs incurred by the Department of Veterans' Affairs.

Whether deployed or non-deployed, the inappropriate employment of medically unsuitable personnel poses threats to the health of those affected and to the mission of their units. Furthermore, evacuating deployed personnel with known pre-existing conditions wastes assets and poses operational hazards for other members.

Conversely, however, inappropriately limiting or preventing personnel from undertaking their normal duties also has significant adverse consequences. For the affected member, it delays or blocks their career progression, deployments, promotions or attendance at courses. For their units, it increases the workload for other personnel (who themselves may already be under strain) and may also limit or even prevent normal operations if the affected member is essential to their unit's functions.

These consequences may also have unintended second- and third-order effects regarding future patient compliance and willingness to report injuries,

illnesses and symptoms, or receive treatment. It may also lead to perception management issues not only regarding individual health staff members who needlessly block their career aspirations but in relation to the ADF's health services in general.

These considerations mean that in addition to diagnosis and treatment, every Defence primary health care provider must make a decision regarding the anticipated medical suitability for duty of every ADF member at every patient presentation. This not only prevents or limits further workplace injuries by limiting or stopping personnel from working when necessary but also facilitates effective personnel utilisation by ADF commanders by keeping affected personnel at work where and when it is clinically appropriate to do so.

Hence, Defence primary health care providers who cannot assess medical suitability for ADF employment and deployment on these terms are both a threat to the work-related health and safety of the patients they treat (if they keep them at work inappropriately) and a liability to ADF operational capability (if they stop them from work inappropriately). Making these decisions necessitate a risk-management approach to patient care that balances the anticipated risks and benefits of the member's duties to their health, and vice versa. This further supports the contention that Defence primary health care providers need to be not only good clinicians but also need a comparable understanding of the duties their patients undertake.

However, the author has previously referred to studies indicating that even civilian medical fitness-for-work certification can be challenging for GPs and other providers, which is one reason why understanding how to assess medical suitability for ADF employment and deployment typically takes full-time novice military and civilian GPs up to 12 months. The author has also previously described how civilian GP training does not provide the full range of primary health care skills and expertise required for the ADF workforce.

In summary, ascertaining health suitability for employment and deployment of temporarily medically unfit personnel is an occupational and environmental health function that is intrinsic to providing appropriate health care for every ADF member. However, it is not recognised as such by the current health care model used by Joint Health Command for its garrison health services, or in the fundamental inputs to health capability for either Joint Health Command or Defence's Work Health and Safety Branch.

The ADF Medical Employment Classification System

Defence medical practitioners who consider an ADF member to be temporarily medically unfit for their normal duties for more than 28 days should conduct a Unit Medical Employment Classification Review in accordance with the relevant joint and single-Service references.¹⁶ Depending on the outcome, personnel who remain medically unfit for more than a specified period (typically 12 months) should undergo a Central Medical Employment Classification Review. These reviews refer members to the relevant single-Service Medical Employment Classification Review Board for a determination regarding their long-term employability and deployability, which may (but by no means always) include medically-based separation from the ADF.

All review outcomes have two components. The first is a Medical Employment Classification code, which describes the member's employability and deployability, for use by their career management agency for posting and other longer-term career-related purposes. The second lists the member's employment restrictions that specify their duty limitations and approvals, for use by the member's Command for day-to-day personnel management purposes.

Unlike the current medical absence process, this system is unique to the ADF, with no civilian equivalent. Yet for the same reasons as for temporarily medically unfit personnel, recognising when to conduct a Medical Employment Classification Review is an occupational and environmental health function that is intrinsic to providing health care for ADF members. This further supports the assertion that Defence primary health care providers need to have a good understanding of the duties their patients undertake.

It is also essential that Defence primary health care providers appreciate that this system is not a patient management tool but a process to inform personnel management decision-making while maintaining patient confidentiality. Abuse of the system for patient management purposes leads to unnecessary personnel management decision-making delays, which may adversely affect the member's command and other unit personnel and their future employability in or out of the ADF.

Anecdotal evidence suggests that the average Defence medical practitioner conducting these reviews should consume about 30-40 per cent of their level of effort, or about the same as their clinical workload. This

is because the frequently substantial career (and at times operational capability) implications and future compensation entitlements mean that every review requires careful consideration and detailed documentation, in particular regarding:

- The circumstances as to how the member first presented (particularly for conditions that are or may be work-related, for subsequent compensation purposes);
- The clinical findings at that presentation ('baselining');
- Initial and current treatment after presentation;
- For personnel with multiple conditions or injuries, repeating these steps for each condition or injury;
- Describing the member's current clinical status, and any limitations regarding their ability to undertake normal duties ('re-baselining' for subsequent Reviews); and
- Recommended Medical Employment Classification code and employment restrictions, and justification.¹⁷

However, of the 13,816 Central Medical Employment Classification Reviews conducted by garrison health staff between 1 February 2011 and 30 September 2016, at least 35 per cent were inadequate with respect to documenting these findings.¹⁸ While comparable figures with respect to Unit Medical Employment Classification Reviews do not exist, the relative lack of supervision suggests they would probably be higher.

Poor-quality reviews have important career and other implications with respect to the affected member's employability and deployability, as well as the time and effort wasted on representations, appeals and ministerial inquiries. It also makes it more difficult to assess the eligibility of members for treatment and compensation services provided by the Department of Veterans' Affairs and, in particular, ascertaining the extent to which their medical conditions may relate to their ADF service.

Conclusion

With ADF personnel arguably exposed to the most diverse range of occupational and environmental hazards of any Australian workforce, high rates of preventable workplace illness and injury indicate the need to improve the management of occupational and environmental health hazards, with better emphasis on prevention.

Among its other attributes, the proposed occupational and environmental health paradigm would entail basing the timing and content of health assessments on personnel management and/or legislative requirements, with a maximum interval of five years. Rather than generally irrelevant lifestyle-related health promotion considerations, it would also entail Defence medical officers who accept the need to assess medical suitability for employment and deployment at every ADF patient presentation as intrinsic to providing health care for the ADF workforce, while adequately informing the relevant personnel managers.

Author

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His seagoing service includes HMA Ships *Swan*, *Stalwart*, *Success*, *Sydney*, *Perth* and *Choules*. Deployments include DAMASK VII, RIMPAC 96, TANAGER, RELEX II, GEMSBOK, TALISMAN SABRE 07, RENDERSAFE 14, SEA RAIDER 15, KAKADU 16 and SEA HORIZON 17. His service ashore includes clinical roles at *Cerberus*, *Penguin*, *Kuttabul*, *Albatross* and *Stirling*, and staff positions as J07 (Director Health) at the then HQAST, Director Navy Occupational and Environmental Health, Director of Navy Health, Joint Health Command SO1 MEC Advisory and Review Services, and Fleet Medical Officer (January 2013 to January 2016).

Disclaimer

The views expressed in this reprinted article are the author's, and do not necessarily reflect those of the RAN or any of the other organisations mentioned.

Notes

1. N. Westphalen, 'Occupational and environmental medicine in the Australian Defence Force', *Australian Defence Force Journal*, Issue 200, November–December 2016, pp. 49–58, available at <http://www.defence.gov.au/ADC/ADFJ/Documents/issue_200/Westphalen_Nov_2016.pdf> accessed 13 October 2017; and N. Westphalen, 'Primary health care in the Australian Defence Force', *Australian Defence Force Journal*, Issue 202, July/August 2017, pp. 91–7, available at <http://www.defence.gov.au/adc/adfj/Documents/issue_202/Westphalen_July_2017.pdf> accessed 13 October 2017.
2. A.G. Butler, *Official History of the Australian Army Medical Services, 1914–1918*, Vol. 3, Australian War Memorial: Canberra, 1943, Chapters 14, 15 and 17. 103,897 AIF personnel were returned to Australia as invalids. These included 71,048 sick or injured, and 31,375 wounded.
3. As each voyage from England to Australia took around three months, returning AIF invalids required a high level of en-route care. However, only two dedicated 'white' hospital ships were available, which moved 17,760 AIF invalids between September 1915 and November 1919, while the remaining 86,137 invalids were moved in non-dedicated 'black' transports: see Butler, *Official History of the Australian Army Medical Services, 1914–1918*, Chapter 14; and C. Lloyd, and J. Rees, *The Last Shilling: a history of repatriation in Australia*, Melbourne University Press: Melbourne, 1994. The repatriation of ex-AIF injured and ill members after World War I was one of the first and by far the largest nation-wide health scheme in Australia.
4. For example, Navy personnel with obstructive sleep apnoea were considered medically unsuitable for sea until the development of compact, quiet and generally unobtrusive Continuous Positive Airway Pressure machines. Using these machines at sea, however, would still not have been possible prior to the widespread availability of mess-deck bunks with suitable access to mains power. As another example, ships' air conditioning systems have facilitated the entry and retention of Navy personnel with skin conditions such as acne, which are more susceptible to exacerbation in tropical climates.
5. Exceptions include all ADF aircrew and Navy clearance diver entrants, who require confirmation by the relevant ADF Senior Medical Adviser.
6. Anecdotal and an illustrative case in point is that the author can recall only one routine medical in 15 years where he identified a significant new medical condition in an ADF member. Even then, the patient did not see a doctor for (what turned out to be) lymphoma for two months, because he had decided to wait for his medical. While preventive health assessments can and should be used to detect conditions such as high blood pressure, the majority of such conditions do not prevent the affected member from deploying or being employed.
7. The US Army Medical Command therefore instituted a 'reset' program to resolve this issue by 31 March 2017: see A.G. Tolson, 'Health center sees success in medical readiness reset', *The Redstone Rocket* [website], 15 March 2017, available at <http://www.theredstonerocket.com/military_scene/article_0707fb3e-0989-11e7-836e-e7c56c19bfc.html> accessed 13 October 2017.
8. For instance, in 2013–14, the author undertook confirming civilian pre-employment medicals (not too dissimilar to ADF pre-deployment health assessments) for a major mining project in northwest Australia. Completing all the clinical and administration requirements for each medical would have taken examining doctors and supporting nursing staff at least two hours, at an estimated total cost of over \$700. For another example, civilian pilot medicals can take over 90 minutes to complete, and cost the applicant up to \$300.
9. Safework Australia, 'Model Work Health and Safety Regulations' Safework Australia [website], available at <<http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/model-whs-regulations>> accessed 13 October 2017; and Safework Australia, 'Publications and resources', Safework Australia [website], available at <<http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/publication>> accessed 13 October 2017.
10. Normal occupational and environmental health practice groups workplace hazard controls (in descending order of effectiveness) as elimination, substitution, isolation, engineering controls, administrative controls, and personal protective equipment. Workplace health assessments are one of several means of biological monitoring the effectiveness of each of these controls for individual workplaces. This means that they are not a hazard control.

11. For a recent civilian example, see ABC News, 'Queensland coal mining industry slammed in black lung review', ABC News [website], 12 July 2016, available at <<http://www.abc.net.au/news/2016-07-12/queensland-coal-mining-industry-slammed-in-black-lung-review/7589918>> accessed 13 October 2017; see also F111 Deseal/Reseal Board of Inquiry, 'Homepage: the BOI Report, Vol. 1', Air Force [website], available at <<http://www.airforce.gov.au/docs/Volume1.htm>> accessed 13 October 2017; F111 Deseal/Reseal Board of Inquiry, 'Homepage: the BOI Report, Vol. 2', Air Force [website], available at <<http://www.airforce.gov.au/docs/vol2/VOLUME2%20Part1.htm>> accessed 13 October 2017; and Michael McKenna, 'Poisoned and dumped', *The Weekend Australian* [website], 19 November 2008, available at <<http://www.theaustralian.com.au/national-affairs/defence/poisoned-and-dumped/news-story/ee89481a11c81726527648b7e32a39e7>> accessed 13 October 2017
12. The only ADF workplace hazards for which Joint Health Command has provided occupational health assessment guidance to date are audiometry (hearing tests), cadmium, 'range fuel', isocyanates, aircraft cockpit fumes, depleted uranium, inorganic lead, diesel exhaust and asbestos. As this list only constitutes ad hoc responses to specific incidents rather than proactive interventions, it is neither systematic nor comprehensive. For a full list of chemicals alone, see Safework Australia, 'Hazardous chemicals requiring health monitoring', Safework Australia [website], available at <<https://www.safeworkaustralia.gov.au/system/files/documents/1702/hazardous-chemicals-requiring-health-monitoring.pdf>> accessed 13 October 2017.
13. *Royal Australian College of General Practitioners*, 'Guidelines for preventive activities in general practice', *Royal Australian College of General Practitioners* [website], available at <<http://www.racgp.org.au/your-practice/guidelines/redbook>> accessed 13 October 2017.
14. B. Hocking, 'How frequently should safety critical workers be examined?', *Journal of Health, Safety and Environment*, Vol. 29, No. 2, 2013, pp. 113-9.
15. Royal Australian Air Force, Australian Air Publication (AAP) 8000.010: *Defence Operational Airworthiness Manual*, Section 5, Chapter 5 (only available on Defence intranet); and Department of Defence, Defence Health Manual, Vol. 2, Part 2, Chapter 3 'Medical absence' (only available on Defence intranet). Although an 'Occupational Aetiology' box has been added to ADF health records per the Defence eHealth System (DeHS) since the original article was published, there has so far not been any guidance for Defence health staff to ensure consistency as to what should and should not be considered work-related; workplace- and sports-related injuries are not recorded separately, it is not known whether ticking this box will facilitate identifying work/sports-related treatment costs or Lost Time Injury Frequency Rate, and it does not initiate the compensation claims process (which still has to be done separately). While the new 'Occupational Aetiology' box is a start, most of the remaining shortfalls identified in this article therefore remain extant.
16. *Department of Defence*, *ADF Military Personnel Manual (MILPERSMAN)*, Part 3, Chapter 2 'Australian Defence Force Medical Employment Classification (MEC) System' (only available on Defence intranet); Joint Health Command, *Health Manual (HLTHMAN)*, Vol. 3 'Retention standards', Chapter 1 'Medical Employment Classification System' (only available on Defence intranet); Australian Book of Reference, *RAN Health Services Manual*, Chapter 8 'The Australian Defence Force Medical Employment Classification System and the Maritime Environment' (only on Defence intranet); and Australian Army, 'Army Standing Instruction (Personnel)', Part 8, Chapter 3 'The Application of the Medical Employment Classification System and PULHEEMS Employment Standards in the Australian Army' (only available on Defence intranet).
17. The author placed this guidance on the MECARS (Medical Employment Classification Advisory and Review Service) website (only available on Defence intranet) sometime between July 2011 and December 2012. It was removed prior to 18 January 2017, apparently without replacement.
18. Joint Health Command, 'Medical Employment Classification Advisory and Review Service (MECARS): Medical Administration System (MAS) database' (only available on Defence intranet).

A History of Australian Navy Health Sailor Uniforms and Ranks (Part 2)

Commander Neil Westphalen, Royal Australian Navy Reserve

Purpose

More than a century after its establishment, many Royal Australian Navy (RAN) uniforms and ranks still reflect those used by the (British) Royal Navy (RN). The first of this three-part article described the history of Navy sailor uniforms since 1509,¹ while this part examines the development of Navy medical and dental sailor uniforms for male and female personnel since 1879. The third will describe the evolution of Navy medical and dental sailor rank and rate badges since 1827. A subsequent article will do likewise for RAN health officers.

Male medical and dental sailors

The first reference to Navy medical assistants is dated 1597, where they were referred to as 'loblolly boys'; the name derived from a thick porridge, often enriched with pieces of meat or vegetables for sick and injured crewmembers. Loblolly boys also restrained patients during surgery, obtained and cleaned surgical instruments, disposed of amputated limbs and emptied and cleaned toilet utensils.²

These duties were performed at sea on an ad hoc basis by sailors or marines who either had some interest in caring for the sick or were deemed useless for any other seagoing duties. In addition, these duties were sometimes performed by women, who ranged from sailor's wives to prostitutes.³ It was not until the early 18th century that loblolly boys conducted their duties in a dedicated sick bay.⁴

Treatment for ill and injured British seamen ashore before 1672 was provided wherever accommodation was available, in accordance with the *Laws of Oléron*.⁵ The first British naval hospital was founded that year at Plymouth during the Third Dutch War (1672–74). Additional Navy hospitals followed in 1691 at Greenwich and Chatham during the War of the Grand Alliance (1688–97), and at Portsmouth in 1745 during the War of Jenkin's Ear (1739–48).⁶

Over the next century, nursing duties ashore were conducted on similar but separate terms to that afloat, by non-qualified, non-proficient female nurses, assisted by itinerant pensioners and laborers. The women were replaced by men in 1854, with a view to amalgamating nursing care ashore with that afloat. However, these men were still not assessed for their suitability for nursing duties, nor did they receive any training.⁷

Sailors who had completed gunnery training in Portsmouth aboard HMS *Excellent* in 1830 (later moved ashore to Whale Island), were the first to be given a formal job description or 'rate' as gunners.⁸ Ships' captains were instructed to allocate dedicated sickbay staff in 1833; however, the only requirements were that they had to be over 18 years old, be able to read and write, possess a fair knowledge of keeping accounts and pass a medical examination.⁹

While these seagoing health staff were divided into three classes (Assistant Sick Berth Attendant, Sick Berth Attendant and Sick Berth Steward), their career progression through these ranks was entirely dependent on local service requirements, resulting in inconsistent and unfair advancement. When not at sea, they undertook non-medical duties, whether they were retained aboard non-seagoing 'guard ships' or even when released to work in local port hospitals.¹⁰

It was not until 1884 that sick berth staff received a formal training and career structure, based on that for officer stewards.¹¹ On completing 18 months' training, sailors were rated Sick Berth Attendants and sent to sea. After 3 years they were eligible for promotion to Second Class Sick Berth Steward (equivalent to Second Class Petty Officer) and returned to sea. After an additional 3 years, they were rated First Class Sick Berth Steward (equivalent to First Class Petty Officer).¹²

Selected sick berth stewards were eligible for promotion to Wardmaster (equivalent to Chief Petty Officer [CPO]) after 14 years' service for hospital

duties ashore. In 1900, the warrant officer rank of Head Wardmaster was established,¹³ thereby instigating what eventually became the current Medical Administration Officer branch.¹⁴

While Sick Berth Attendants initially wore the same 'square rig' as seaman branch personnel, Sick Berth Stewards First Class and above wore a 'fore-and-aft rig' with double-breasted jackets, ties and peaked caps, while Wardmasters wore a single-breasted long frock coat. White tunics were worn on the hospital wards.¹⁵

In 1890, all CPO fore-and-aft jackets acquired gilt buttons and became the 'Class I' rig, while the square rig became the 'Class II' uniform worn by 'military branch' seaman personnel. 'Class III' uniform referred to fore-and-aft double-breasted jackets with black horn rather than gilt buttons, ties and peaked caps for wear by non-seamen 'civil branch' personnel. Among other branches, these included Junior Sailor Sick Berth Stewards and 'artificer' engineering sailors,¹⁶ which probably explains why Navy medical staff are often still referred to today as 'sickbay tiffies'. Class III rigs for male medical and dental junior sailors were abolished in the RAN in 1959.¹⁷

The RAN introduced dental mechanics in 1920,¹⁸ and the following year all medical and dental sick berth stewards were renamed Sick Berth Attendants (SBAs).¹⁹ RAN dental rates were issued with 'bluette' (medium blue) working overalls from 1925.²⁰ In 1948, dental sailors were split from medical SBAs into their own branch. In 1953, the RAN replaced the white jackets for medical and dental sailors undertaking patient duties with the current white ward working dress.²¹

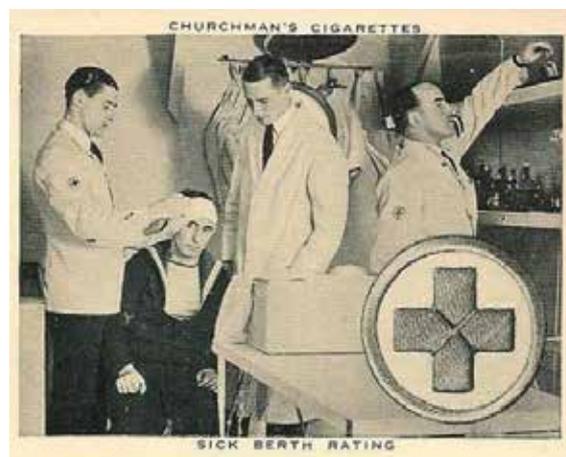
RAN SBAs and dental assistants were renamed Medical and Dental sailors in 1974.²² All square rig and fore-and-aft rig uniforms for office-type duties were replaced by the current utility or 'battledress rig' (similar to that worn by Army and Air Force personnel) in 1998.²³



Sick Berth Attendant in Class III fore-and-aft rig, 1909.²⁴ Note the double-breasted jacket with black horn buttons, peaked cap with red cap badge, and Geneva cross on the right upper arm.



Medical Department, HMAS *Australia I*, 1918.²⁵ Note the Class I and Class III fore-and-aft rigs worn by the sailors in the back two rows, rather than Class II 'square rig' worn by seaman branch personnel.



RN SBAs, 1930s.²⁶ Note the white jackets with Geneva crosses.



Khaki cotton drill tropical rig worn by SBA William Lambeth, HMAS *Napier*, 1945.²⁷ Note the peaked cap and the lack of rank or rate badges.



Action Working Dress worn by POMED Glen 'Wacka' Payne and ABMED Darren Penny, HMAS *Derwent*, c1988. Note the rank badge on the left arm, the post-1974 rate badge on the right arm, anti-flash hoods and gloves. (Sea Power Centre – Australia)



Blue cotton drill action working dress worn by Leading SBA 'O' John Wilden, HMAS *Perth II*, 1968.²⁸ Note the rank badge on the left arm and the pre-1974 rate badge on the right arm.



Proban® overalls, worn by ABMED Trent Crossdale, HMAS *Warramunga*, 2006.²⁹ Note the gold shoulder rank slides.



Medic's whites worn by SMNMED David Spencer, Medical School HMAS *Cerberus*, 1981. Note the rolled-up long sleeves. (Sheena Macdougall)



Disruptive Pattern Naval Uniform (DPNU) worn by LSMED SM Kerrin Lyon, Royal North Shore Hospital, 2013.³⁰ Note the (unofficial) submariner and medical rate badges on the name tag.



Winter utility jacket or battledress rig for office-type duties, 2017.³¹ Note the similar cut to the 19th century 'bluejacket rig' per Part One of this article series.

Female medical and dental sailors

Forty-four female health sailors (including 11 dental sailors and a single dental mechanic)^{32,33} served from 1941–1948 in the wartime Women's Royal Australian Naval Service (WRANS).³⁴ The winter uniform for WRANS junior sailors consisted of a feminised Class III jacket, matching skirt and broad-brimmed felt hat, with the same cap badge as worn by males. A blue summer frock with a white belt and collar was introduced in early 1942, which was replaced from 1943 until 1953 by a khaki dress.

Female SBAs were recruited into the postwar WRANS from its recommencement in 1951,³⁵ while the first female dental sailors were recruited in 1975.³⁶ Apart from the felt hat, the postwar winter WRANS uniform was similar to the wartime version. Female senior sailors still wear the tricorn cap originally intended for (British) Women's Royal Naval Service (WRNS) personnel, while RAN female junior sailors have worn the same cap as males since 1993.³⁷

The WRANS was incorporated into the RAN in 1985, and in 1991 the 'WRAN' sailor rank titles (per Table 1) were abolished in lieu of those used by males. The first Navy maternity uniforms were introduced in 1993,³⁸ while female RAN junior sailors have worn their own square rig ceremonial dress uniform since 1997.³⁹

WRANS medical sailors undertaking ward duties wore a medium blue dress with rank badges, white apron and nurse's cap from 1952 until the apron and cap were abolished in the late 1970s.⁴⁰ Female medical and dental sailors undergoing patient duties have worn the same 'medics' whites' as males since the medium blue dress was abolished in 1994.⁴¹

Like all other WRANS personnel, female medical and dental sailors who joined before 1983 did not have a seagoing obligation. This largely – but not entirely – precluded their need for action working dress until 1992. Since then, female sailors have worn the same uniforms as males, apart from skirts as an alternative to trousers for some uniforms.



WRAN SBA ward and outdoor uniforms, November 1945⁴²
Note the Geneva crosses on the right arm, and wartime outdoor wide-brimmed felt hat.

Table 1: Women's Royal Australian Naval Service Ranks Titles and Equivalents, 1951–91

WRANS Rank	Abbreviation	Male equivalent	Abbreviation
Recruit WRAN	RCTWR	Recruit	RCT
WRAN	WR	Seaman	SMN
Senior WRAN	SWR	Able Seaman	AB
Leading WRAN	LWR	Leading Seaman	LS
Petty Officer WRAN	POWR	Petty Officer	PO
Chief Petty Officer WRAN	CPOWR	Chief Petty Officer	CPO
Warrant Officer WRAN	WOWR	Warrant Officer	WO



WRANS tropical khaki uniform, c1944⁴³



ABMED Erin Matterson, HMAS *Tobruk*, 2008⁴⁴ Note the square rig uniform and same cap worn by males.



WRAN SBA outdoor summer uniform, 1950s-60s. Note the white gloves and female-pattern, flat wide-diameter cap (Sea Power Centre - Australia)



WRANS SBA ward uniforms, 1972 (Lorraine Grey)



WRANS winter uniform, 1970s-90s. Note the tall reduced-diameter female-pattern cap (Sea Power Centre - Australia)



WRMEDs Cathy Kerwick and Rachel Smith, and SMNMED Doug Doherty, Phase 3 Medics Course, HMAS *Cerberus* Medical Training School, 1988 (Steven Carroll)



Proban® overalls, worn by ABSTD Chris Duglison and POMED Sue Hollis, HMAS *Anzac* III, 2005.⁴⁵ Note the Red Cross brassards and camouflaged shoulder rank slides.



DPNU, worn by ABDEN Shannon Byzdra, HMAS *Stirling*, 2017.⁴⁶ Note the gold shoulder rank slides and (unofficial) dental rate badge on the name tag.

Summary

Although seagoing personnel have performed sickbay duties since the 16th century, it was not until 1833 that they were performed by dedicated 'sickbaymen'. Even then, it was another 50 years before there was an official training and career structure. The RAN introduced dental sailors in 1921, who were formed into their own branch in 1948.

For much of the last century, the uniforms for male SBAs consisted of the double-breasted jacket and tie with peaked cap, as for other non-seaman sailors. Class I rig with gilt buttons was worn by senior sailors, while Class III rig with black horn buttons were worn by junior sailors. The wartime and post-war WRANS uniforms were likewise based on the male Class I and Class III uniforms until the 1990s. Like the rest of the RAN, the square rig ceremonial dress uniforms worn by all medical and dental junior sailors, have hardly changed in over 150 years.

Male SBA clothing for patient duties generally reflected RN practice from the 1880s, while female

SBA apparel did likewise from the 1940s. It was not until the 1990s that female medical and dental sailors were issued with the same 'medic's whites' as males. Both sexes have since worn the same Proban® overalls, DPNUs and the new MMPUs at sea, in non-office Navy workplaces and in joint workplaces.

Author

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Commander Westphalen transferred to the Active Reserve in July 2016.

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Disclaimer

The views expressed in this article are the author's, and do not necessarily reflect those of the RAN or any of the other organisations mentioned.

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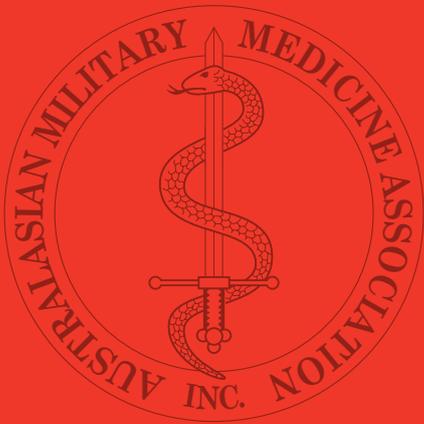
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