JMVH

Volume 28 Number 3 July 2020
Journal of Military and Veterans' Health

- The Navy and the 1918-19 Influenza Pandemic
- Roman Warfare, Ships and Medicine
- Art, Trauma, and PTSI: An Interview with Dr Frank Ochberg

The Journal of the Australasian Military Medicine Association

Do you have an article of interest to our readers?

The Journal of Military and Veteran's Health is a peer reviewed quarterly publication published by the Australasian Military Medicine Association.

Authors are invited to submit articles of relevance to the Editor for consideration for publication in the Journal of Military and Veterans' Health (JMVH).

Categories include:

- Original Research/Original Articles
- Short Communication
- Review Articles
- Reprinted Articles
- Case Studies
- Abstracts from the Literature
- Biographies
- History
- Book Reviews
- Commentary
- View from the Front

See the JMVH website for authors' instructions and submit your article online at www.jmvh.org

JMVH

Table of Contents

Cover Photo: Operation COVID-19 Assist *Department of Defence, LACW Jacqueline Forrester*

Journal of Military and Veterans' Health

Australasian Military Medicine Association

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
- Bringing together those with an interest in military medicine
- 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.

JMVH is published by the Australasian Military Medicine Association

227 Collins Street Hobart Tas 7000 Australia
Ph: +61 3 62347844
Email: editorial@jmvh.org

ISSN No. 1835-1271

Editorial

COVID-19: THE MIDDLE GAME

In early January 2020, we all started to hear about an outbreak of acute respiratory illness in Wuhan City, China. Within weeks, we were preparing for a pandemic, which first reached Australia in late January 2020. By March, we were all dealing with the first wave of this new disease as Australians returned from overseas, many from international cruise ships. Six months on, we are in the middle game, as Victoria comes out of its second wave and New South Wales and Queensland get their outbreaks under control. Australia looks very different to even nine months ago—international borders are closed, interstate borders are tightly controlled and restrictions on movement, mixing and mass gatherings vary from relative normality in certain states to full lockdown in others. States of emergency abound, and the Australian Defence Force is assisting with everything from border controls and hotel quarantine, through to operational planning and the delivery of health services in a range of settings. As a Chief Health Officer for one of the jurisdictions, the response to the disease has been all-consuming. Consequently, I have had limited time to edit this journal and have been grateful for the deputy editor and associate editors stepping in and taking up the slack, including two excellent editorials.

In chess, the middle game is that portion of play between the opening and the endgame. Both players have completed their starting game, and the positioning of most of their pieces, and the king has been brought to relative safety. To use this analogy, we now have most of our pieces in place for the identification, tracking, tracing and isolation of people with the virus. Broader societal measures are in place to prevent the introduction, seeding and spread of the virus, from quarantine and border controls to restrictions on behaviour and gatherings, and our state governments are moving to positions of relative safety. The middle game is also the time for preparing for the next stage, as we continue to build up our capacity and capability to react while we learn the hard lessons from around the world. We even have a reasonable concept of the what the endgame might look like—herd immunity of some type, ideally from an effective vaccine. However, the endgame is undoubtedly not as definitive as a checkmate, but hopefully less frustrating than a stalemate. Our moves during the middle game in the next 9–12 months will be critical in determining the ultimate success or not of the endgame. Military health practitioners will continue to have a critical role in supporting the next steps of the middle game.

Our third issue of 2020 contains a diverse range of articles from mental health and military medical training through to infectious disease and naval history. We continue to get a good range of articles. However, 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. We would particularly welcome papers based on our 2020 conference theme, but encourage any articles across the broader spectrum of military health.

Dr Andy Robertson, CSC, PSM
Commodore, RAN
Editor-in-Chief

BEFORE THE NEXT MISSION

earthquake
war
fire
natural disaster
FLOOD
MASS CASUALTY
TERRORISM
IED

PREPARING FOR CONFLICT AND DISASTER

2020 AMMA VIRTUAL CONFERENCE COMING TO YOUR SCREEN

25-27 NOVEMBER 2020

www.amma.asn.au/amma2020

The Navy and the 1918-19 Influenza Pandemic

G Swinden

The world is currently combating the Coronavirus (COVID-19), which originated in China and has now spread throughout the globe. So far, Australia has fortunately been spared the worst of the outbreak, but this is not the first pandemic to reach our shores.

In 1918, towards the end of World War I, the world suffered the worst pandemic since the Black Death (Great Bubonic Plague of 1346–1353, which killed an estimated 75+ million). The 1918–19 Influenza Pandemic killed more than 50 million people worldwide and was erroneously called the 'Spanish Influenza' as it was neutral Spain that first reported the outbreak that is now widely accepted as having originated in the United States in late 1917. The disease was taken to Europe by US troops where it spread throughout Britain and France during 1918.[1] There were three waves of the virus as it mutated, and these became more and more virulent as the disease spread worldwide.[2]

In Australia, quarantine measures were enacted in October 1918; however, cases of 'Spanish Influenza' began to appear throughout the country. About 40 per cent of the Australian population (then five million people) fell sick, and around 15 000 died as the virus spread throughout Australia.

The first infected ship to enter Australian waters was SS *Mataram*, arriving in Darwin from Singapore, on 18 October 1918. Over the next six months, the quarantine services intercepted 323 vessels, 174 of which carried the infection. Of the 81 510 people who were checked, 1 102 were infected. In a sign of things to come the troopship *Boonah*, which had left England in October 1918, arrived in Western Australian waters in December with over 300 sick men on board. She was diverted to the quarantine station at Woodman Point where the soldiers disembarked. One of the nursing staff later recorded 'There was little that could be done for the cyanosis, the croupy cough, the delirium and final unconsciousness';[3] 27 soldiers and four medical staff died.

During 26–27 November 1918, the federal government held a national influenza planning conference in Melbourne, where state health ministers, the directors-general of their health departments and British Medical Association representatives met to discuss what action was to be taken. The conference agreed that the federal government would take responsibility for proclaiming which states were infected along with organising maritime and land quarantine. The states would arrange emergency hospitals, vaccination depots, ambulance services, medical staff and public awareness measures. All states had quarantine stations, but more were planned in case numbers overwhelmed their capacity. In due course, temporary quarantine stations and influenza hospitals were set up to handle the increasing volume of affected Australians.

Figure 1 Temporary beds at Melbourne's Great Exhibition Building during the Spanish Flu pandemic. NMA

Additionally, the Commonwealth Serum Laboratories had been established during the war to alleviate Australia's dependence on imported vaccines and developed its first experimental pneumonic influenza vaccine. Between 15 October 1918 and 15 March 1919, over three million doses were given to returning Australian soldiers and sailors and also to the civilian population. The vaccine was deemed to be partially effective in preventing death in inoculated individuals.

In Melbourne, the first recorded case of pneumonic influenza appeared on 9/10 January 1919, but the disease may have reached Victoria before then as there was a delay in the Victorian Government advising federal authorities. Early cases were also so mild that there was confusion about whether the virus was 'Spanish Influenza' or a continuation of the seasonal flu virus from the previous winter. This uncertainty delayed the confirmation of an outbreak by Victorian health authorities, which allowed the infection to spread to New South Wales and South Australia by the end of January 1919. New South Wales was the first state to officially proclaim an outbreak of pneumonic influenza on 27 January 1919, with Victoria declaring the outbreak the following day.[4] In New South Wales, the wearing of masks was made compulsory on 31 January 1919 but with mixed results across the state.

The Royal Australian Navy was both a victim of the outbreak and also a part of the solution. In late 1918, Australian warships operating in the northern hemisphere were struck by the virus with the destroyer HMAS *Huon*—then in dry-dock in Genoa, northern Italy—suffering five deaths in late October 1918, including two brothers (Stokers Ernest and Reginald Browne from Wollongong who died within a few days of each other).[5] HMAS *Torrens*, a sister ship of *Huon*, lost only one of her ship's company, 30-year-old Lieutenant Reginald Farmer who died at Messina, Sicily on 9 October 1918. The light cruiser HMAS *Brisbane*, arriving in the eastern Mediterranean in late November 1918, was also greatly affected with 183 of her ship's company of 400 men contracting the disease with three dying as a result.

The battlecruiser HMAS *Australia* and the light cruisers HMA Ships *Melbourne* and *Sydney*, then in English waters, were also affected, but the death toll was lower as they had access to better medical facilities. Among the dead was 35-year-old Chief Yeoman of Signals Thomas Moylan, from Australia, who died in the Naval Sick Quarters on the island of Guernsey on 16 February 1919.

The troopship HMAT *Barambah*, departing Australian waters in early September 1918, allegedly in a filthy state from her previous troopship voyage to Australia, had an outbreak of influenza on board while off the west coast of Africa. More than 20 soldiers and four Royal Australian Navy (RAN) personnel died. The naval casualties were Engineer Lieutenant Norman Davies, Stoker Petty Officer William Craddock, Stoker George Nye and Stoker Albert Thatcher whom all died between 19 October and 1 November 1918. Nye and Thatcher died in hospital in Freetown, Sierra Leone, while Craddock and Davies died on board *Barambah* and were buried at sea.

Figure 2 NSW medical staff at Surry Hills Depot during Spanish Flu pandemic 1919. NSW National Archives

Following the Armistice of 11 November 1918, the RAN ships overseas began to return to Australia, however, many sick personnel were left behind in hospitals in Britain where some died. The battlecruiser *Australia* was one of the last ships to return to Australia, arriving in Fremantle on 28 May 1919 for a four-day visit. Due to the city's relative isolation and effective state border quarantine control, Perth had effectively avoided pneumonic influenza, but an outbreak occurred in June 1919. There is a possibility that the battlecruiser may have brought the contagion to Western Australia and Perth experienced a spike in infections after crowds gathered to celebrate Peace Day on 19 July 1919.

Sub-Lieutenant (later Vice Admiral) John Collins was one of the few RAN personnel remaining behind in England after the Armistice. He was appointed to the new destroyer HMS *Spencer* and recalled the ship carrying the bodies of influenza victims from England to Holland for burial.[6]

Overall, the RAN suffered 284 deaths between 4 August 1914 and 31 August 1921 (the Commonwealth War Graves Commission official period for commemoration) of which 35 can be directly linked to the influenza pandemic. The illness potentially exacerbated another 15 deaths, thus making one in every six members of the RAN who died during World War I a victim of the pandemic. Hundreds more were hospitalised, and, at times, ships were unable to proceed to sea due to the lack of fit crewmembers. The RAN's major training base, Williamstown Naval Depot in Victoria, was also placed in quarantine with 345 personnel affected.[7] Those who died were often young fit men, although the oldest was 44-year-old Lieutenant Commander David Ross, who was a senior Naval Transport Officer in Sydney, and is believed to have contracted the disease while visiting a returning troopship in June 1919.

The Australian navy was also part of the solution to the pandemic. In late November 1918 news was received in Australia that the influenza pandemic had struck the South-West Pacific islands of Samoa (a former German colony now controlled by New Zealand), Fiji and Tonga (both British protectorates). All three outbreaks were linked to infected people arriving by ship and quarantine procedures not being enforced. Britain and New Zealand requested immediate assistance from Australia (the influenza pandemic had struck New Zealand in October 1918 resulting in several thousand deaths and overwhelming the nation's health systems). The Australian government acted quickly and the light cruiser HMAS *Encounter* was directed to embark navy and army medical personnel, equipment to set up field hospitals and all necessary medical equipment and supplies to combat the scourge.

Encounter sailed on 24 November 1918 visiting all three islands and medical teams disembarked at Samoa and Tonga to combat the disease. These teams effectively brought the disease under control but not before hundreds had died. The sloop HMAS *Fantome* had operated in the Pacific for most of the war and provided support to a New Zealand medical team in Fiji even though 67 members of her crew were suffering from disease (although none died). *Encounter* returned to Sydney on 17 December 1918, and her crew were immediately placed in quarantine which lasted until 26 December. The naval and army medical teams left in Samoa and Tonga returned to Australia during January–February 1919.[8]

Maritime quarantine also played a significant part in containing the spread of the virus until its virulence lessened. The RAN also assisted with this activity. HMAS *Sleuth*, a former patrol vessel attached to the training ship HMAS *Tingira*[9] moored in Rose Bay (Sydney), was utilised as a patrol vessel off the North Head Quarantine Station during the first few months of 1919. Her task was to monitor the ships that had been quarantined after entering Sydney Harbour, and prevent passengers and returning soldiers from 'breaking out' from the ships and the North Head Quarantine Station. Some of the soldiers had been away from Australia for many years and escape attempts by boat or swimming ashore had to be prevented.

The task of quarantining these returning soldiers should not be underestimated with over 160 000 Australian military personnel returning from Europe and the Middle East from December 1918 until September 1919 (in 147 troopships). Many of the men who had served on the Western Front had married in England and were bringing wives and children with them. In addition, there were several thousands more Australians who had served in the various British forces also returning to Australia from the epicentre of the virus.

The various measures employed in each state (i.e. mandatory wearing of masks and prevention of mass gatherings) did not stop the disease but did dramatically slow its spread, and by the end of 1919, the influenza pandemic was over. The 'Spanish Flu' had a devastating effect across the globe, killing at least 50 million people. In Australia, the estimated death toll of 15 000 people was still high, but it was less than a quarter of the country's 62 000 service personnel who died as a result of World War I.

The greatest number of deaths occurred in the capital cities of the Australian states where the population was more densely housed, particularly in the working class 'slums' with lower standards of health, hygiene and diet. RAN warships were also susceptible to higher infection rates due to overcrowded mess-decks and lack of fresh vegetables and fruit when at sea. Overall, however, Australia's death rate of 2.7 per 1000 head of population was one of the lowest recorded of any country during the pandemic.

Corresponding Author: Greg Swinden, greg.swinden@defence.gov.au
Authors: G Swinden[1]
Author Affiliations:
1 Department of Defence, SO2 Force Options Development

Notes

1. A number of counterclaims have been made that the influenza (H1N1) was 'brought' to Europe by members of the Chinese Labour Corps who had transited via Canada in 1916–17 (following an outbreak of virulent influenza in southern China) and who subsequently served on the Western Front. This theory was first proposed in 1942 by Australians Frank MacFarlane Burnett and Ellen Clark in *Influenza: A Survey of the Last 50 Years in the Light of Modern Work on the Virus of Epidemic Influenza* (published by Macmillan and Co. Ltd of Melbourne) and further detailed by Christopher Langford in September 2005 (*Population and Development Review*) and 2014 by Mark Humphries from the Memorial University of Newfoundland, Canada. Counterclaims have also been made by the Chinese Medical Association in their Journal, stating that members of the Chinese Labour Corps suffered from the disease only after they had arrived in France and also after the disease had affected other troops. This article will not delve into this complex issue.
2. In New South Wales, 50 deaths were recorded as attributable to the virus during January–March 1919, during March to May 1919 there were 1 542 deaths and during May to September 1919 the state recorded 4 302 deaths.
3. Plowman, P. *Across the Sea to War,* Rosenberg Publishing Pty Ltd: Dural NSW. 2003. p. 73.
4. A returned soldier who had disembarked from a troopship in Melbourne before travelling by train to Sydney was the first reported case in NSW (on 24 January 1919) with seven other soldiers, who also disembarked in Melbourne, soon falling ill at the No 4 Military Hospital at Randwick.
5. The entire ship's company of 70 personnel was affected to various degrees by the virus and hospitalised.
6. Macdougal, A. *Collins of the Sydney*, Clarion Editions: Mudgee NSW. 2018. p. 99.
7. HMAS *Encounter* was located at Williamstown from early 1919 onwards as the RAN's sea-going training ship, and an infected member of her ships company may have spread the virus to those at the training depot.
8. For more information, refer to *Influenza in Samoa* by Surgeon Lieutenant Francis Temple Grey, RAN in the *British Medical Journal* 1919; Volume 1.
9. Despite the threat of influenza, the training ship HMAS *Tingira* continued to recruit boys aged between 14 and 16 throughout the pandemic. Those recruited spent up to two weeks at the recruiting processing buildings at Lyne Park before going on board the ship.

Roman Warfare, Ships and Medicine

N Westphalen

Introduction

Previous articles describe the development from prehistory to the ancient Egyptians and Greeks, of a cycle whereby increasing trade required larger and more efficient ships to transport merchandise and better weapons to defend or attack them; both of which in turn facilitated further trading opportunities.[1:2] However, it was not until the 18th century that Western medicine had developed sufficiently for its role as an enabler of this cycle to be recognised, which among other developments, made possible the European settlement of Australia.[3]

While the technical developments in weapons, ships and medicine driven by this cycle often developed independently in multiple regions worldwide, they remained closely linked throughout Western history in particular. This article describes the technical and other developments in Roman warfare, ships and medicine, from its foundation in c. 800 BCE to its demise in Western Europe in c. 500 CE.

Roman warfare

Previous articles describe how the scope of prehistoric warfare was limited by the supplies and social structures that sustained it, and a lack of reasons for conflict. Advances in weapons and their use during the 2000 years after 4000 BCE were made possible by societal developments that could sustain formed armies and—for better and for worse—provide them with the means and motives to fight.

Regarding the latter, Romans believed absolutely in defending their perceived cultural superiority and imposing it on others. War also provided prestige for the ruling class, whose career progression came from successful military endeavours. Hence, throughout its history, Rome was customarily either at war or preparing for one.[4]

The societal attributes supporting these motives included a vast pool of potential recruits, and an innovative and disciplined army, with a centralised command structure and the most robust logistics and engineering support of the era. The Romans also employed effective diplomacy through a network of allies, and an inclusive approach to conquered peoples. These attributes created synergies, whereby the roads and bases that supported Roman armies also promoted their influence and power among their erstwhile opponents who came under their rule.[5]

Conversely, the progressive collapse of the Roman's societal institutions from 200 CE made their armies unsustainable. Power struggles that routinely led to the murder of the ruling emperor resulted in currency debasement, hyperinflation and economic depression, as well as civil unrest, mutinies, civil wars and external invasions. To these can be added the 'Plague of Cyprian' pandemic (250–270 CE), which killed two emperors and at one point claimed up to 5000 people daily within Rome itself. These calamities led to the demise of the Western Roman Empire by 476 CE, leaving the Eastern or Byzantine Empire to continue until its capital Byzantium (modern Istanbul) fell to the Ottoman Turks in 1453 CE.[6]

Monarchic and republican Roman armies used the Greek phalanx formation until c. 300 BCE when their largest unit became the legion, consisting of 4 200 heavy infantry divided into 30 divisions or *maniples*. Each legion was supported by 800–1200 light infantry *(velites)*, often from Rome's allies, and 300 cavalry.[7]

In battle, the *maniples* deployed in three lines in a chequerboard formation *(quincunx)*, with the younger *hastate* in front, followed by the more seasoned *principes* and the veteran *triarii* behind. This allowed each forward row to fight hand-to-hand, and then withdraw behind the third line while the second moved forward to take their turn. This tactic kept fresh and rested men in action against progressively more tired opponents until the latter broke. Meanwhile, the *velites* and cavalry formed a protective screen for the *maniples* while harassing the enemy from the flanks.[8]

From c100 BCE, Roman legions were reorganised into 10 cohorts of 400–500 heavy infantry, each with six centuries of about 80 men. These continued to

provide their own weapons and armour until the first permanent and entirely professional Roman army with a central command and logistics structure was formed in 31 BCE. This was followed in 6 CE by a dedicated military treasury *(aerarium militare)*, which was funded by taxes and included a pension system.[9]

Each imperial Roman soldier received a bronze helmet (*galea*) with nape and cheek guards, and a reinforced rib across the forehead to protect against downward slashes. Their *lorica segmentata*, a segmented armour of iron weighing about 9 kg, afforded good protection for the chest and shoulders from spears, missiles and swords. They were armed with one or two javelins (*pilae*), which they threw before engaging in hand-to-hand combat. Each *pilum* spearhead had a long soft iron shank that bent on impact, making them harder to remove from opponents' shields and rendered them useless for throwing back. Each soldier then used their left arm and shoulder to interlock their *scutum*, a heavy (~10 kg) curved rectangular shield, and charged their opponents to knock down and stab them, in a highly bloody form of 'reverse crowd control'. They then kneeled behind their *scutae* and pushed them forward together, while using their short double-edged swords (*gladii*) in their right hand to slash and thrust.[10]

Imperial Roman legionary, post 31 BCE.[12] From left to right, note the pilum, gladius, galea and lorica segmentata and scutum. His equipment clearly posed concerns when fighting at sea... even if he could swim.

Roman maniples infantry, post 275 BCE.[11] Left to right: hastati, velites, triarii and principes.

Replica imperial Roman helmet, post 31 BCE.[13] Note the brow ridge and cheek and nape guards.

Original pilum spearhead.[14] Note the distorted shaft.

Original scutum, 200–300 CE, found in 13 pieces at Dura Europos in modern Syria.[15] Note the horizontal carrying handle, which was originally covered by a metal plate or 'boss'.

Original gladius and scabbard belonging to an officer of Tiberius, the second emperor of Rome (42 BCE–37 CE)[16]

Re-enacted Roman testudo (tortoise) formation, typically used for assaulting fortified positions.[17] Note the shields raised overhead by each rank to protect the one in front.

Roman ships

Although they had used warships to fight piracy since 400 BCE, the Romans did not develop a navy until the Punic Wars against Carthage (modern Tunis) from 264 to 146 BCE. The Carthaginians' control of the sea between Tunisia and Sicily allowed them to dominate maritime trade throughout the Mediterranean. Besides the ensuing trade disputes, their military maritime power endangered Roman land power, by threatening the grain supplies from Sicily and Egypt that kept the average Roman (civilian and soldier) fed.[18]

The first Roman warships were little different to the old Greek trireme galleys. These had sails for longer journeys; while for battles at sea, their masts and sails were left ashore and the ship was rowed by up to 170 rowers arranged in three tiers or 'banks'. Their speed and endurance under oars were limited by the strength and stamina of the rowers; while limited food and water stowage and the inability to cook or even sleep at sea meant the ships were beached ashore each night. Their primary tactic initially entailed sweeping close inboard to smash their opponents' oars and injure the rowers, thereby rendering them susceptible to being sunk by ramming. Alternatively, their embarked soldiers comprising up to 14 archers and hoplites were used to shoot up their opponents' crews before grappling and boarding. While their inability to row and fight simultaneously meant the rowers were not expected to engage in combat at sea, they still acted as light infantry ashore. Rowers were recruited locally from the poorer classes, but also included prisoners of war and slaves. [19]

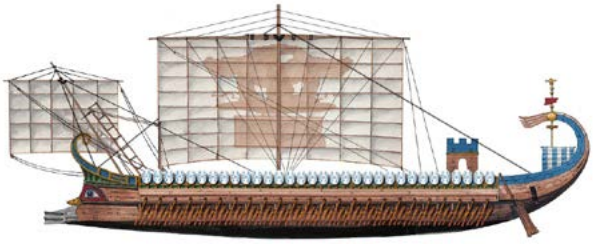
However, the most common warship used by both the Carthaginians and Romans became the quinquereme galley. These still had three banks of oars, but with two rowers per oar for the upper two banks. The

increase from 170 to 300 rowers provided additional motive power, not only for ramming but to carry up to 120 rather than 14 soldiers to do at sea what the Romans were feared for ashore: fight hand-to-hand. The quinquereme's additional space and payload capacity also allowed the carriage of deck-mounted, torsion-powered artillery weapons such as *ballistae* and catapults.[20]

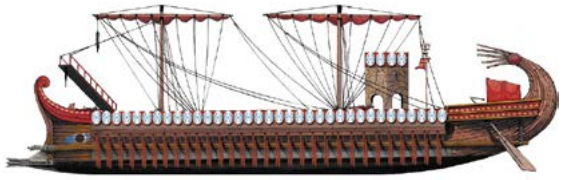
The Romans further extrapolated land warfare to the sea, by mounting towers on their galleys from which archers shot regular and fire arrows. Another innovation was the *corvus* ('raven'), a boarding gangway with a large iron spike at the end that penetrated an opponent's deck on being dropped, to prevent their escape and allow boarding. The *corvus* was replaced from 36 BCE by the much lighter *harpax*, a catapult-launched grappling hook that could be winched in to drag opponents alongside.[21]

Following the naval victory by Octavian (later Emperor Augustus) over Antony and Cleopatra in 31 BCE, at Actium (near modern Arta, off the coast of western Greece), the lack of maritime opponents apart from pirates led to the displacement of most quinqueremes by smaller and lighter ships. These included the seagoing *liburna*, which had a single bank of oars with two rowers per oar, and the *navis lusoria* for riverine operations.[22]

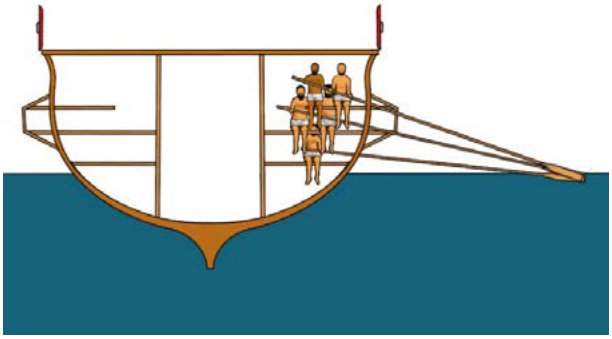
To this end, Octavian established the *classis Ravennatium* at Ravenna in the northern Adriatic, and the *classis Misenatium* near modern Naples. Additional bases were established at Alexandria, Antioch, Rhodes, Sicily, Libya and Britain, while an additional fleet operated on the Rhine and another two on the Danube. Over the next four centuries, these fleets allowed Rome to quickly respond to military threats and maintain supplies for the army in its various campaigns until the progressive collapse of its societal institutions from 200 CE likewise made them unsustainable.[23]



Roman trireme, 218–201 BCE.[25] Note the corvus forward and the archery tower aft.



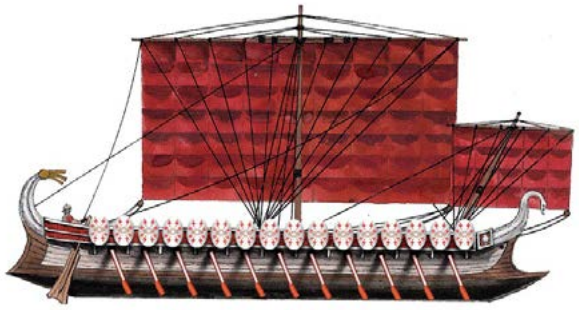
Roman quadreme (bireme with two rowers per oar), c. 260 BCE.[26] Note the heavier overall build compared to the trireme, the corvus forward and the archery tower aft. Quinqueremes were similar but with five rowers for three banks of oars.



Cross-section, Roman quinquereme, c. 260 BCE.[27] Note the rower arrangement (in particular the lack of freeboard), and the amount of upper deck space for troops and artillery weapons.

Roman corbita merchantman, 100–400CE.[24] These ships were used to transport up to 400 tons of grain each, from Egypt and Sicily to feed Rome itself.

Deck-mounted ballista and harpax projectile used for grappling, c. 31 BCE[28] A smaller version of the ballista (scorpio) was used as an anti-personnel weapon.



Roman liburna, c. 150 CE, used for grain ship convoy escort and counterpiracy operations.[29] Note the non-functional ram-shaped bow.

Forward view, replica Roman navis lusoria, c. 300 CE, Mainz Museum Germany.[30] Used on the Rhine as a troop transport. Note the faux ram bow.

Quarter view, replica Roman navis lusoria, c. 300 CE, Mainz Museum Germany.[31]

Roman medicine

Traditional Roman medicine was originally administered by the head of each family (*paterfamilias*), using water and wine combined with massage, bathing and gentle exercise. This contrasted with the somewhat more robust Greek approach, whose influence in Rome began with a series of epidemics that led to the construction of the Temple of Apollo in 430 BCE, followed by worshipping his son Asclepius, the demi-god of healing, from 292 BCE. The first known Greek medical practitioner in Rome was Archagathus of Sparta in 219 BCE, who specialised in battle wounds and dermatology.[32]

However, the Romans quickly expanded on their Greek medical forebears, if at times with limited actual therapeutic effect. Although it remains unclear whether he practised medicine himself, Aulus Cornelius Celsus (c. 25 BCE–50 CE) wrote an encyclopedia, of which only the seventh volume *De Medicina* survives. Besides lamenting the practice of medicine for financial gain, Celsus was the first writer to distinguish between 'empiricists', who believed that trustworthy medical knowledge had to be based on actual observations of ill health and treatment outcomes, and 'dogmatics', who insisted that it depended on understanding the underlying causes and mechanisms that explain how treatments work.[33]

Celsus was also the first Greco-Roman author to deal systematically with ophthalmology and oculoplastic surgery. While he believed dietetics was the most important branch of medicine, less usefully he divided food into that which cooled the patient (e.g. lettuce, cucumber, cherries and vinegar) and that which provided heat (e.g. pepper, salt, onions and wine). He also advocated eating snakes to treat abscesses and believed that drinking the blood of a slain gladiator cured epilepsy.[34]

Scribonius Largus (c. 1–50 CE) was a physician to the emperor Claudius, during the latter's visit to Britain in 43 CE. Like other authors, he used Greek terms for medicine and plants and supported the Hippocratic Oath. His *Compositiones* had 271 remedies including a salve for arthritis, use of the trefoil plant against snakebites, and blood from turtles or doves (rather than gladiators) for epilepsy. He also indicated that doctors must help even enemies to the best of their ability.[35]

The most influential work on medications, however, was the five-volume *De Materia Medica*, which was written by Dioscurides of Anazarbus (modern Turkey) in c. 50–70 CE, and remained in use for the next 1700 years. Dioscurides described over 600 herbal and plant remedies, such as poppy juice and the autumn crocus that contain morphine and colchicine respectively. Somewhat less usefully, he also describes the helpful properties of specific stones if worn as amulets.[36]

The writings of Soranus of Ephesus (c. 60–130 CE) on obstetrics, gynaecology and paediatrics also remained in use for 1700 years. His advice to midwives and wet nurses in his *Gynaecology* stated they should be literate, sober, discreet, know both theory and

practice and not be influenced by superstition. However, the latter advice was somewhat negated by Soranus reiterating the common belief that pregnancy was avoidable by holding one's breath during intercourse or sneezing shortly after.[37]

Although the most important surgeons were Heliodorus (c. 60–140 CE) and Antyllus (c. 150 CE), very little of their written work survives. Like other ancient cultures, apart from concern for the patient's comfort and acceptance of the futility of causing further pain when recovery was unlikely, the risks of surgery meant it was usually employed only as a last resort. While most surgery was therefore minor in scope, the development of specialised instruments facilitated more sophisticated operations such as cataract removal, draining of fluids, trephination and circumcision reversal. Dressings were of linen bandages or sponges kept either dry or wet, the latter using wine, oil, vinegar or water covered by fresh leaves. Wounds were stitched with flax, linen thread or metal pins.[38]

The most influential Roman physician remains Claudius Galenus, or Galen of Pergamon (129–c. 216 CE). He studied in Smyrna and Alexandria, and worked at a gladiator school before becoming a prolific writer of medical treatises that were translated into many other languages. Galen was a favourite of several Roman emperors, and even claimed that Septimius Severus said of him after solving a stomach problem, 'we have one doctor, and he is a consummate gentleman'.[39]

Although Galen gained considerable anatomical knowledge by treating wounded gladiators, a ban on human cadaver dissection from c. 250 BCE until after 1300 CE meant his research was otherwise limited to vivisecting Barbary apes and pigs. He ascertained which spinal nerve roots controlled which organs and muscles by cutting or stimulating them, and discovered that it was the kidneys and not the bladder that produces urine, by clamping the ureters of living apes and watching the kidneys swell.[40]

However, Galen erred regarding the role of the veins with respect to returning blood to the heart, while a misunderstanding of his writings regarding the need to drain abscesses led to a belief that 'laudable pus' was a positive sign of wound healing. Furthermore, he also supported the Greek *Corpus Hippocraticum* regarding the idea that illness was caused by imbalances of the four bodily fluids (or humours) of phlegm, yellow bile, black bile and blood. This idea was coupled with the four qualities of heat, cold, wet and dry, which underpinned all treatments in Western Europe for the next 1600 years. Among other shortfalls, this theory of illness led to the use of bloodletting as a treatment and the view that diseases such as malaria were caused by bad air from rotting animal and plant matter.[41]

The most common conditions presenting to Roman physicians were skin, digestion and fertility disorders, fractures, gout *(podagra)*, depression *(melancholia)*, dropsy or fluid retention *(leukophlegmasia)* and epilepsy (*comitialis*). They knew that penetrating head, chest and abdominal injuries were usually fatal and protected their medical reputations by avoiding such cases. This highlights the relevance of Celsus's advice that the pointing of the nose, sunken temples and eyes, cold ears and the skin of the forehead being taut and hard indicated the imminent death of a patient.[42]

Health care for Roman soldiers was mostly limited to self-care and buddy aid until after 31 BCE. They had their own bandages—on at least one occasion they used them on uninjured limbs to avoid battle. Considerable reliance was also placed on civilian assistance, in particular the local *paterfamilias*. Otherwise, Roman battlefield medical attendants formed part of the commander's retinue.[43]

The establishment of a permanent Roman army led to the first soldiers to undertake exclusively medical duties. These *milites medici* included a *medicus legionis* who was appointed to each legion, while *medici cohora* were assigned to cohorts. The Romans also developed *valetudinaria* or tented field hospitals capable of holding up to 200 sick and wounded, in the charge of a *medicus castrensis* or *castrorum*. By 100 CE, the mobile *valetudinaria* had led to fixed military hospitals. Meanwhile, the two fleets established by Augustus were provided with physicians, and each trireme likely had a *medicus triremis*, while the larger vessels may have carried more. However, Roman *milites medici* were never formed into a discrete medical corps but functioned independently of each other as part of their assigned unit, which endured in English (and later British) armies until the 1870s.[44]

Fresco of the Trojan (later Roman) hero Aeneas receiving treatment for a leg wound (possibly the removal of an arrowhead), Pompeii (destroyed 79 CE).[45]

Roman battle casualties, Dacian Wars (modern Romania), 101–106 CE.[46] *To the left, a legionary is assisted by another (behind), while a medicus in auxiliary dress holds his arm. On the right, an auxiliary is having his right thigh bandaged by another medicus standing front centre.*

Roman surgical instruments, found at Pompeii (destroyed 79 CE).[47] *They include spatulas, scalpels, probes, curettes, bone hooks, forceps, awls and levers, male catheters and a rectal speculum. The large fearsome-looking instrument centre-left is a tissue spreader and the one centre-right a vaginal speculum.*

Galen (18th-century engraving)[48]

Conclusion

By the birth of Christ, Roman societal developments not only made possible a permanent and entirely professional army, but also the most sophisticated central command and logistics structures of the era that even included health and pension services. The use of this force was driven by their perceived cultural superiority and career development of the ruling class.

Like the Greeks, Roman naval warfare entailed cramming hundreds of men aboard ships with very lightly built hulls and limited freeboard. All were susceptible to penetrating injuries from spears and arrows, while an under-recognised risk in the literature pertains to blunt force trauma from the rower's own oars, if they failed to unship them fast enough to prevent them being smashed. Unlike the Greeks, however, the Romans relied less on ramming in favour of grappling and boarding with larger numbers of embarked troops, who were supported by torsion-powered artillery weapons more often found on land.

Although Roman sea battles were still mostly fought close inshore, the more-or-less universal inability to swim meant that ending up in the water would have been fatal. The number of wounded would therefore have been limited to ships that were not sunk, or were beached before they did. The proximity to land and absence of on-board space would also have led to the embarked *medici triremis* treating their seagoing battle casualties ashore, on more-or-less the same terms as if they had been fighting on land.

While the presence of a *medicus legionis* on a legion's staff hypothetically made it possible to conduct health planning and supervision, such activities were probably embryonic at best. Forward and tactical casualty evacuation via *valetudinaria* to fixed health facilities was likewise feasible; however, as the state of overland transport limited and the state of the medical art at that time obviated the need for a strategic medical evacuation capability, most soldiers either recovered or died in situ.

Humanitarian aid / disaster relief was most likely ad hoc and presumably limited to dependants and their supporting civilians, while assessing suitability for employment and deployment was most likely 'on-the-job'. Although the need for a healthy lifestyle with respect to diet and exercise had been recognised, effective health promotion was limited by the miasmatic theory of infectious disease transmission.

Concerning treatment services, current medical practice suggests that the effectiveness of Celsus's 'empiricists' was constrained by the absence of a systemic approach to their observations, while that of his 'dogmatics' was negated by physiological theories of disease causation that were more plausible than based on hard fact. While Galen's acceptance of the humoural theory of disease stymied any meaningful physiological research for the next 1600 years, it seems likely such research would have been problematic in any case until formal scientific methods were developed in the 17th century. Roman medicine was further constrained by Galen's anatomical errors caused by a ban on human dissection.

Even so, Roman surgical capabilities—if not their anaesthetics, analgesia and post-operative wound care—probably compared relatively well with current practice; at least for limb injuries and minor wounds.

Author

Dr Neil Westphalen graduated from Adelaide University in 1985 and joined the RAN in 1987. He is an RAN Staff Course graduate and a Fellow of the Royal Australian College of General Practitioners, the Australasian Faculty of Occupational and Environmental Medicine, and the Australasian College of Aerospace Medicine. He also holds a Diploma of Aviation Medicine and a Master of Public Health.

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 (2013–2016).

Commander Westphalen transferred to the Active Reserve in July 2016.

Disclaimer

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

Corresponding Author: Neil Westphalen, neil.westphalen@bigpond.com
Authors: N Westphalen [1,2]
Author Affiliations:
1 Royal Australian Navy Reserve
2 Navy Health Service, C/O Director Navy Health

References

1 Westphalen, N. 'Warfare, Ships and Medicine: Prehistoric Origins', *Journal of Military and Veteran's Health*, Jan 2020, vol. 28 no. 1, pp. 16-28 available from https://jmvh.org/wp-content/uploads/2020/04/AMMA-JMVH-Jan-2020.pdf.

2 Westphalen, N. 'Warfare, Ships and Medicine in Ancient Egypt and Greece', *Journal of Military and Veteran's Health*, May 2020, vol. 28 no. 2, pp. 18-30 available from https://jmvh.org/article/warfare-ships-and-medicine-in-ancient-egypt-and-greece.

3 See Westphalen N. 'Naval Medicine and the European Settlement of Australia', *The Navy and the Nation: The Influence of the Navy on Modern Australia*, Eds Stevens D and Reeve J, 2005, Allen and Unwin: Crow's Nest NSW, pp 69-83.

4 Cartwright M, 'Roman Warfare', Ancient History Encyclopedia, 22 October 2013, available from https://www.ancient.eu/Roman_Warfare.

5 Cartwright M, 'Roman Warfare', Ancient History Encyclopedia, 22 October 2013, available from https://www.ancient.eu/Roman_Warfare.

6 Mark JJ, 'Roman Empire', Ancient History Encyclopedia, 22 October 2018, available from https://www.ancient.eu/Roman_Empire.; also Mark, JJ, 'Crisis of the Third Century', Ancient History Encyclopedia, 09 November 2017, available from https://www.ancient.eu/Crisis_of_the_Third_Century; also Mark, JJ, 'The Barracks Emperors' Ancient History Encyclopedia, 13 November 2017, available from https://www.ancient.eu/Barracks_Emperors.

See also Horgan J, 'Plague of Cyprian', Ancient History Encyclopedia, 13 December 2016, available from https://www.ancient.eu/article/992/plague-of-cyprian-250-270-ce. Although the infectious agent for the Plague of Cyprian has not been identified, the most likely candidates may be either zoonotic pandemic influenza or a viral haemorrhagic fever: see Harper K, 'Solving the Mystery of an Ancient Roman Plague', The Atlantic: Science, 01 November 2017, available from https://www.theatlantic.com/science/archive/2017/11/solving-the-mystery-of-an-ancient-roman-plague/543528.

7 Cartwright M, 'Roman Warfare', Ancient History Encyclopedia, 22 October 2013, available from https://www.ancient.eu/Roman_Warfare.

8 Cartwright M, 'Roman Warfare', Ancient History Encyclopedia, 22 October 2013, available from https://www.ancient.eu/Roman_Warfare.

9 Cartwright M, 'Roman Warfare', Ancient History Encyclopedia, 22 October 2013, available from https://www.ancient.eu/Roman_Warfare; also Hollis B, 'Structure of the Legion', Victorii: The Roman Military', available from https://romanmilitary.net/strategy/structure; also Hollis B, 'Armor', Victorii: The Roman Military', available from https://romanmilitary.net/tools/armor.

10 Hollis B, 'Armor', Victorii: The Roman Military', available from https://romanmilitary.net/tools/armor; also Lloyd J, Roman Army', Ancient History Encyclopedia, 20 April 2013, available from https://www.ancient.eu/Roman_Army; also Hollis B, 'Armor', Victorii: The Roman Military', available from https://romanmilitary.net/tools/armor; also Cartwright M, 'Gladius Hispaniensis', Ancient History Encyclopedia, 15 June 2017, available from https://www.ancient.eu/Gladius_Hispaniensis; also Hollis B, 'The *Pilum* (Spear)', Victorii: The Roman Military', available from https://romanmilitary.net/tools/pilum.

11 Mandal D, 'Incredible animation showcases the Roman maniple army formation 'Triplex Acies' in action'. Realm of History, 20 June 2016, available from https://www.realmofhistory.com/2016/06/20/animation-roman-maniple-warfare-superb-visual.

12 Elliott S, 'Servius to Severus: the evolution of the Roman legionary's armour', Battles of the Ancients, 12 August 2018, available from http://turningpointsoftheancientworld.com/index.php/2018/08/12/evolution-roman-legionary-armour.

13 'How "good" was the Roman legionary armor (Lorica Segmentata)?', available from https://www.quora.com/How-good-was-the-Roman-legionary-armor-Lorica-Segmentata.

14 'Roman Legion: The Reforms of Marius', Warfare History Network, available from https://warfarehistorynetwork.com/daily/military-history/the-reforms-of-marius.

15 'Roman Shield from Dura-Europos', Bensozia, 25 August 2011, available from http://benedante.blogspot.com/2011/08/roman-shield-from-dura-europos.html; also 'The Roman Soldier's Shield Scutum', The Romans in Britain: Britain before, during and after the Roman occupation – 100 BC to AD 450, available from http://www.romanobritain.org/8-military/mil_roman_soldier_shield.htm.

16 'Ancient Roman Weapons', Weapons Universe, available from http://www.weapons-universe.com/Swords/Ancient_Roman_Weapons.shtml.

17 'The testudo formation in a Roman military reenactment', Wikipedia, available from https://en.wikipedia.org/wiki/Testudo_formation#/media/File:Testudo_formation.jpg.

18 Cartwright M, 'Roman Naval Warfare', Ancient History Encyclopedia, 13 April 2014, available from https://www.ancient.eu/Roman_Naval_Warfare; also Mark JJ, 'Punic Wars', Ancient History Encyclopedia, 17 April 2018, available from https://www.ancient.eu/Punic_Wars.

19 Cartwright M, 'Salamis', Ancient History Encyclopedia, 05 May 2013, available from https://www.ancient.eu/Battle_of_Salamis; also, Cartwright M, 'Roman Warfare', Ancient History Encyclopedia, 22 October 2013, available from https://www.ancient.eu/Roman_Warfare; also Cartwright M, 'Roman Naval Warfare', Ancient History Encyclopedia, 13 April 2014, available from https://www.ancient.eu/Roman_Naval_Warfare;,

20 Cartwright M, 'Roman Warfare', Ancient History Encyclopedia, 22 October 2013, available from https://www.ancient.eu/Roman_Warfare; also Cartwright M, 'Roman Naval Warfare', Ancient History Encyclopedia, 13 April 2014, available from https://www.ancient.eu/Roman_Naval_Warfare; also War Matrix – Quinquereme', available from http://heihachi.eu/history/warmatrix/time1/time6/time1/quinquereme.html.

21 War Matrix – Quinquereme', available from http://heihachi.eu/history/warmatrix/time1/time6/time1/quinquereme.html; also, Cartwright M, 'Roman Warfare', Ancient History Encyclopedia, 22 October 2013, available from https://www.ancient.eu/Roman_Warfare; also Cartwright M, 'Roman Naval Warfare', Ancient History Encyclopedia, 13 April 2014, available from https://www.ancient.eu/Roman_Naval_Warfare.

22 'Roman Ships', Naval Encyclopedia, available from http://www.naval-encyclopedia.com/antique-ships/roman-ships.; also 'Museum of Ancient Seafaring (Mainz, Germany)', Following Hadrian Photography, 6 June 2017, available from https://followinghadrianphotography.com/2017/06/06/museum-of-ancient-seafaring-mainz-germany.

23 Cartwright M, 'Roman Warfare', Ancient History Encyclopedia, 22 October 2013, available from https://www.ancient.eu/Roman_Warfare.

24 'Roman Ships', Naval Encyclopedia, available from http://www.naval-encyclopedia.com/antique-ships/roman-ships.

25 'Roman Ships', Naval Encyclopedia, available from http://www.naval-encyclopedia.com/antique-ships/roman-ships.

26 'Roman Ships', Naval Encyclopedia, available from http://www.naval-encyclopedia.com/antique-ships/roman-ships.

27 Based on Laudon A, 'The ascent and demise of Carthage Module 2', 14 May 2015, available from http://alaudun2.blogspot.com/2015/05/phase-4-actions-in-iberia-and-at-sea.html.

28 'The Harpax', Weapons and Warfare: History and Hardware of Warfare, available from https://weaponsandwarfare.com/2016/01/17/the-harpax.

29 'Roman Ships', Naval Encyclopedia, available from http://www.naval-encyclopedia.com/antique-ships/roman-ships.

30 'Museum of Ancient Seafaring (Mainz, Germany)', Following Hadrian Photography, 6 June 2017, available from https://followinghadrianphotography.com/2017/06/06/museum-of-ancient-seafaring-mainz-germany.

31 'Museum of Ancient Seafaring (Mainz, Germany)', Following Hadrian Photography, 6 June 2017, available from https://followinghadrianphotography.com/2017/06/06/museum-of-ancient-seafaring-mainz-germany.

32 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also Hart GD, *Asclepius: The God of Medicine*, 2000, London: Royal Society of Medicine Press.

33 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also Howick J, 'Aulus Cornelius Celsus and 'empirical' and 'dogmatic' medicine', James Lind Library, available from http://www.jameslindlibrary.org/articles/aulus-cornelius-celsus-and-empirical-and-dogmatic-medicine.

34 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also Lazzeri D, Agostini T, Figus M, Nardi M, Spinelli G, Pantaloni M, Lazzeri S, 'The contribution of Aulus Cornelius Celsus (25 B.C.-50 A.D.) to eyelid surgery', Orbit, June, 2012;31(3):162-7. Available from https://www.ncbi.nlm.nih.gov/pubmed/22551367.

35 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also Baldwin B, 'The Career and Work Scribonius Largus', Rheinisches Museum für Philologie, University of Cologne Faculty of Arts and Humanities, 1992, pp 74-82. Available from http://www.rhm.uni-koeln.de/135/Baldwin.pdf

36 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also Lahanus M, 'Dioscorides of Anazarbus', available from http://www.hellenicaworld.com/Greece/Science/en/Dioscorides.html.

37 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also Dunn PM, 'Soranus of Ephesus (circa AD 98-138) and perinatal care in Roman times', Archives of Disease in Childhood,1995;73:F51-F52. Available from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2528358/pdf/archdischfn00064-0055.pdf,

38 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also Ross WD, Nutton V, 'Heliodorus (3), surgeon, 1st–2nd cent. CE', Oxford Classical Dictionary, available from: http://classics.oxfordre.com/view/10.1093/acrefore/9780199381135.001.0001/acrefore-9780199381135-e-2983; also Grant RL, 'Antyllus, the elusive surgical genius of antiquity: an analysis of his writings', Surgery, September 1961;50(3):572–578. Available from https://www.surgjournal.com/article/0039-6060(61)90080-0/pdf

39 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also 'Galen', Famous Scientists, available from https://www.famousscientists.org/galen.

40 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also 'Galen', Famous Scientists, available from https://www.famousscientists.org/galen; also 'Galen: Greatest Physician of the Roman Empire', Greek Medicine.net, available from http://www.greekmedicine.net/whos_who/Galen.html; also

41 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine; also 'Galen', Famous Scientists, available from https://www.famousscientists.org/galen; also Freiberg JA, 'The mythos of laudable pus along with an explanation for its origin', Journal of Community Hospital Internal Medicine Perspective, 13 July 2017;7(3):196–198. Available from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5538214

For a history describing how medicine has arguably done more harm than good until comparatively recent times (and possibly continues to do so), see Wootton D, 2006, *Bad Medicine: Doctors Doing Harm Since Hippocrates*, Oxford University Press: London, 2006; see also 'Bad Medicine: Doctors Doing Harm Since Hippocrates', available from http://www.badmedicine.co.uk.

42 Cartwright M, 'Roman Medicine', Ancient History Encyclopedia, 26 October 2013, available from https://www.ancient.eu/Roman_Medicine.

43 Byrne EH, 'Medicine in the Roman Army', The Classical Journal, April 1910;5(6):267-272. Available from https://www.jstor.org/stable/pdf/3286964.pdf?refreqid=excelsior%3Afee3e32db63782b076891a79d4b18deb

44 Byrne EH, 'Medicine in the Roman Army', The Classical Journal, April 1910;5(6):267-272. Available from https://www.jstor.org/stable/pdf/3286964.pdf?refreqid=excelsior%3Afee3e32db63782b076891a79d4b18deb; also Prioreschi, Plinio. *Roman Medicine.* A History of Medicine. 3 vols. Vol. 3, Omaha: Horatius Press, 1998, pp 537-571; also Wesselingh R, 'From Milites Medici to Army Medics – A two thousand year tradition of military medicine', Journal of Military and Veteran's Health, July 2008;16(4):28-30. Available from https://jmvh.org/wp-content/uploads/2012/12/JMVH-Vol16-No4-Wessel.pdf

45 From Adhikari S, 'Top ten ancient Roman inventions', Ancient History List, 25 May 2015, available from https://www.ancienthistorylists.com/rome-history/top-10-ancient-roman-inventions; also Haeger K, The Illustrated History of Surgery, 1989, Harold Stake (Medical): London, pp 46-7.

46 Trajan's Column, Scene 40/XL, Cast 13 Museo della Civiltà Romana, Rome, available from http://www.trajans-column.org/?flagallery=trajans-column-scenes-xxii-xlv-22-45.

47 'On Roman Surgery', The Romans in Britain: Britain before, during and after the Roman occupation – 100 BC to AD 450, available from http://www.romanobritain.org/13_roman_medical/roman_surgery.html.

48 Busch GP (engraver), 'File:Galenus.jpg', Wikimedia Commons, available from https://commons.wikimedia.org/wiki/File:Galenus.jpg.

Effects of Linear Periodization Training on Performance Gains and Injury Prevention in a Garrisoned Military Unit

C Heard, M Willcox, M Falvo, M Blatt, D Helmer

Abstract

Purpose: Performing well in combat requires military service members to be in peak physical shape. Although each branch of the United States military has fitness guidelines and assessments, there are no exact prescriptions for physical training programs. The absence of a standardised approach may lead to suboptimal physical performance and increased risk of musculoskeletal injury. To address this gap, we evaluated the feasibility of a pilot combat conditioning program based on linear periodisation.

Methods: Twenty-nine garrisoned US Marine Corps service members (25 men, 4 women; 23.5±4.4 years) enrolled in our 11-week conditioning program that was supervised by a strength and conditioning professional. Military-specific (physical/combat fitness tests) and general (treadmill-based maximal exercise test) assessments were performed at baseline and 11 weeks. Training and injury logs were maintained throughout the duration of the program.

Results: Approximately 80% (23/29) of service members completed the entire program. Cardiorespiratory fitness (Peak $VO^{2;}$ +8.10±10.9%; p=0.011), upper-body strength (pull-ups; +47.0±58.2%; p<0.001) and core strength (abdominal crunches; +9.2±23.3%; p=0.029) significantly increased from pre- to post-training. No statistically significant improvement or worsening was noted in any other performance assessment measure. Eight (28%) participants reported minor musculoskeletal concerns, of which only one required medical attention (injury rate 1.3 injuries/100 person-months).

Conclusion: A protocolised linear periodisation training program was feasible and demonstrated improvements in fitness in a group of garrisoned Marines with low injury rates. Other military units may benefit from a similar approach.

Introduction

Military service members in combat environments are subject to physically and mentally challenging conditions making it essential that they achieve and maintain a high level of fitness. Army Field Manual (FM) 7-22 describes the physical demands that soldiers face and states that 'all these activities of warfare and many others require superb physical conditioning'.[1] To ensure service members stay fit, each branch of the United States (US) military service has established fitness standards and fitness tests.[2–4] However, these documents lack the detail needed to create a systematic training program that would increase fitness and minimise musculoskeletal injuries. For example, the Marine Corps Physical Fitness Program provides an overview for use but does not provide enough details for unit leaders to create a systematic training program.[3] In the absence of clear guidelines, unit leaders may implement suboptimal programs that fail to improve fitness in service members and may even increase the risk of musculoskeletal injuries. Effective conditioning requires a balance between intense training sessions and periods of rest/recovery. Too much overload and/or not enough recovery can result in both physiological and psychological symptoms that limit performance and may cause individuals to cease participation in a previously enjoyable activity. In many non-competitive exercisers, inadequate rest/recovery because of busy work lives, family, work and health stressors, meal skipping and poor sleep can result in overtraining syndrome.[5]

The prominence of musculoskeletal injuries (MSIs) among military personnel has significant repercussions on the readiness of the armed services and can result in high cost. For example, studies have shown that during Army deployments, more medical air evacuations result from non-battle activities, such as physical training and recreational sports, than from combat.[6,7] The leading cause of healthcare visits for all military personnel in 2012 was MSIs, resulting in the largest number of lost duty days annually – greater than illness or any other reason.7 These injuries are often avoidable and can compromise mission success. For these reasons, prevention of MSIs is of the utmost importance for the US military.

Systematic training programs may reduce the risk of injury from physical training activities, particularly overuse injuries.[8] In particular, linear periodised training programs have been used by athletes for training.[9,10,11] Linear periodised programs increase load and repetitions systematically over an extended period. Usually, every fourth week is an unloading week where repetitions and load are decreased. This allows coaches to control the amount of stress put on the body. Such programs have been shown to increase physical fitness while keeping injuries to a minimum.[5]

To address the current gaps in fitness training among military personnel, we report the results of a pilot trial of an 11-week linear periodised training program. We explored the feasibility, safety and effectiveness of a systematic approach to physical fitness training in an active duty administrative unit of the US Marine Corps (USMC).

Methods

Population/subjects

A single garrisoned administrative unit of the USMC was targeted for this study with explicit approval from the commanding officer. All unit members were informed of the purpose and expectations of the study through written and verbal communication and asked to approach the on-site program leader to volunteer. The study was reviewed and approved by all relevant research oversight committees.

Study inclusion criteria included male and female Marines, ages 18–55 years, stationed at a USMC facility in the western US who were granted permission to participate by their chain of command. Exclusion criteria included individuals with contraindications for exercise studies according to the American College of Sports Medicine (ACSM) pre-participation screening algorithms.[12] This included individuals with significant cardiovascular disease, neurological impairment/disorder, pregnancy, uncontrolled hypertension (SBP > 160; DBP > 100) or musculoskeletal injury impeding the required physical activities of the interventions. A total of 29 garrisoned US Marines were recruited and consented to participate in an 11-week combat conditioning assessment program (CCAP) from September to December 2012.

Physical conditioning program

The CCAP is a linear periodisation program starting with low-intensity and low-volume training that builds weekly. Increasing the number of repetitions, mileage and/or time spent working out alters the intensity and volume of the program. Additionally, the intensity is also increased by increasing load carriage, or the weight of the clothing or gear worn throughout the training session, such as combat boots and flak jackets. The 11-week training program evaluated in this study included one-hour sessions every Monday, Wednesday and Friday (total of 32 sessions). Intensity would build over a three-week period, while every fourth week was an unloading week, during which the intensity and the volume were decreased, allowing for active recovery. The 11-week duration balanced practical considerations with the completion of three 3-week intensity building periods with post-intervention assessment in the unloading week of the final cycle. This duration was estimated to be adequate to demonstrate changes in physical performance measures.

The 29 Marine participants were randomised into two test groups using a random number generator: high-intensity CCAP (CCAP-High) and moderate-intensity CCAP (CCAP-Mod). The two test groups differed only by relative volume of activity and total repetitions. Each one-hour session included variations of exercises derived from the Combat Conditioning Manual from the Marine Corps Martial Arts Center for Excellence, including 440-yard sprint, pull-ups, push-ups, squats, front and side planks, squat presses, lunges, woodchoppers, side toss, crunches, burpees, thrusters, bent-over row, bench press, overhead press, Russian twists, tire flips, rope climbs and more. The routines for both CCAP-High and CCAP-Mod groups are seen in Appendix 1.

Assessment

Each participant completed baseline medical screening, self-report health/behaviour instruments and physical function assessments. Medical screening consisted of height, weight, waist circumference and skinfold measurement to compute body fat percentage via Jackson/Pollock 3-site method.[13,14]

The physical fitness test (PFT) and combat fitness test (CFT) are the standard fitness measures used by the USMC and performance can be summarised using a total score for each (PFT range 120-300; CFT range 120-300).[15] In 2012, the Marine Corps PFT included a three-mile run, a sit-up requirement (two minutes) and a pull-up (untimed) or flexed arm hang (female) requirement. The Marine Corps also utilised an annual combat fitness test to standardise the assessment of common battlefield manoeuvres. The test components included: Movement to Contact (MTC; 880-yard run in boots and camouflage uniform bottoms); Ammunition Lift (AL; maximally repeated overhead lifts of a 30-pound ammo can for two minutes); and Manoeuvre under Fire (MANUF; 300-yard standardised combat obstacle course). These standard USMC assessments were replicated as part of the study assessments, administered on separate days at baseline and conclusion of the study intervention.

Cardiorespiratory fitness was assessed using a maximal treadmill test (Bruce protocol) and performed on a separate day from PFT/CFT. A clinical exercise physiologist conducted exercise testing, supervised by a registered nurse and an independent active duty ombudsman. Metabolic and ventilatory measures were obtained breath-by-breath using a portable commercial system (Cosmed K4b^2), and heart rate was measured continuously using an integrated chest strap heart monitor (Polar). Blood pressure was manually taken every two minutes. Primary variables of interest from exercise testing included peak oxygen consumption (VO_2) and ventilatory anaerobic threshold (VAT), as determined using the modified v-slope method.[16] Maximal effort was determined according to ACSM criteria, which included meeting two of the following: 1) respiratory exchange ratio ≥ 1.1; 2) achievement of 85% of age-predicted maximum heart rate; 3) a rating of perceived exertion of 17 or higher; and 4) no change in VO_2 of 200 mL with an increase in workload. ACSM criteria were also used for test termination to ensure participant safety.[17]

Monitoring of participation and injuries

An on-site program leader certified as a strength and conditioning specialist and personal trainer monitored adherence to the CCAP training program and injury rate, as well as training fidelity assessment surveys and injury logs, administered to each participant after each training session. Musculoskeletal concerns were recorded at each training session on a log by the participant and confirmed by the program leader. The documentation included the specific location, context and severity of any musculoskeletal concern, whether that person sought medical attention, and if it resulted in light or no duty assignment following the injury. When participants missed sessions, the on-site program leader contacted the participant and recorded the self-reported reason for the absence. Participants were allowed to make up a missed session (either anticipated or actual) +/- one day of the scheduled session.

Data analysis

Originally designed as a randomised controlled trial comparing moderate and high-intensity training regimens, once in the field, it was clear that the small sample sizes recruited required a change in scope. Data collection plans remained unchanged, but the expectations shifted to focus on feasibility, safety and generation of pilot performance and fitness data.

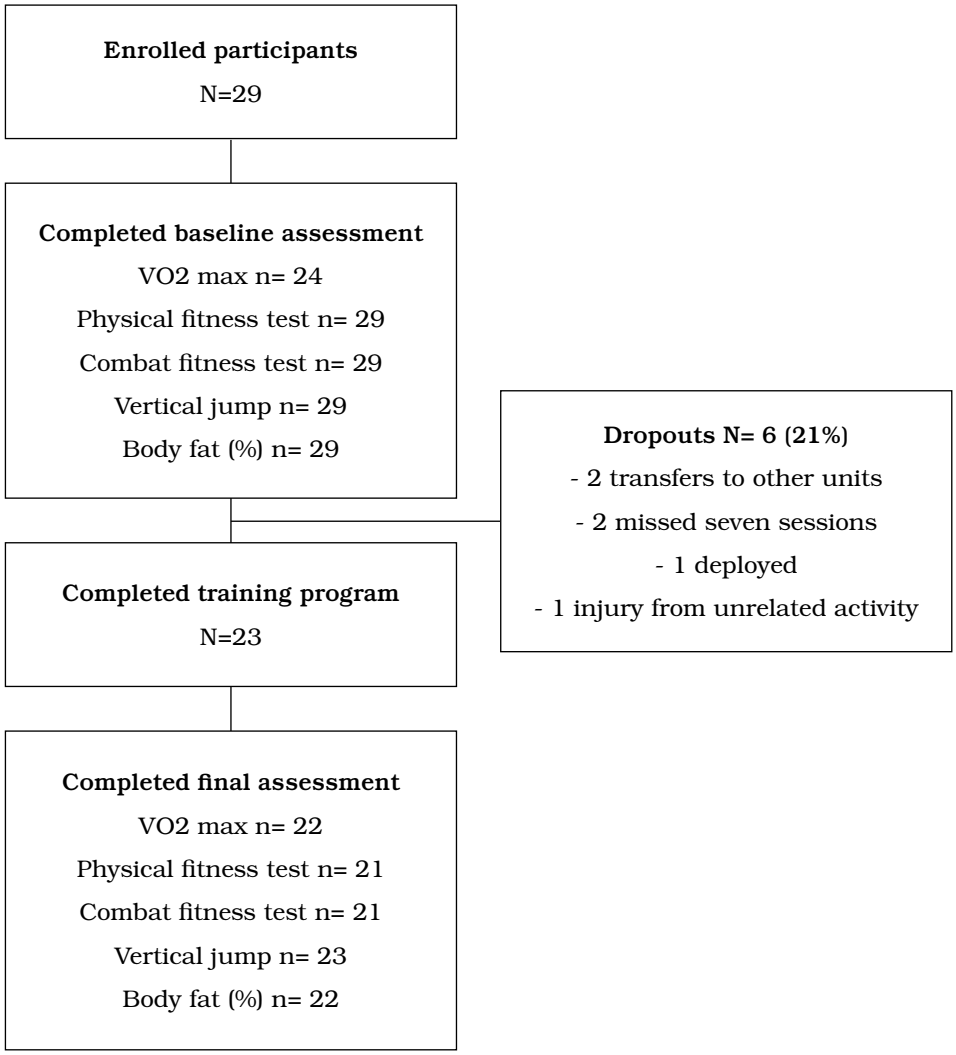
The primary outcome measures for this study reflected physical performance as measured by peak voluntary oxygen consumption (VO_2 peak) and PFT scores. Secondary outcome measures include CFT scores, lower body power and injury rates. Paired sample t-testing was used to detect statistically significant changes in primary outcome measures from baseline to the end of the 11-week period in the merged CCP-High and CCP-Mod groups.

Injury was defined as a musculoskeletal concern requiring medical attention as recorded on training session logs from each participant and investigated by the program leader. Injury rate/100 person-months was calculated ((total number of injuries from all participants / number of participants) / total number of days enrolled in the study (77 days x 30 days/month x 100 months)). Drop-out was defined a priori as explicit withdrawal from the study by a participant or missing three consecutive sessions.

Results

A total of 29 garrisoned US Marines were recruited and consented to participate in the 11-week CCAP. Six participants (21%) dropped out of the program – two transferred to different units, two missed seven sessions, one deployed to Afghanistan, and one broke his wrist in an activity not related to the research or fitness training (Figure 1). The sample group was comprised of 25 males and 4 females, and the mean ± SD values for age was 23.1 ± 4.4 years. The overall time in the USMC was 3.47 ± 3.52 years, meaning most study participants were nearly done with their first four-year enlistment. Only 4 (13.8%) had deployed to combat previously; 13 (44.8%) were current cigarette smokers; 12 (41.4%) were past smokers, and 4 (13.8%) were never smokers (Table 1).

Figure 1. Flow diagram of participation.



Sixteen Marines completed maximal cardiopulmonary exercise tests before and after training (Table 2). Baseline VO_2 peak (49.0±10.4 ml·kg·min^{-1}) increased by +5.3% (51.6±6.3 ml·kg·min^{-1}) following training (p = 0.011). Similarly, VO_2 at the VAT increased by +4.7% following training (Pre vs Post: 33.5±7.6 vs 35.0±4.2 ml·kg·min^{-1}, $p < 0.001$). The mean increase in VO_2 peak and VO_2 at the VAT from pre- to post-training was 0.33±0.4 L·min^{-1} and 0.24±0.6 L·min^{-1}, respectively (Figure 2).

Other measures of fitness, including PFT, CFT, vertical jump and % of body fat, all improved from baseline to endpoint. Of these, only improvement in the PFT was statistically significant in the paired-t test (p <0.05) (Table 2).

Among the entire sample (n=29), participants completed 744 training sessions, – mean 25.7 (78%) of 32 planned sessions. Among participants who did not drop out (n=23), participants completed 677 sessions – mean 29.4 (89%). A total of 79 sessions were missed (prior to drop-out among non-completers): 63 (80%) were missed due to conflicting duties; 12 (15%) due to leave or other excused absence; 2 (2.5%) due to musculoskeletal concerns; and 1 (1.3%) due to feeling tired.

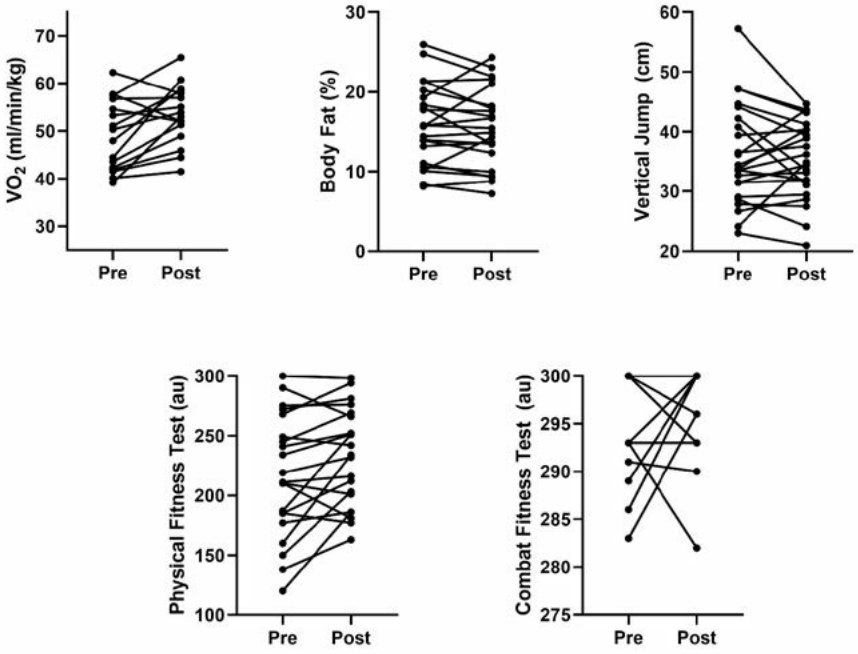
Eight participants (27.6%) recorded musculoskeletal concerns in 13 (1.7%) training session log entries. Five concerns were among the moderate-intensity participants and three among the high-intensity participants: musculoskeletal concerns related to knee (4 (31%)); ankle (2 (15%)); and one report each for hamstring, shin, low back, foot/toe, calf, groin and unknown (8% each). Only one of these concerns ('groin pull') was associated with medical attention, meeting our a priori definition of an injury. Two entries ('groin pull' and 'shin splints') were associated

Table 1. Characteristics of participants (by intervention group).

	Overall (n=29)		CCAP-Mod (n=16)		CCAP-High (n=13)	
Characteristic	*Number*	%	*Number*	%	*Number*	%
Sex (male)	25	86.2	14	87.5	11	84.6
Race						
White	16	55.2	10	62.5	6	46.2
Black	7	24.1	4	25	3	23.1
Other	4	13.8	2	12.5	2	15.4
Missing	1	3.4	0	0	1	7.7
Ethnicity (Hispanic)	11	37.9	5	31.3	6	46.2
Deployed (yes)	4	13.8	2	12.5	2	15.4
Tobacco Use						
Current	13	44.8	8	50	5	38.5
Past	12	41.4	8	50	4	30.8
Never	4	13.8	0	0	4	30.8
PCL PTSD Screen Positive (yes)	4	13.8	2	12.5	2	15.4
AUDIT Screen Positive (yes)	3	10.3	0	0	3	23.1
	mean	*SD*	*mean*	*SD*	*mean*	*SD*
Age (years)	23.1	4.4	23.94	4.25	22.1	4.1
Time in service (years)	3.47	3.52	3.59	2.95	3.15	4.4
IPAQ score (METs/week)	4557.49	3740.38	4453.5	3057.4	5662.34	4607.1

Notes: CCAP- combat conditioning assessment program; SD- standard deviation; IPAQ- International Physical Activity Questionnaire; METs- metabolic equivalents; PCL- PTSD Checklist List; PTSD- Post-traumatic stress disorder; AUDIT- Alcohol Use Disorders Identification Test.

Figure 2. Pre- post-changes in physical performance measures



Note: Individual plots of selected for performance variables before (pre) and after (post) exercise training. The figures illustrate individual participant change in performance variables of potential value to future studies of systematic training regimens.

Table 2. Physical performance of participants (high- and moderate-intensity combined) at baseline and endpoint.

	Baseline		Endpoint			95% CI for mean difference			
Outcome	M	SD	M	SD	n		r	t	df
VO_2 peak (ml/min/kg)	49.06	7.37	53.54	6.30	16	-7.77, -1.19	0.60	-2.90*	15
Body fat (%)	15.82	5.05	15.52	4.92	22	-0.82, 1.42	0.87*	0.55	21
Vertical jump (cm)	35.91	8.39	35.24	6.50	23	-1.71, 3.04	0.76*	0.58	22
Physical fitness test score	215.52	50.94	231.95	40.84	21	-29.32, -3.53	0.83*	-2.66*	20
Combat fitness test score	295.24	5.26	295.95	4.77	21	-3.52, 2.09	0.25	-0.53	20

* $p < 0.05$

with missing a training session but did not meet our criteria for injuries (Table 3). The calculated injury rate was 1.34 injuries/100 person-months.

Discussion

As hypothesised, this pilot project supports the use of a linear periodised training program to improve cardiopulmonary fitness, with a low rate of musculoskeletal injuries. In comparison to traditional continuous training, shorter periods of interval training appear superior with respect to improving cardiorespiratory fitness (i.e., peak VO_2). In fact, shorter interval-style training appears to increase VO_2 peak on average 0.5 $L{\cdot}min^{1}$ whereas more traditional continuous style training increases VO_2 peak by approximately 0.2–0.3 $L{\cdot}min^{1}$.[18] In the present study, our training program elicited significant improvements in VO_2 peak with a mean increase of 0.3 $L{\cdot}min^{-1}$. Previous studies have examined healthy sedentary populations; therefore, the above-average VO_2 peak recorded before training (49.0±10.4 $ml{\cdot}kg{\cdot}min^{-1}$) in our sample may have limited participants' trainability. Moreover, our program was not designed specifically to increase cardiorespiratory fitness. Additionally, we recorded improvement in strength as demonstrated by increased counts of crunches and pull-ups. Figure 2 illustrates the individual-level changes in key measures of fitness and performance to inform future studies of systematic physical training programs.

The CCAP training program was safe with a low injury rate. Our only musculoskeletal injury occurred to a participant while running outside of the program and attribute the injury to the extra mileage volitionally undertaken by the participant. This resulted in an injury rate of 1.34 injuries/100 person-months, at the low end of published rates for garrisoned units. Non-combat MSIs have been similarly observed in all settings of military service, including basic training, garrison and deployment. For instance, during basic training, injury rates in the Army and Navy

Table 3. Summary of all musculoskeletal concerns (n=13) and injuries (n=1).

	Location	n	%
Musculoskeletal concern			
	Knee	4	31
	Ankle	2	15
	Hamstring	1	8
	Shin	1	8
	Low back	1	8
	Foot/toe	1	8
	Calf	1	8
	Groin	1	8
	Missing	1	8
Musculoskeletal injury			
	Groin	1	100

have been shown to be 6–12 per 100 male recruits per month (100 person-months), with rates rising as high as 30 per 100 per month for Naval Special Warfare training.[19] Rates of MSIs are higher among women.[20] Rates of injury among garrisoned infantry have been observed to be 95 injuries per 100 soldiers per year (7.9 per 100-person-months), with 50% of those injuries occurring during physical training. Another study reported that 51% of garrisoned infantry sustained an injury over six months.[21] Rates of injury in the military are significantly higher than those observed in civilian populations of the same age.[22] Studies have shown that some of the risk factors for sustaining injury include low baseline fitness, participation in sports, high running mileage and high weekly exercise volume.[19]

Decreasing musculoskeletal injuries should be a priority for the Department of Defense. While numerous studies[7] acknowledge the problems created by the military's unstructured fitness program, changes have mostly been incremental (e.g., reduced running mileage, modifications to footwear) rather than shifting to a more modern,

evidence-based paradigm that incorporates modern physiology and exercise science principles. One attempt at an overhaul was the Army's Physical Readiness Training during advanced infantry training. The program incorporated progressive and individualised overload as well as injury control education that resulted in both reduced injury occurrence and time loss from injury.[21] This program's preliminary success demonstrated the likely benefits of a systematic approach and the need to evaluate the broader implementation of linear periodised training programs.

Feasibility of a more structured training program is critical. Military units train in a variety of locations/settings, and often do not have a lot of equipment for physical training. In addition to formal physical training, service members are regularly assigned to non-fitness activities that are physically demanding. Marines and other military personnel have tasks such as rifle range training, work details that arise with little notice, or training changes to alternative locations. Our data indicated that these other duties contributed to 80% of the missed sessions and showed that they take priority over fitness training. Disruptions like these can affect the effectiveness of a training program; although, in this pilot, some measures of fitness demonstrated improvement despite these disruptions. Attributes of the program to address missed sessions including careful documentation of the reason for missing, rescheduling sessions +/- one day, and close supervision of adherence may be necessary to maintain the fitness benefits. Training programs based on linear periodisation must factor in such disruptions and mitigate them to the extent possible.

This study provided proof of concept that properly trained active-duty Marines can improve their fitness, with a low injury rate, while still participating in other critical assignments. While we did not explicitly assess cost, the program was administered by a single program leader, trained as a strength and conditioning coach, who could be utilised by several units or monitor a group larger than 30 individuals. Unit commanders can apply similar programs to their units to increase physical fitness. This program would likely need to be adapted to serve units of different types or in a different phase of the deployment cycle and may involve more sophisticated periodisation strategies, such as block periodisation.

A weakness of the study is that the sample was small and recruited from a single unit; although this allowed for very close supervision and maximised interaction by the program leader. Larger groups should be studied to see if the same results will occur without this intimate level of guidance and oversight. We were also unable to follow up with the cohort beyond the completion of the training program. Thus, the sustainability of this approach without supervision or the maintenance of the observed fitness benefits is unknown. Incomplete data also limit the internal validity of our performance and fitness findings. For example, various challenges, including power outages at the time of testing, inability to schedule testing for a participant, participant drop-out and poor-quality data limited the number of participants with pre- and post-maximal exercise data to 16. For these reasons, the purpose of the study evolved after it was in the field and the focus shifted to assessing feasibility and informing future projects. In future research, a more considerable effort may be required to enhance complete data collection.

Conclusion

Our findings provide evidence of the feasibility, safety and physical performance and fitness benefit of a systematic approach to physical training of a garrisoned military unit. The USMC and other branches of the US military should build on studies such as this one and further assess a linear periodised training program and assess improvements in fitness and injury rates.

Acknowledgements

This material is based upon work supported in part by the Department of Veterans Affairs, Veterans Health Administration and the use of facilities at the VA New Jersey Health Care System at East Orange, NJ, and in part by the Center for Innovations in Quality, Effectiveness and Safety (CIN 13-413, Michael E. DeBakey VA Medical Center, Houston, TX).

The views expressed in this manuscript are those of the authors and do not reflect the official policy or position of the U.S. Department of Veterans Affairs, Department of the Army, Department of Defense, or any other aspect of the United States Government.

Corresponding Author: Drew Helmer
drew.helmer@va.gov
Authors: C Heard[1], M Willcox[2], M Falvo[3,4], M Blatt[5], D Helmer[3,4]
Author Affiliations:
1 Protac
2 US Army Medical Department
3 Department of Veterans Affairs
4 War Related Illness and Injury Study Center
5 Hackensack University Medical Center

References

1. Department of the Army. Army Physical Readiness Training (FM 7-22). 22%20INC%20C1%20Final.pdf Published May 3, 2013. Accessed September 30, 2018. Available from: https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN7938_FM%207-
2. Department of the Navy. Marine corps physical fitness program (MCO 6100.13). Published August 1, 2008. Accessed September 30, 2018. Available from: http://www.marines.mil/Portals/59/Publications/MCO%206100.13%20W_CH%201.pdf.
3. Department of the Navy. Guide 5 – Physical Readiness Test (PRT). Navy Physical Readiness Program. Published January 2016. Accessed September 30, 2018. Available from: http://www.public.navy.mil/bupers-npc/support/21st_Century_Sailor/physical/Documents/Guide%205-%20Physical%20Readiness%20Test%20%202016.pdf.
4. Department of the Air Force. Air Force Fitness Program. Air Force's Personnel Center. Accessed September 30, 2018. Available from: http://www.afpc.af.mil/Air-Force-Fitness-Program/
5. Roy BA. Overreaching/Overtraining: More Is Not Always Better. ACSM Health & Fitness Journal. 2015 Apr;19(2):4–5. doi: 10.1249/FIT.0000000000000100
6. Patel AA, Hauret KG, Taylor BJ, Jones BH. Non-battle injuries among U.S. Army soldiers deployed to Afghanistan and Iraq, 2001–2013. J Safety Res. 2017 Feb;60:29–34. doi: 10.1016/j.jsr.2016.11.004. Epub 2016 Nov 28. PMID: 28160810
7. Nindl BC, Williams TJ, Deuster PA, Butler NL, Jones BH. Strategies for optimizing military physical readiness and preventing musculoskeletal injuries in the 21st century. US Army Med Dep J. 2013 Oct–Dec:5–23.
8. Evans JW. Periodized Resistance Training for Enhancing Skeletal Muscle Hypertrophy and Strength: A Mini-Review. Frontiers in physiology. 2019 Jan 23;10(13). doi: 10.3389/fphys.2019.00013
9. Vantarakis A, Chatzinikolaou A, Avloniti A, Vezos N, Douroudos II, Draganidis D, Jamurtas AZ, Kambas A, Kalligeros S, Fatouros IG. A 2-Month Linear Periodized Resistance Exercise Training Improved Musculoskeletal Fitness and Specific Conditioning of Navy Cadets. J Strength Cond Res. 2017 May;31(5):1362–1370. doi: 10.1519/JSC.0000000000001599.
10. Zwolski C, Quatman-Yates C, Paterno MV. Resistance Training in Youth: Laying the Foundation for Injury Prevention and Physical Literacy. Sports Health. 2017 Sep/Oct;9(5):436–443. doi: 10.1177/1941738117704153.
11. Heilbronn B, Doma K, Gormann D, Schumann M, Sinclair W. Effects of Periodized vs. Nonperiodized Resistance Training on Army-Specific Fitness and Skills Performance. Journal of Strength and Conditioning Research. 2019 Publish Ahead of Print. 1. 10.1519/JSC.0000000000003029.
12. American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription. Lippincott Williams & Wilkins; 2013 Mar 4.
13. Jackson, A.S. and Pollock, M.L. Generalized equations for predicting body density of men. Br.J.Nutr. 1978;40:497–504.
14. Jackson, A.S. and Pollock, M.L. and Ward, A. Generalized equations for predicting body density of women. Medicine and Science in Sports. 1980;12:175–182.
15. Department of the Navy. PFT-CFT Standards 2017. Marine Corps Physical Fitness. Accessed September 30, 2018. Available from: https://www.fitness.marines.mil/PFT-CFT_Standards17
16. Walsh S, Davis J. 331 Noninvasive Lactate Threshold Detection Using the Modified V-Slope Method with Non-breath-by-breath Data. Med Sci Sport Exercise. 1990 Apr;22(2):S56. doi: 10.1249/00005768-199004000-00331.
17. Gibbons RJ, Balady GJ, Bricker JT, Chaitman BR, Fletcher GF, Froelicher VF, Mark DB, McCallister BD, Mooss AN, O'Reilly MG, Winters WL, Gibbons RJ, Antman EM, Alpert JS, Faxon DP, Fuster V, Gregoratos G, Hiratzka LF, Jacobs AK, Russell RO, Smith SC; American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Committee to Update the 1997 Exercise Testing Guidelines. ACC/AHA 2002 guideline update for exercise testing: summary article. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1997 Exercise Testing Guidelines). J Am Coll Cardiol. 2002 Oct 16;40(8):1531–40. doi: 10.1016/S0735-1097(02)02164-2

18. Bacon A, Carter RE, Ogle EA, Joyner MJ. VO2max Trainability and High Intensity Interval Training in Humans: A Meta-Analysis. PLoS One. 2013;8(9):e73182. Published online 2013 Sep 16. doi: 10.1371/journal.pone.0073182
19. Kaufman KR, Brodine S, Shaffer R. Military training-related injuries: surveillance, research, and prevention. Am J Prev Med. 2000 Apr;18(3 Suppl):54–63. PMID: 10736541.
20. Nindl BC. Physical Training Strategies for Military Women's Performance Optimization in Combat-Centric Occupations. J Strength Cond Res. 2015 Nov;29(Suppl 11):S101–6. doi: 10.1519/JSC.0000000000001089.
21. Knapik JJ, Bullock SH, Canada S, Toney E, Wells JD, Hoedebecke E, Jones BH. Influence of an injury reduction program on injury and fitness outcomes among soldiers. Inj Prev. 2004 Feb;10(1):37–42.
22. Cameron KL, Owens BD. The burden and management of sports-related musculoskeletal injuries and conditions within the US military. Clin Sports Med. 2014 Oct;33(4):573–89. doi: 10.1016/j.csm.2014.06.004.

Appendix 1: CCP program details

CCP-HIGH PROGRAM DETAILS:

Week	Monday	Wednesday	Friday
1	Boots & Utilities (This workout will be used as a baseline measurement. It will appear again in weeks 5,9, and 12. The goal is to do more rounds each time you do this workout.) Complete as many rounds as possible in 30 minutes 440 yd sprint Pull-ups x 5 Push-ups x 10 Squats x 15 Front and side planks 30 seconds each position	Green on Green (PT gear) 5-minute warm-up jog, run six 440 yd sprints with a 1-minute break in between. 3 rounds for time Pull-ups x 6 Squat to press x10 with 25lbs sandbag Lunges x 10 each leg Seated twist x 20 each side Planks are done after the rounds. Planks (all positions) x 30 seconds	Boots & Utilities Complete 1 round of the below exercises (warm-up). Squats x 8 Push-ups x 8 Lunges x 8 each leg Pull-ups x 6 Woodchoppers x 10 Side toss x 12 each side Crunches x 20 After completing the warm-ups negotiate the obstacle course twice for time. Time starts at the first log and ends when top of the rope touched 2nd time. *If no obstacle course is available do 1 burpee +1pull up for 50 repetitions for time.
2	Green on Green 2 miles Complete as many rounds as possible in 20 minutes Crunches x 10 Woodchopper x 10 each side Thrusters x 10 Bent-over rows with ammo cans x 10 Lunges with ammo cans x 10	Boots & Utilities After a 5-minute warm-up jog, run four 440 yd sprints with a 1-minute break in between. Complete as many rounds as possible in 20 minutes Pull-ups x 7 Buddy squats x 8 Push-ups x 12 Lunges x 12 each leg Woodchoppers x 12 Russians x 12 Combination hyperextensions x 12	Boots &Utilities Obstacle course suicides (run to each obstacle, complete the obstacle, run back to start and start the course again. Each suicide should be one obstacle longer than the previous suicide) *If no obstacle course is available do 1 burpee +1pull up for 75 repetitions for time.

3	Boots & Utilities Complete as many rounds as possible in 25-minutes Overhead press x 12 (with barbell or ammo can) Buddy Squats x 12 Bent-over rows with ammo cans x 12 Lunges x 12 with ammo cans in each hand All plank positions 30 seconds Run eight 440 yd sprints with a minute and a half break in between sprints.	Green on Green Front squats 4 sets of 5 Back squats 4 sets of 5 Bench press 4 sets of 5 Seated rows 4 sets of 5 Note: This is to be done in a weight room with a barbell and weights. Choose a comfortable weight to start with. Your first 2 sets are warm-up sets and your last 2 sets are work sets.	Boots & Utilities with flak After a 5-minute warm-up jog, run eight ½ mile sprints with ¼ mile recovery runs between sprints 3 rounds with flak: Push-ups x20 Lunges x 20 Buddy dead lift x12 Combination hyperextensions x 20 Sandbag partner toss x 20
4 Unloading week.	Boots & Utilities After a 5-minute warm-up jog, run eight 440 yd sprints with eight 440 yd quarter-mile jogging after each sprint (recovery) 3 rounds of: Push-ups x 10 Squats x 10 Pull-ups x 5 Lunge and reach x 10 each leg Woodchoppers x 12 Planks x 20 seconds	Green on Green (PT gear) 2 miles (easy pace) 3 rounds of: Overhead press with 40lbs ammo cans x 10 Squats with 2 forty lbs ammo cans x 10 Pull-ups with flak x 5 Walking lunges with ammo cans x 10 each leg Russian twists x 10 each side Swimmer combination hyperextensions x 10	Boots & Utilities 2 miles (easy pace) 3 rounds Lunges x 12 each leg Combination hyperextensions x 12 Wall ball x 12 Pull-ups x 6 Side and front shoulder raises with 5 pounds each hand Sandbag partner toss x 14 each side
5	Boots & Utilities Complete as many rounds as possible in 30 minutes Pull-ups x 5 Push-ups x 10 Squats x 15 Front and Side Planks 30 seconds each position	Boots & Utilities 3 miles 3 rounds as fast as possible Dive bombers x 15 Squats x 15 pull-ups x 8 Lunges x 15 each leg Overhead press x 12 (with sandbags)	Boots & Utilities After a 5-minute warm-up jog, run eight 440yd sprints with 440 yd jogs between sprints Complete as many rounds as possible in 25-minutes Pull-ups x 8 Squat to press with ammo cans x 15 Reverse lunges x 12 each leg Planks x 30 seconds
6	Boots & Utilities For time run the obstacle course 3 times. Time starts as you cross the first log and it ends when you touch the top of the rope for the 3rd time. *If no obstacle course is available do 1 burpee +1pull up for 75 repetitions for time.	Boots & Utilities (Wednesday) 5-minute warm-up jog run six ½ mile sprints with six ½ mile jogging after each sprint (recovery) Complete as many rounds as possible in 30 minutes Rope climbs x 3 Buddy squats x 8 Push-ups x 12 Lunges x 12 each leg Sit & reach x 12 Buddy leg raises x 12	Boots, Utilities & Flak 5-minute warm-up jog, run six 440 yd sprints with 1-minute recovery between sprints Complete as many rounds as possible in 27 minutes Tire flips x 8 Squat to press with ammo cans x 8 Lunges x 8 each leg L-Pull-ups x 6 Woodchoppers x 10 Planks 30 seconds Russians x 20

7	Boots & Utilities Run the obstacle course 3 times for time. *If no obstacle course is available do 1 burpee +1pull up for 100 repetitions for time.	Boots & Utilities 3 miles With flak Max push-ups in 2 minutes Max squats in 2 min Lunges (as many as you can get in 2 min) Max pull-ups Woodchoppers (as many as you can get in 2 min)	Boots & Utilities 5-minute warm-up jog, sprint ½ a mile then jog ¼ mile. 4 rounds of sprints Push-up challenge (every 30 seconds do one more push-up than you did before ex. 1 push-up wait 30 seconds 2 push-ups until 12 push-ups have been reached). Note: you stay in the lean and rest position when waiting. Pull-ups challenge (without dismounting the bar do 1 pull-up then wait 30 seconds do 2 then 30seconds do 3…. Until you cannot do one more than you previously did) 7 Overhead squats with barbell
8 Unloading week	Green on Green (Pt gear) 3-mile run (easy pace) 4 rounds Windshield wipers x 14 Push-ups x 14 Squats with ammo cans x 14 Pull-ups x 8 Lunges x 14 each leg	Green on Green (Pt gear) 5-minute warm-up jog, run eight 440yd sprints with 1-minute recovery between sprints 4 rounds of Overhead press with pack or barbell x 10 Bent-over rows with pack or barbell x 10 Squats with 2 forty-pound ammo cans x 10 Farmers walk with ammo cans for 30 yards Russian twists x 14 each side Romanian dead lifts x 10 (if bar bell is not available use ammo cans)	Green on Green (Pt gear) 2 miles (easy pace) 4 rounds of Front squat to press with ammo can x 14 Reverse lunges with ammo cans x 14 each leg Bent-over rows with ammo cans 90-degree abdominal crunch Woodchoppers x 14
9	Boots & Utilities As many rounds as possible in 40 minutes Thrusters x10 (Exercise is done with 45lbs ammo can or barbell. If this is too easy and you can add weight.) Pull-ups x5 Box jumps x10 Plyo push-ups x5 Mountain climbers x20 Front & side planks 30 seconds each position	Green on Green Front squats 4 sets of 5 Back squats 4 sets of 5 Bench press 4 sets of 5 Seated rows 4 sets of 5 Note: This is to be done in a weight room with a barbell and weights. Choose a comfortable weight to start with. Your first 2 sets are warm-up sets and your last 2 sets are work sets. You should be able to lift more than week 7.	Boots & Utilities with flak After a 5-minute warm-up jog, run eight ½ mile sprints with ½ mile recovery runs between sprints 3 rounds with flak: Push-ups x20 Lunges x 20 Buddy dead lift x12 Combination hyperextensions x 20 Sandbag partner toss x 20
10	Boots & Utilities with flak Run the obstacle course 4 times for time.	Boots & Utilities with flak After a 5-minute warm-up jog, run twelve 440yd sprints with 1-minute breaks in between. Complete 6 rounds of Pull-ups max set Squats max set Push-ups max set Planks max time	Boots & Utilities with flak As fast as possible: 3 miles for time Overhead press with ammo cans x 16 Squats with ammo cans x 16 Pull-ups x 12 Farmers walk with ammo cans for 30 yards Windshield wipers x 16 each side Sit & Reach x 16

11	Boots & Utilities After a 5-minute warm-up jog, eight ½ mile sprints with ¼ mile recovery runs between sprints 5 rounds with flak Push-ups x 16 Squats with ammo cans x 16 Pull-ups x 13 Lunges x 16 each leg Ammo can pick up with 6 cans Woodchoppers x 16	Boots & Utilities After a 5-minute warm-up jog, run twelve 440yd sprints with 1-minute breaks in between Complete as many rounds as possible 35-minutes Planks 60 seconds Ammo can press x 16 Walking lunges for 30 yards Bent-over rows with ammo cans x 16 Squats with ammo cans x 16 Woodchoppers x 16	Boots & Utilities 3 mile run for time Complete as many rounds as possible in 35-minutes Buddy drag for 25 yards Stretcher press (with groups of 4 to 6 Marines lift a stretcher containing one Marine and lift up as if doing a press) x 10 Pull-ups x 14 Woodchoppers x 18
12 Unloading week. Last week of the program.	Boots & Utilities (Monday) (At this point in training you should be maxing out the number of rounds you can do in 30 minutes) Complete as many rounds as possible in 30 minutes 440 yd sprint Pull-ups x 5 Push-ups x 10 Squats x 15 Front and Side Planks 30 seconds each position	Boot & Utilities After a 5-minute warm-up jog, run six ½ mile sprints with ½ recovery runs 2 rounds Pull-ups x 6 Squats x 12 Push-ups x 12 Lunges x 12 each leg Sit & reach x 12 Windshield wipers x 12	Green on Green 2 miles (easy pace) 2 rounds Planks 30 seconds Push-ups x 10 Squats x 10 Pull-ups x 6 Lunges x 10 each leg Crunches x 12 Woodchoppers x 12

–

Skill fade in Military Medical Training: A Literature Review of Supraglottic Airway use in the Prehospital Environment

W Maddocks

Abstract

Background: Skill fade is a potential issue in any military medical training environment. Within the current New Zealand Defence Force (NZDF) medic training programme, emergency skills are taught and practised in a simulated environment but are rarely used in real-life situations. As there is infrequent exposure to emergency situations during training, there is a potential for skill fade to occur with some emergency techniques. One such technique is the use of supraglottic airway devices (SADs) as used in the prehospital emergency environment from both a military and civilian context. However, an optimum training interval has not been clearly defined for this skill within a military medic context.

Purpose: This literature review explores the issue of skill fade, in particular with prehospital emergency airway management using SADs. This review can guide the framework for an evaluative study, which could be conducted in a military medic training context to help determine the extent of skill fade and how it could be mitigated through manipulation of training intervals.

Material and methods: Literature was reviewed from military and civilian prehospital contexts to identify key extant studies in the use of SADs. The review has been placed in a wider context of skill fade within emergency care training in general as well as recognising the unique military contexts in which prehospital emergency care is provided.

Discussion: Several studies identified that the rate of skill fade within emergency care is consistent across several medical disciplines, with skill fade occurring from around eight weeks and peak decline at six months. Different instructional methods do not seem to reduce skill fade when used in isolation, suggesting a mixed-method approach is needed with regular retesting to ensure competency in the use of SADs. The review did not identify any research that specifically explored the issue of skill fade within NZDF medic training; however, the information provided would assist further research in this area.

Conflict of interest: The author does not have a conflict of interest. Preliminary planning of this literature review and potential research commenced while the author was employed by the NZDF as a civilian medical lecturer at the Defence Health School at Burnham Military Camp in Christchurch. The paper was completed while employed as an academic at Canterbury University. No payment or royalty has been received. All expenses incurred in retrieving literature was met by Canterbury University.

Introduction

The training of military medics worldwide varies from country to country, as is the exposure to life-threatening emergencies in both a tactical or non-tactical environment. As with other technical military skills, continuous training is undertaken to guard against skill fade.[1] In simple terms, skill fade is when a clinician becomes 'rusty' in their practice due to non-use of a skill over an undetermined period[2] and is of particular importance in procedural skills where there is a set sequence to follow for the skill.[3] Early educational psychology research has identified that the human brain can recall up to seven procedural steps from memory depending on complexity.[3] Understanding these principles formed the basis of the development of the User Decision Aid (UDA) model by the United States Army Research Institute

(USARI), which helped predict skill retention and develop the schedule for refresher training of skills.[4]

Emergency airway management is a key part of the military medic's toolkit in the prehospital setting, and while the use of an endotracheal tube (ETT) is considered the gold standard for airway security, it is recognised as a difficult skill to learn and remain competent in the prehospital setting. In addition, it requires particular equipment and drugs,[5] which are not practical in the military prehospital context. Using a supraglottic airway device (SAD) is easier than an ETT with a higher degree of accuracy of insertion when used by non-anaesthetists.[5] It is the recommended airway management for use in a tactical setting.[6] In a prehospital civilian setting, the error rate of ETT insertions by paramedics can be as high as 25%,[7] and for competency to be achieved it needs to be conducted at least 25 times on real patients.[8] Because of this high error rate, it is not the preferred airway management of choice in the prehospital setting for paramedics. Therefore, in the prehospital civilian environment, ETT insertion is considered an advanced skill, taught to a selected few advanced paramedical practitioners to reduce skill fade.[8]

Within New Zealand, tri-service military medics are trained by the NZDF Defence Health School (DHS), and graduates are responsible for providing comprehensive medical care of all personnel, including routine primary healthcare of personnel, both in a domestic or deployed operational environment. In addition, they are trained in emergency and tactical care for use in humanitarian and disaster relief (HADR) and deployed tactical environments as required by the New Zealand Government[9, 10] where they follow the guidelines of Tactical Combat Casualty Care.[11] Since 2017, all NZDF military medic training has occurred solely within the NZDF environment using a range of instructional methodologies, including high fidelity simulation-based training. The potential use of simulated, virtual and augmented reality in medical training has an associated perceived reduction in training cost, which suggests a revision of some of the core principles to mitigate the risk of skill fade effectively without increasing the training burden as mentioned previously.[2]

Currently, NZDF medic trainees do not receive any clinical experience in civilian emergency healthcare such as emergency departments or ambulance services while training.[12] With the ever-present potential of a life-threatening emergency with military personnel while at land, sea or in the air, a NZDF medic must be able to respond appropriately and sustain life until transfer to a civilian provider. Recent incidents (2018 and 2019) have occurred in New Zealand where military personnel have sustained serious injuries during live firing exercises.[13, 14] The NZDF medics attached to these units were responsible for providing immediate lifesaving care until transfer to advanced care occurred.

Emergency medical care can be provided to civilians by NZDF medics during humanitarian, disaster relief (HADR), when a state of emergency is declared or when life or limb is in danger.[10, 15] Examples include; the provision of disaster aid and care to NZDF staff and casualties during the 2011 Canterbury earthquakes;[16, 17] provision of lifesaving emergency care by three recently graduated medics at a serious car accident outside a military base;[18] and finally, a medic, travelling as part of a military convoy, administered emergency care to a casualty who was having an anaphylactic reaction while driving.[19] The March 2019 terror attacks in Christchurch also had medical staff at nearby Burnham Camp on standby to assist if required.[20] These incidents highlight that NZDF medics could be required to use their emergency skills in unexpected contexts outside of their routine NZDF work, and thus need to be able to provide this care appropriately.

Aims

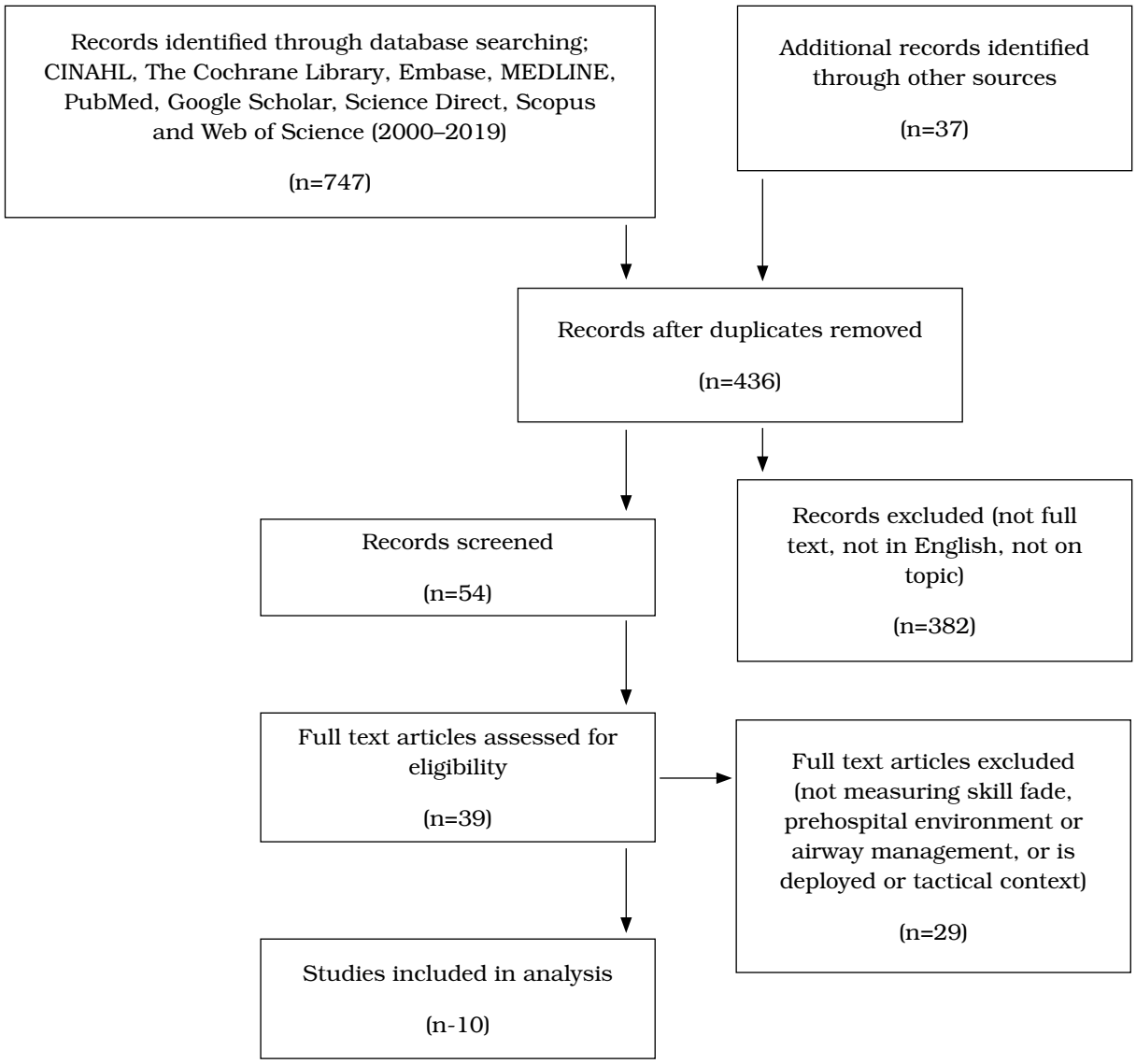
1. Explore the issue of skill fade of emergency skills within a prehospital context as performed on adults by trained providers; and
2. Identify key research in the area of skill fade, relating to the prehospital (non-deployed) military medical context, in particular with relevance to the use of supraglottic airway devices (SADs).

This review can guide the development of a framework for an evaluative study in the military medic training context to help determine the extent of skill fade and how it could be mitigated through appropriate training intervals and instructional methodologies.

Method

A literature search was conducted following the PRISMA (www.prisma-statement.org) guidelines, using the University of Canterbury library multisearch function. Search terms included; 'skill* fade*', 'skill* retention', 'train* interval*' and 'cognitive decline' 'prehospital* emergency care', 'use of SADs, 'supraglottic airway devices', 'airway management'. Figure 1 summarises the search process.

Figure 1: Search process for review



Inclusion criteria included the date range of 2000–2019, as this was when SADs were introduced into patient care; any use of SADs in the prehospital setting; adult resuscitation training; and military medic training. Exclusions were the use of SADs in the tactical space and effects on survival; studies conducted on children, live tissue or animals; studies that did not include SAD use; and studies involving routine inpatient use of SADs (e.g. the operating room) The final articles were added to NVIVO software for scanning, coding and duplicate removal. Finally, a manual crosscheck of reference lists was conducted to ensure all possible articles had been sourced. For the purpose of consistency throughout this review, the term 'skill fade' encompasses all terms used in the literature.

Assumptions made about each study were that they replicated, as close as possible, a simulated emergency scene and that all testing was conducted on adult mannequins unless indicated otherwise. Information on possible bias in studies was checked and considered in the interpretation of the findings by the author.

Results

Table 1 summarises the findings of the 10 research articles reviewed.

Table 1: Summary of review articles

Authors	Year	Number/type of participants	Methodology	Outcome
Abraham et al (26)	1998	211 military GPs	Theory testing and retesting of ALS and CTLS	Linear skill decline
Barlow et al (27)	2018	14 Military GPs	Focus group	Felt under prepared to respond to emergency
Bukiran et al (28)	2014	225 civilian ICU/ emergency nurses	Theory testing BLS and ALS	Skill fade by six month, emergency nurses retained skills longer
Kenward et al (21)	2017	41 military and civ senior nurses	Delphi study until consensus	Confirms risk of skill fade, highlights unique need of military nurses
Mitchell et al (30)	2018	63 deployed personnel	Survey	Perception of confidence low to perform BLS-need to continue refreshers on deployment
Inglis (30)	2019	Deployed navy number not stated	Survey	Perception of confidence to perform BLS increases with 3 or more refreshers
Jensen et al(31)	2019	795 high school students	Observational	Skill fade by four–six months
Sun et al (34)	2017	Sim based training	Literature review	Skill fade begins at four weeks, combined SBT and non SBT more effective
Hensel et al(33)	2017	285 non-medical soldiers	RCT	Mixed methodology best instruction, skill fade by three months

Defining skill fade

Skill fade occurs in a continuous downward scale, initially quite rapidly, then more gradually as the more time has elapsed between initial training.[21, 22] Overlearning – where a new skill is taught and practised repetitively beyond initial mastery to the point of being 'automatic'[23] – is a core part of emergency skill learning.[24] In a military context, skill decline was fastest in the first few months after learning the skill and motor skills decline faster than knowledge skills.[22] Poor self-perception of ability can also increase a decline in performance.[2] Despite various efforts to identify the peak time of skill fade, factors such as the actual skill, experience of the operator, teaching methodology, training time, use of simulation and repeated practice, and actual use of the skills all have an impact on the degree of skill fade.[2, 22]

In an extensive literature review of skill fade across a range of military skills, the Canadian Army note that a clear distinction needs to be made between skill retention, which they note, is the 'sustainment of skills as learned behaviours and procedures over long periods of time without practice'[25] p.14 and reduced performance, which can be due to degradation of several processes underpinning the skill, such as motor skills, cognition or accessibility of memory. This distinction is important to consider when trying to predict and remediate skill fade or depreciation.[25] While this review did not specifically cover military medical skills such as emergency airway management, the theoretical constructs presented in this review would help future researchers exploring skill fade within a military context.

Skill fade within a theoretical context

Skill fade includes cognitive knowledge recall as measured by the first study, which compared two groups of military physicians from the Israeli Defence Force.[26] In this study, two groups were asked to complete theoretical tests on recall of airway management similar to their initial training (n=211). The first group (n=138) had completed Advanced Trauma Life Support (ATLS) training, and the second group (n=73) had completed Combat Trauma Life Support (CTLS) training in the previous 3–66 months. This study noted that the IDF physicians are mainly reservists, and are most likely not exposed to trauma in their day-to-day work but are required to be able to deliver advanced trauma care in their role as military physicians. The recall test results were then compared with their original test scores, which had a pass mark of 80%. A refresher course was deemed necessary when 50% of participants scored less than 80% in the test. The skill fade was similar in both groups and occurred in a linear fashion with all participants retaining 80% or higher scores up to 52 weeks post-training, and the point at where 50% of participants' scores were below 80% was 192 weeks. While age was stated with a mean age of 39 years (+/- 6.2), there was no mention of gender in the

analysis.[26] This study contributes significantly to the notion of skill fade as it relates to theoretical recall over an extended period, which would help in the development of guidelines for refresher training.

This situation is similar in the UK where military GPs are infrequently exposed to emergencies. Fourteen participants were interviewed in focus groups to understand their perception of preparedness for acute trauma care; the respondents indicating they felt underprepared as skills did fade over time.[27] A detailed response to this article supported the need for continued work in this area,[24] further supporting the concern of the uniqueness of the military medical environment where both routine care is provided for as well as the need to be skilled in advance emergency care. While this work was conducted on a focus group, further exploration would need to be undertaken to establish if these perceptions were actualised in practice.

A similar type of study was conducted in Turkey, assessing nurse's (n=225) theoretical knowledge of combined Basic Life Support (BLS) and Advanced Life Support (ALS) at three intervals after initial training.[28] The aim of this civilian study was to see if retention of learning related to BLS and ALS was sustained over time. All participants were pre-tested and achieved a mean score of 12.6/25, which increased to 21.1/25 post-training. (A pass mark of 18/25 was required). Four tests were administered over the next 12 months, with 149 nurses completing all four tests (N=149). Results were mixed at the six-month testing interval, with male nurses (n=15) statistically not achieving an average pass mark compared to the females (n=134) (p=0.07). Those nurses who worked in areas such as emergency, critical care and medical care still achieved pass marks in the first three tests; however, by 12 months, only emergency care nurses achieved a pass mark. In their discussion, the authors noted that the optimal repeat training interval based on other studies is probably between three and six months, but, in reality, this may not be possible in hospital settings.[28] While this study was not in either a military or a prehospital context, it has been included here to show the effect of time on skill fade as well as the effect of repeated skill exposure through the work environment in the reduction of skill fade.

In an attempt to understand and mitigate the risk of skill fade and to find the optimum training needs for British military nurses, the return to practice and clinical contact time needed by British military nurses was explored in a Delphi panel study.[21] This methodology aimed to achieve consensus from 41 senior military nursing and NHS staff on a number of statements around the length of weekly clinical time needed to remain competent. All panel members recognised the real risk of skill fade if there is significant time away from clinical practice. After eventually achieving consensus policy was developed to ensure maintenance of both military and clinical skills.[21] This process enabled personal bias to be removed from a wide range of experts until a consensus was reached and makes a significant contribution to the knowledge around the military medical/nursing context of the balance needed in maintaining competency and military skills.

Another UK study explored the need for continued refreshers for deployed medical personnel who are on prolonged deployment.[29] Sixty-three currently deployed UK medical professionals were surveyed who had been deployed for between three and six months at a level 2 hospital in South Sudan (n=55). While all had undergone BLS before deployment, 84% felt that further practice in BLS should be initiated on deployment, especially on a contingency deployment where patient numbers may be low or unpredictable, and the risk of skill fade was higher.[29, 30] This perceived confidence and the effect on potential skill fade was explored in a very recent study within a deployed naval context.[30] The authors tried to determine the impact of personnel confidence in the ability to give BLS on a ship-based emergency and found that non-medical personnel who had attended three refresher sessions at an unknown interval felt more confident of performing BLS than before.[30] These two studies address the potential risk that the perceived lack of confidence by military personnel to respond appropriately to an emergency in a difficult location. Undertaking regular refresher training while on deployment enhances confidence, and this needs to be factored into planning of training.

Skill fade of procedural skills

The impact of the quality of training on skill retention, both in terms of resources and personnel providing the training, was explored in a nationwide Danish study of civilian CPR courses.[31] The authors reviewed 16 training publications provided by different agencies who taught bystander CPR to civilians according to European Resuscitation Council (ERC) guidelines. In addition, researchers observed courses and a selected number of participants were followed up and retested at between four to six months post-course. The authors found that not all necessary content was covered in the books and that people performed better if the class size ratio was 6:1, and if the instructor came from a healthcare background. When retested at between four to six months, the skill retention of the practical skills was poor as was

retention of knowledge, which had not been included in the book.[31] This study highlights the importance of having clear written material that is effectively reinforced with practical learning and hands-on practice in small group settings. These findings seem to support a slightly earlier study,[32] which tested skill retention of CPR in high school students. This study consisted of 795 high school students with a median age of 15 who were allocated to either one arm who had learnt CPR three months previously (n=431) or the second arm who had learnt it six months previously (n=364). Regardless of which arm, both groups had poor skill and knowledge retention, with more than 65% demonstrating errors in techniques, especially with chest compression.[32] While this particular study does not specifically include the use of SADs, it continues to add substance to the notion that skill fade in emergency skills occurs between three and six months. This time frame being consistent with other studies measuring CPR.[22, 24, 25, 28, 29, 33]

The use of simulated based training (SBT) such as virtual reality and other measures is an accepted and cost-effective way to reduce the chance of skill fade in certain clinical skills such as airway management.[34] A systematic review and meta-analysis of studies (n=17) compared entry-level medical personnel learning airway techniques with either SBT or non-SBT. The authors found that the level of skill fade is consistent regardless of the type of device used to manage an airway. It can occur as early as four weeks after learning the skill and is even worse eight months later. There was no difference in this study between SBT and non-SBT methodology in the development or rate of skill fade.[34] Further, studies using combinations of SBT, including augmented reality within a tactical environment, will help in determining the ideal training methodology.

One key study specifically investigated skill fade in non-medically trained soldiers using SADs. This study, which directly relates to the military context, compares different approaches to teaching the use of SADs within the German military to all soldiers.[35] The authors evaluated which teaching method would involve the best skill retention, as it needed to be taught quickly to a large number of personnel. The group of non-medically trained soldiers (n=285) were randomly allocated to one of three groups, each testing a different style of instruction. One was a theory lecture, one a practical demonstration and the third was an instructional video. The authors measured both time to insert (had to be under 60 seconds) and accuracy determined by an assessor blinded to the method of instruction. To measure the level of skill fade, participants were retested three months later with only one day's notice before the test. Two different airway devices were also tested. The greatest accuracy immediate post-instruction was achieved by the group, which had practice instruction at a combined success rate of 94%. The lecture and video groups were 68% and 74% respectively. The practical group also achieved a faster insertion rate at of 28.1 seconds (=/-19.6) seconds compared to between 43.2–49.2 seconds for the other methods. By the three-month retest stage, all groups had significantly dropped their accuracy, with the practical group dropping to 66% accuracy ($p<0.001$), and all groups had a significantly longer insertion time. The only exception was that the video group had a shorter insertion time when using the laryngeal mask, which is a type of supraglottic airway device ($p=0.002$). These authors concluded that no single method would reduce the skill fade and that a combination of both theoretical with practical followed up by video instruction has improved long-term outcomes.[35] This study would be ideal to replicate within a domestic NZDF context.

Discussion

Despite the well-recognised concept of skill fade and the impact it has on personnel performing emergency airway management, both within a hospital, military deployed and domestic context, none of the literature reviewed has identified an ideal training interval. While in most cases, mandatory skill updates are in the region of one to two years, studies have identified that skill fade of practical skills can occur in as short a time frame of four weeks post-learning or practising the skills, with peak skill fade starting from six months post-skill and then continuing to decline. Theoretical skill fade can take longer to eventuate but still occurs, especially when recalling complex detail such as pharmacology use and calculations. An austere environment or the lack of opportunity to use these skills in a real-life setting adds another layer of complexity in finding the optimal training interval within a military context. With the rapid speed of virtual reality being incorporated into various types of medical simulation, there is still no definitive answer as to what is the best method and what the optimal training interval between practice would be for a skill such as emergency airway insertion as no single method of instruction protects against skill fade. Those studies that compared different types of instruction found a combined mix of practical and theory offered the best results. Most studies measured both accuracy of insertion as well as speed of insertion with an acceptable period of 20 seconds to a maximum of 60 seconds. Finally, care needs to be taken to ensure written content matches practical instruction.

Recommendations

This review has provided the background literature exploring the topic of skill fade in military medical care as it relates to airway management. Of note, no studies relating to skill fade could be sourced that explored the NZDF medic training context or other prehospital emergency care. Due to the range of approaches and limited number of studies in this area, it is clear that further research is needed to determine both the level of skill fade in emergency airway management in the military medic environment and the optimal training interval for relatively new skills such as supraglottic airway insertion.

Study limitations

The author's lack of access to classified training data or literature as well as foreign language articles may have limited exposure to other potential studies or information. However, through the extensive search, nothing was apparent that warranted further cost or other means of retrieval. In addition, while there is potential for author bias, as the literature was not cross-examined by another reviewer for accuracy or acceptability topic, this has been mitigated as far as possible through cross-checking of sources.

Corresponding Author: W Maddocks, wendy.maddocks@canterbury.ac.nz
Authors: W Maddocks[1]
Author Affiliations:
1 Canterbury University, School of Health Sciences

References

1. Australian Army Land Warfare Procedures-General LWP-G 7-0-1. In: Command DGTF, editor: Commonwealth of Australia (Australian Army) 2015.
2. Linde A, Caridha J. Kunkler KJ. Skills Decay in Military Medical Training: A Meta-synthesis of Research Outcomes. Military Medicine. 2018;183(1–2):e40–e4.
3. Cahillane M, MacLean P, Smy V. Novel application of a predictive skill retention model to technical VLE content production skills among Higher Education teachers: a case study. Interactive Learning Environments. 2019;27(3):336–48.
4. Radtke PS, H. Training program for predicting military task retention: evaluation report. In: Research AIf, editor. U.S. Army Research Institute for the behavioral and Social Sciences; 1985. Available from: https://apps.dtic.mil/dtic/tr/fulltext/u2/a161790.pdf
5. Bielski A, Smereka J, Madziala M, Golik D, Szarpak L. Comparison of blind intubation with different supraglottic airway devices by inexperienced physicians in several airway scenarios: a manikin study. European Journal of Pediatrics. 2019;178(6):871-82.
6. Otten EJ, Montgomery HR, Butler JFK. Extraglottic Airways in Tactical Combat Casualty Care: TCCC Guidelines Change 17-01 28 August 2017. Journal of special operations medicine: a peer reviewed journal for SOF medical professionals. 2017;17(4):19.
7. Ragazzi R, Finessi L, Farinelli I, Alvisi R, Volta CA. LMA Supreme™ vs i-gel™– a comparison of insertion success in novices. Anaesthesia. 2012;67(4):384–8.
8. Deakin CD, Peters R, Tomlinson P, Cassidy M. Securing the prehospital airway: A comparison of laryngeal mask insertion and endotracheal intubation by UK paramedics. Emergency Medicine Journal. 2005;22(1):64–7.
9. New Zealand Defence Force; 2019. https://www.defencecareers.mil.nz/army/careers/browse-roles/medic/
10. Civil Defence Emergency Management Act 2002. In: Defence MoC, editor. New Zealand Government; 2018. Available from: www.legislation.govt.nz/act/public/2002/0033/latest/DLM149789.html?src=qs
11. Joint Trauma System TCCC Guidelines 1 Aug 2018. Department of Defense; 2018. Available from: https://deployedmedicine.com/market/11/content/40
12. Maddocks W. Incorporating reflective practice as an assessment tool in the training of New Zealand Defence Force (NZDF) medics. Journal of Military and Veterans Health. 2018;26(3):36–41.
13. NZ Herald. NZ Soldier injured during live firing exercise. 2018. Available from: https://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=12100760
14. Neale I, Williams C, Hunt K. Soldier shot during training at SAS facility in south Auckland. Available from: https://www.stuff.co.nz/national/112112309/person-injured-in-incident-on-same-road-as-sas-facility-in-south-auckland2019

15. Humanitarian Assistance and Disaster Relief (HADR) Domestic and Offshore Aide Memoire. In: JFNZ) HQJFNH, editor. Trentham, Upper Hutt, NZ: New Zealand Defence Force J8 Branch 2012. Available from: http://www.nzdf.mil.nz/downloads/pdf/public-docs/2019/hadr2019a4format.pdf
16. Sutton G, Fourie M. NZ defence force response to the Christchurch earthquake of February 2011. New Zealand Journal of Psychology. 2011;40(4):79–82.
17. New Zealand Defence Force: Photographs; 2011. https://quakestudies.canterbury.ac.nz/store/collection/13004
18. New Nealand defence Force. Medics graduate a year after earthquake delay. 2012. Available from: http://www.nzdf.mil.nz/media-centre/news/2012/20120221-mgayaed.htm2012
19. Eder J. Truck driver stung by bee saved by partner and passing military.2017. Available from: https://www.stuff.co.nz/national/99209747/truck-driver-stung-by-bee-saved-by-partner-and-passing-military2017
20. Jacinda Ardern on Christchurch mass shooting-9am 16 March. New Zealand Government Press Release; 2019. Available from: community.scoop.co.nz/2019/03/jacinda-ardern-on-christchurch-mass-shooting-9am-16-march/
21. Kenward G, Marshall S, Irvine K. How much is enough? Using Delphi to explore the clinical-contact-time and return-to-practice needs of military nurses. Nursing Management. 2017;24(2):20-4.
22. General Medical Council [GB]; nd. Skills fade: a review of evidence that clinical and professional skills fade during time out of practice, and how skills fade may be measured or remediated. Available from: https://www.gmc-uk.org/-/media/about/skills-fade-literature-review-full-report.pdf?la=en&hash=8B32071AF03167EE588EE574F6DCC4C85B1FEF0B
23. annonymous. Overlearning https://en.wikipedia.org/wiki/Overlearningnd
24. Wilkins D. Addressing perceived shortfalls in prehospital emergency care skills among UK military GPs: Skill fade literature provides the evidence base for training modifications. Journal of the Royal Army Medical Corps. 2019.
25. Bryant DJ, Angel H. Retention and fading of military skills: Literature review.. UMANSYSTEMS INC GUELPH (ONTARIO). 2000
26. Abraham RB, Blumenfeld A, Stein M, Shapira SC, Paret G, Rivkind A, et al. Advanced trauma life support versus combat trauma life support courses: A comparison of cognitive knowledge decline. Military Medicine. 1998;163(11):747–9.
27. Barlow A, Smith M. Do UK military General Practitioners feel adequately skilled in the provision of care to the acutely unwell or injured patient? Journal of the Royal Army Medical Corps. 2018;001035.
28. Bukiran A, Erdur B, Ozen M, Bozkurt AI. Retention of Nurses' Knowledge After Basic Life Support and Advanced Cardiac Life Support Training at Immediate, 6-month, and 12-month Post-training Intervals: A Longitudinal Study of Nurses in Turkey. Journal of Emergency Nursing. 2014;40(2):146–52.
29. Inglis D. Combating skill fade: basic life support refresher training in the remote military environment. Resuscitation. 2019;142:e53–e4.
30. Mitchell G, Smith J. Continuation resuscitation training on deployed contingency operations. Journal of the Royal Naval Medical Service. 2018;104(2):2.
31. Jensen TW, Møller TP, Viereck S, Roland Hansen J, Pedersen TE, Ersbøll AK, et al. A nationwide investigation of CPR courses, books, and skill retention. Resuscitation. 2019;134:110–21.
32. Brown LE, Carroll T, Lynes C, Tripathi A, Halperin H, Dillon WC. CPR skill retention in 795 high school students following a 45-minute course with psychomotor practice. American Journal of Emergency Medicine. 2018;36(6):1110–2.
33. Inglis D. Combating skill fade: basic life support refresher training in the remote military environment. Resuscitation. 2019.
34. Sun Y, Pan C, Li T, Gan TJ. Airway management education: simulation based training versus non-simulation based training-A systematic review and meta-analyses. BMC Anesthesiology. 2017;17(1):17.
35. Hensel M, Schmidbauer W, Benker M, Schmieder P, Kerner T. Comparative assessment of three approaches of teaching nonmedically trained persons in the handling of supraglottic airways: A randomized controlled trial. Military Medicine. 2017;182(3):e1774–e81.

Australian Defence Force' Role in Regional Health Security: Missions Defined by Infectious Diseases

G D Shanks

> *'God alone would not have sent such an epidemic.'*
>
> Samoan Chief during New Zealand Samoan Epidemic Commission hearings 1919.[1]

History shows that infectious diseases often determined the ability of armed forces to maintain soldiers on campaign and sailors in ships. Prior to the industrialisation of warfare in World War I, disease casualties outnumbered combat casualties often by a large margin. For example, during the last stages of the Australian Imperial Force's Palestine campaign, disease casualties outnumbered combat injuries > 30:1.[2] Infectious disease threats still require careful pre-deployment planning and good medical support, especially in tropical operations where insect vectors may greatly increase disease risks. On occasion, however, infectious disease has been the mission focus rather than just part of the battlespace equation. Weapons of mass destruction include epidemic infectious diseases, whether purposefully introduced or—more likely—as an evolution of a naturally occurring infection. Because such missions are very context and disease-specific, it is worth examining the Australian Defence Force's (ADF) experience with military missions defined by an infectious disease epidemic. As new infectious diseases (Zika, Chikungunya, COVID-19) emerge to spread across the region potentially destabilising fragile island nations rapidly, the ADF needs to consider its history in order to inform its planning for future scenarios where its transport and logistical assets from both the military and civilian sector could be applied in defending Australia by controlling an epidemic in the region.[3]

Military forces have been applied to control infectious diseases historically when no other state function was available or seemed appropriate. During the last major outbreak of bubonic plague in Europe in 1720, the French Army constructed fortifications including a long perimeter wall to keep the citizens of Marseille confined in a type of quarantine to protect the rest of the nation.[4] The soldiers of the British regiment the King's Shropshire Light Infantry were awarded a campaign medal for their efforts in controlling plague in Hong Kong in 1894.[5] Human infections have not been the only ones requiring military forces. Animal 'depopulation' exercises in order to protect a livestock industry and prevent zoonotic infections spreading to humans have been conducted by the Malaysian Army in 1999 to destroy Nipah infected pigs, the British Army to kill cattle in areas of hoof and mouth disease in 2001 and the Thai Army to kill and dispose of avian influenza-infected chickens during the early 2000s.[6, 7] The ADF's own experience has been largely limited to pandemic (globally epidemic) influenza. The ADF's first-ever humanitarian mission was to send medical teams in *HMAS Encounter* to the influenza-stricken islands of Samoa in 1918.[8] In 1969 ADF medical teams were airlifted into the Papua New Guinea Highlands when pandemic influenza hit this particularly vulnerable, socially isolated population.[9] Both operations bear examination for future lessons regarding the use of military forces to control epidemic infectious diseases as part of humanitarian assistance missions.

HMAS Encounter to Samoa during the Influenza Pandemic of 1918

Influenza is one of the few diseases that can rapidly incapacitate an entire population leaving it vulnerable to other social disruptions. The influenza pandemic of 1918–1920 remains the world's most notable recent human mortality event, with an estimated 50 million people killed across the world. The ADF in Europe and the Middle East in 1918 suffered at least 1200 deaths due to influenza; some military missions were cancelled for lack of sufficiently healthy men.[10] Immediately following the defeat of the Turkish Armies in Palestine in September 1918, entire cavalry divisions were unable to move and barely able to water their horses due to influenza.[11] Influenza struck Australia in early 1919 and remains the nation's greatest natural disaster ever recorded

with at least 12 000 deaths occurring within a few months.[12] Some Pacific Island states were completely devastated by this respiratory virus. More than 8000 persons died in New Zealand from influenza during the 'Black November' of 1918[13] (See Figure 1). Approximately the same number of people died in Western Samoa from a population three per cent of the size of New Zealand.[14] This occurred following the New Zealand Army's capture of the German Colony of Samoa during the islands' military occupation at the end of World War I. A tramp steamer, the *SS Talune*, had managed to infect Fiji, Tonga and Samoa on a single trip leaving Auckland on 30 October.[15] Then as now, isolated Pacific islands remain highly dependent on imported items, especially food, energy and medical supplies. The New Zealand Government, on 19 November, requested that the Australians help Samoa as the New Zealand soldiers on Samoa had been overwhelmed; Auckland had no spare medical personnel due to its own influenza epidemic, and Australia had not yet been infected in late 1918.[1]

Figure 1: Karori Commonwealth War Graves Cemetery in Wellington, New Zealand showing tombstones of some of the 110 military recruits who died of influenza during two weeks in 1918.

Source: GD Shanks, February 2018.

The only available naval unit able to reach Samoa was the Royal Australian Navy's (RAN) *HMAS Encounter*, a cruiser that had just returned to Melbourne[16] (See Figure 2). A warning order was issued on 20 November, and the ship moved to Sydney to take on a Royal Australian Army Medical Corps (RAAMC) medical team of seven medical officers and 33 medical orderlies and a large cargo of medical supplies. Coal was a critical factor as the ship could not proceed at maximum speed and still reach the first refuelling point in Suva, Fiji, so it left Sydney moving at 13 knots. The crew and medical team were all 'vaccinated' in route with a Commonwealth Serum Laboratory's mixed bacterial vaccine which hurt everyone's arm but was unlikely to have provided any protection against the as yet undiscovered influenza virus.[17] *HMAS Encounter* arrived in Suva on 30 November; on discovering that Tonga had also been hit by influenza, a medical team of seven was detached to go to Nuku'alofa on another ship. Although a well-meaning decision of the RAN medical officer in charge, the sloop *HMAS Fantome* stationed in Suva was unable to sail to Tonga due to 67 sailors sick with influenza and the alternative civilian vessel developed mechanical failures and had to return without reaching Nuku'alofa.[16]

Figure 2: *HMAS Encounter* was the RAN cruiser sent on a medical relief mission to Samoa in November 1918 during the highly lethal influenza pandemic.

Source: http://www.navy.gov.au/hmas-encounter-i

HMAS Encounter proceeded to Apia, Samoa arriving on 3 December, by which time the epidemic was already waning, and most of the deaths had already occurred. Medical teams consisting of a medical officer and six medical orderlies were sent to different parts of Samoa to render what aid they could. *HMAS Encounter's* role was primarily limited to transportation of the medical teams to the point of embarkation. Most of the tents and blankets loaded in Sydney in anticipation of a different type of population disaster were not required and returned with the ship to Sydney on 17 December. Military personnel landed in Samoa did not return with *HMAS Encounter* to avoid any appearance of bringing influenza back into Australia. *HMAS Encounter's* crew underwent quarantine in Sydney and were not released from the ship until 26 December. The medical teams remained in Samoa until their return to Australia 7 February 1919. Ironically, they initially travelled to Suva on the *SS Talune* and arrived in Australia on the *SS Atua* just as influenza was spreading from Melbourne. It is uncertain how much use was made of the influenza vaccine among the Samoan people as opposed to the Australian soldiers/sailors.[16]

Although certainly appreciated by the local civilian medical and New Zealand military staff, the fastest possible response from the ADF arrived too late to deflect the enormous disaffection felt by the Samoan people towards the New Zealand military government. Over a fifth of the Samoan population had died following the introduction of a virus that could be directly traced to Auckland. This compared poorly with the successful quarantine of American Samoa 40km away where the US Naval Base Commander stopped all direct contact with populations outside Pago Pago; American Samoa was one of the few places globally that completely escaped the 1918–1920 influenza pandemic.[18] The military governor of Samoa LTCOL Logan was relieved, and a commission of inquiry set up. The commission noted that the captain of *SS Talune* was economical with the truth when he claimed not to know that influenza was infectious.[1] The Samoan independence movement traced its beginnings to the influenza disaster in 1918. This remained a serious matter for political discussion as late as 2002 when the New Zealand Prime Minister Helen Clark apologised to Samoa for the infectious disease epidemic that had been brought to Samoa 84 years previously as a tragic mistake caused by inept and incompetent administration.[19]

Papua New Guinea Highlands Relief Mission during Influenza Pandemic 1968–69

In 1918 the large populations living in the New Guinea Highlands were unknown. Subsequent medical experience, however, showed that such socially isolated groups were vulnerable to new respiratory infections, especially influenza, which often developed into lethal pneumonia.[20] Another influenza pandemic known as the 'Hong Kong' flu began in Asia in 1968 when the virus changed its surface proteins, thus escaping neutralisation by the human immune system.[21] Public health authorities in Papua New Guinea were aware of the threat and obtained current supplies of the now efficacious influenza vaccine from Australia, but were reassured when initial reports of influenza from the lowlands were less severe than feared. Over 200 000 doses of influenza vaccine were used in preparation for the arrival of the new influenza strain, but that was not a lot compared to the total Papua New Guinea population of a few million. In 1969 the two battalions of the Pacific Islands Regiment were still under ADF control as part of the Territory of Papua New Guinea. There were three DHC-4 Caribou aircraft from No 38 Squadron based in Port Moresby with occasional C-130 Hercules missions from No 36 Squadron in Australia[16] (See Figure 3).

Figure 3: Koroba airstrip in the southern highlands of Papua New Guinea showing RAAF C-130 Hercules and DHC-4 Caribou in 1969 at approximately the same time as medical relief operations due to the influenza epidemic.

Source: James Hunter[22]

Influenza returned to Port Moresby in May 1969 and had spread into the highland areas by August. The remoteness of the highland populations with little medical infrastructure partially explains the poor outcomes that occurred. By October, the public health authorities were aware of over 1000 influenza-related deaths and knew these were only the ones that the administration had managed to count; the actual mortality was likely to be much higher. An Influenza Relief Committee was formed 20 October 1969 chaired by the Minister of Health. The next day the committee met with ADF unit commanders and began planning what became known as 'Operation Enza'. It was past the time when an influenza vaccine would have been able to stop an epidemic, so emphasis was placed on delivering medical support to remote highland areas with the goal to prevent pneumonia deaths primarily through the administration of penicillin. Initially, the mission was to establish three small field hospitals as bases of operations in the highlands and then to send out foot patrols to remote areas with serious cases being medically evacuated by light aircraft or helicopter. The Commanding Officer of the 1st Battalion Pacific Islands Regiment (PIR) was in charge of ground operations with airlift being provided by 183rd Reconnaissance Flight at Lae and three UH-1 helicopters from No. 5 Squadron then on exercises in Papua New Guinea.[16]

Each of the three contingents was based on a PIR company to which a medical officer and 15 medical assistants were added. Mendi in the southern highlands was the base of operations, which began functioning from 22 October. By 24 October, 350 military personnel were in the highlands assisting

the existing civilian medical personnel. Further medical support was determined to be required on 27 October. Six medical officers with 61 medical assistants from two RAAMC field ambulance units were deployed from Brisbane between 28–31 October. An experienced senior medical officer was the liaison officer to the primary command cell, which was based in Port Moresby. Fourteen medical patrols, each consisting of a medical orderly, radio operator, several PIR soldiers and local health personnel, were expected to travel to remote areas on foot and then treat up to 1000 people per day. Cultural attitudes limited the willingness of severely ill people to leave their villages, so most treatment consisted of injections of penicillin with few evacuations.[9, 16]

By early November it was apparent that the influenza epidemic was waning. Most of the Australian based medical personnel returned to Australia on 20 November with airlift provided by RAAF DHC-4 Caribou and C-130 Hercules aircraft. At its peak, Operation Enza involved 700 military personnel for up to six weeks in the highland areas. Approximately 3500 deaths occurred during the influenza epidemic based on official counts. Although the military support was much appreciated in Papua New Guinea as a sign of commitment to help during a crisis, the reality was that once an epidemic was large enough to cause public health concern sufficient to ask for help, there was little that could be done to ameliorate the outcome.[9, 16]

Influenza remained a medical risk to the ADF in Australia, especially in training units. In 1985 the recruit training battalion at Kapooka was closed by an influenza epidemic. Wagga Wagga's 7 Camp Hospital was over capacity with 60 additional inpatients sent to 3 Camp Hospital in Puckapunyal. Attack rates of only 1–2% were still able to strain the deployed medical facilities during Talisman Sabre 2005 and 2019. The Royal Military College's field exercise of 2006 was cancelled due to 200 cadets with influenza. Although COVID-19 has not caused any epidemics within the ADF (as of June 2020) this possibility certainly cannot be ignored as a potential threat.

Criteria and limitations for infectious disease defined missions

Even from the limited examples cited, one can see that infectious disease epidemics are less predictable that most natural disasters where the ADF might be tasked to respond. Uncertainty is the enemy of planning, but some basic principles can be derived from previous experience. In most situations, the ADF will be in a supporting role to civilian health authorities where the capabilities required are primarily transport and logistics. Situations in which the military could have the leading role might include epidemics in an active war zone where no civilian authority exists, critical incidents where the possibility of a deliberate biological agent attack cannot be ruled out, and epidemics that primarily involve military units.

A recent example is the 2015 deployment of US (engineers) and UK (medics) military forces to Liberia and Sierra Leone to assist in stopping an Ebola epidemic.[23] Although ADF help was requested to assist staffing the UK military field hospital, unlike the Irish and Canadian Armies, Australia devised a civilian response. The decision not to send any ADF members was multi-factorial, including the great distance of the epidemic from Australia and the inability of the RAAF to safely evacuate patients with highly lethal infectious diseases back to Australia. It is likely that future infectious disease epidemic responses from Australia will emphasise civilian rather than military units.

There are distinct limitations to the ADF's or any arm of the Australian Government's ability to intervene successfully in an infectious disease epidemic. Many of these limitations are biologically based, such as once an epidemic has been fully generated, effective options for prevention are limited. Quarantine is a classical public health intervention that has little role in such an interconnected world where a person can be anywhere else in the world in a single day, while asymptomatically incubating an infection. Using military units to try to enforce the isolation of Marseille in 1720 was extremely unpopular and any similar situation today is likely to be infinitely unpopular, impractical and ineffective. Expatriate medical staff make good media impact as a sign of concern and commitment, but they are not a sustainable intervention for developing countries. Advanced diagnostic capability in Indo-Pacific Region is very limited, which means new information about an infectious disease epidemic is likely to be either very limited or completely incorrect (e.g. malaria epidemic turns out to be influenza), which only adds to high levels of uncertainty. Australia has had several bad experiences with biological agents that did not behave as initially planned, such as rabbits and cane toads; therefore, strong prohibitions exist against bringing exotic infectious agents into Australia. This is especially true for veterinary pathogens that could cause tremendous economic damage even if, like foot-and-mouth disease or African swine fever, they never infect humans. One has to always be cognizant of the actual medical capacity of the ADF, which is quite limited. Medical specialists are nearly

all in the Reserve Components, and the only Active Duty specialist infectious disease unit in the ADF is the ADF Malaria and Infectious Diseases Institute at Gallipoli Barracks in Queensland. Deployment of entire ADF medical unit such as a field hospital could severely limit deployment of other ADF units depending on such support and thus compromise more traditional military missions for which there are no alternatives. Smaller ADF medical units have been successfully deployed in the recent past in the Pacific without major decrements to capability.

Possible future scenarios

A few hypothetical scenarios are worth examining to clarify one's thinking about infectious disease epidemics. Persons with fever, rash, headache and joint pains have dengue-like infections, which are caused by several viruses besides the classical dengue viruses. In a person just returned from Bangkok or Bali, dengue is a likely pathogen. Dengue can be indigenously spread by Australian mosquitoes north of Rockhampton. The economic impact of a dengue epidemic in holiday areas of Queensland would be severe, as tourists may cancel hotel bookings. Dengue introductions into Australia might also be blamed on returned military members regardless of the epidemiological evidence. In areas where the ADF have military exercises (Shoalwater Bay Training Area), fever and rash symptoms would be more likely due to Ross River Virus (RRV).[24] RRV is usually not a serious infection, except for the unfortunate few who develop chronic arthritis. RRV has another characteristic that makes it of interest to the ADF; it proved in 1978–80 that it was capable of spreading through small island nations (Fiji, Tonga, French Polynesia) due to the virus' ability to use multiple species of mosquito vector.[25] Island epidemics, when they occur, are explosive, infecting large numbers suddenly, thus incapacitating more people than would be the case for an endemic virus that has a continuous low level of transmission. Having a distinctly Australian virus incapacitate an entire Pacific Island nation has some political implications besides its medical importance.

Haemorrhagic fevers similar to Nipah or Hendra virus are rare zoonoses (disease spread from animals to humans) with a great deal of associated fear due to the high mortality rates that occur in confirmed infections.[26] Such viruses may have a social impact much higher than their actual medical importance due to the ability of various mass media to attract attention to anything that is both novel and lethal. Given social media's propensity to spread conspiracy theories and blame malignant external forces, rare natural infections may be incorrectly presented to the general public as biological weapons. Although extremely unlikely, it is difficult to rule out intentional acts in an infectious disease epidemic, especially when various terrorist groups routinely claim credit for news events entirely unconnected to them. Once the actual epidemiology of an outbreak is documented, it is usually apparent that one is dealing with a naturally occurring infectious disease, but getting to that point may not be quick or easy.

Sometimes, common infections occurring in special populations take on undue importance that may involve the military. Consider the difference in an outbreak of food poisoning in a gathering of state school teachers as opposed to one on the Prime Minister's official aircraft. Unknown fevers occurring in specific groups of Australians living in Asia could also take on importance beyond the facts of the actual illnesses. At times when officials want a quick answer to a difficult problem, they will think of the military as a ready solution. Being able to clearly state what capabilities the ADF does and does not have in such situations can help such officials come to appropriate choices when faced with news media's insistence to do something.

Conclusion

Infectious diseases are a type of threat agent that, has in the past and will certainly in the future, influence military operations. Usually, this will be an additional occupational hazard of the battlefield as with malaria during jungle operations. On occasion, however, infectious disease will become the primary focus of a military mission. If outside a zone of armed conflict, it is likely that the ADF will play a supporting role with other governmental agencies leading the response as in other natural disaster interventions. Careful thought needs to be given to regional contingencies that might be driven by changes in known pathogen (e.g. RRV) or the emergence of a completely new and unfamiliar agent (e.g. COVID-19). Although natural infections are always the most likely possibility, the ADF needs to have access to advanced diagnostic capabilities if required to rule out the intentional release of a biological agent for malign purposes. The ADF's ability to quickly deploy into difficult areas will likely be called on in the future to deal with unanticipated infectious disease problems in the Indo-Pacific Region.

Acknowledgements:

Author affiliations: Australian Defence Force Infectious Disease and Malaria Institute, Gallipoli Barracks, Enoggera, Queensland, Australia (G Dennis Shanks)

University of Queensland, School of Public Health, Brisbane, Herston, Queensland, Australia (G Dennis Shanks)

Funding: No specific funding was given for this work.

The author thanks many un-named military officers, scientists, historians and medical librarians who have unselfishly provided data and ideas for this manuscript especially the librarians at the Australian Defence Force Library at Gallipoli Barracks, Queensland. Mr John Hunter graciously provided one of the photographs.

Disclaimer: The opinions expressed are those of the author and do not necessarily reflect those of the Australian Defence Force.

Conflicts of interest: The author does not claim any conflicts of interest.

Corresponding Author: G Dennis Shanks
Authors: D Shanks[1,2]
Author Affiliations:
1 Australian Defence Force Malaria and Infectious Disease Institute, Director
2 The University of Queensland, School of Public Health

References

1. Elliot G, Wilson T, Moorhouse W. Report of the Samoan Epidemic Commission. Wellington, New Zealand: Government of New Zealand, 1919.
2. Shanks GD. How World War 1 changed global attitudes to war and infectious diseases. *Lancet* 2014;384:1699-707.
3. Coker RJ, Hunter BM, Rudge JW, et al. Emerging infectious diseases in southeast Asia: regional challenges to control. *The Lancet* 2011;377(9765):599-609.
4. Devaux CA. Small oversights that led to the Great Plague of Marseille (1720–1723): lessons from the past. *Infection, Genetics and Evolution* 2013;14:169-85.
5. Pryor EG. The great plague of Hong Kong. *Journal of the Hong Kong Branch of the Royal Asiatic Society* 1975:61-70.
6. Ali R. Nipah virus infection among military personnel involved in pig culling during an outbreak of encephalitis in Malaysia, 1998-1999. 2001.
7. Nerlich B. War on foot and mouth disease in the UK, 2001: Towards a cultural understanding of agriculture. *Agriculture and human values* 2004;21(1):15-25.
8. Anon. The RAN and the 1918-19 influenza pandemic *Royal Australian Navy: Semaphore* 2006(6).
9. Watson W, Campbell J. Operation ENZA. The military operation in support of the administration of the territory of Papua and New Guinea during the influenza epidemic of 1969. *The Medical Journal of Australia* 1970;2(10):465-8.
10. Shanks G, MacKenzie A, McLaughlin R, et al. Mortality risk factors during the 1918-19 influenza pandemic in the Australian army. *J Infect Dis* 2010;201:1880-9.
11. Shanks GD. Simultaneous epidemics of influenza and malaria in the Australian Army in Palestine in 1918. *Med J Aust* 2009;191(11-12):654-7.
12. Curson P. *Deadly Encounters: how infectious disease helped shape Australia*. Bury St Edmunds: Arena Books; 2015.
13. Rice G. *Black November: The 1918 influenza pandemic in New Zealand*. Christchurch: Canterbury University Press; 2005.
14. Shanks GD, Hussell T, Brundage JF. Epidemiological isolation causing variable mortality in Island populations during the 1918-1920 influenza pandemic. *Influenza and other respiratory viruses* 2012;6(6):417-23.
15. McLane JR. *Setting a Barricade against the East Wind: Western Polynesia and the 1918 Influenza Pandemic*. University of Otago; 2013.
16. Bullard S. *In Their Time of Need: Volume 6, The Official History of Australian Peacekeeping, Humanitarian and Post-Cold War Operations: Australia's Overseas Emergency Relief Operations 1918–2010*. Cambridge University Press; 2017.
17. Shanks GD. The 'Influenza' vaccine used during the Samoan Pandemic of 1918. Trop Med Infect Dis. 2018;3(1):17.

18. Shanks GD, Brundage JF. Pacific islands which escaped the 1918-1919 influenza pandemic and their subsequent mortality experiences. *Epidemiology and infection* 2013;141(2):353-6.
19. Helen Clark's apology to Samoa. New Zealand Herald 4 June, 2002.
20. Scragg R. Historical epidemiology in Papua New Guinea. *PNG Med J* 1977;20(3):102-9.
21. Kilbourne ED. Influenza pandemics of the 20th century. *Emerging infectious diseases* 2006;12(1):9.
22. Hunter JO. *Stone Age Moon*. ISBN: 978-0-646-93973-52015 2015.
23. Connor P, Bailey M, Tuck JJ, et al. UK Defence Medical Services Ebola Treatment Facility. *The Lancet* 2015;385(9969):685-6.
24. Hueston L, Yund A, Cope S, et al. Ross River virus in a joint military exercise. *Communicable diseases intelligence* 1997;21:194-202.
25. Aaskov J, Mataika J, Lawrence G, et al. An epidemic of Ross River virus infection in Fiji, 1979. *The American journal of tropical medicine and hygiene* 1981;30(5):1053-9.
26. Eaton BT, Broder CC, Middleton D, et al. Hendra and Nipah viruses: different and dangerous. *Nature Reviews Microbiology* 2006;4(1):23.

Art, Trauma, and PTSI: An Interview with Dr Frank Ochberg

L Abbott

Dr Frank Ochberg is a pioneer in the study and treatment of post-traumatic stress disorder (PTSD), which he believes should be renamed post-traumatic stress injury (PTSI). As his research developed, he believed that PTSI was a more relevant term. Approaching combat trauma through the lens of an injury rather than a disorder was, to him, more beneficial. In 2012, he noted that traumatised people 'tell us that they will feel less stigmatized. But they also explain how the concept of an injury, rather than a disorder, does justice to their experience. Once they were whole. Then they were shattered. When their counselors, employers, friends and loved ones behaved as though they were survivors of injuries, with lingering wounds, they could heal. When they felt like mental patients and were treated as persons with pre-existing weakness, they could not heal'.[1]

Dr Ochberg developed what he termed the Counting Method, a form of exposure therapy. After establishing a relationship based on trust, the therapist counts to 100 as the patient silently recounts their experience. Afterwards, the patient and therapist discuss what has occurred. Dr David Van Nuys notes that 'it has been Dr Ochberg's experience that through this sort of procedure, patients will recall forgotten aspects of their trauma experience that help maintain PTSD symptoms. Through the recall process, some of the intensity of the PTSD symptoms are reduced'.[2]

He received his BA from Harvard and his MD from Johns Hopkins. From 1969 to 1979 he held numerous positions in the National Institute of Mental Health, including serving as Associate Director. Following this, he became director of the Michigan Department of Mental Health for three years. At present, he is a clinical professor of psychiatry at Michigan State University. He was honoured with the Lifetime Achievement Award from the International Society for Traumatic Stress Studies, of which he was a founding board member. In addition to his work with veterans, Dr Ochberg founded the Dart Center for Journalism and Trauma in order to work with war-zone journalists who suffer from PTSI.

In 1993, he was instrumental in starting Gift from Within,[3] an organisation which offers support to trauma survivors. The website provides information not just for war veterans but for anyone who has suffered from trauma. He is also medical advisor to Honor for All,[4] a group that seeks recognition of the invisible wounds of war. He has co-edited three books on trauma and is the author of over 100 articles relating to various aspects of traumatic stress. Most recently he appeared in the documentary To Be of Service (directed by Josh Aronson, 2019), which chronicles the use of service dogs as a way of reducing PTSI symptoms.

Ochberg is not an art therapist, but sees that art can be a valuable strategy in understanding the inner world of the client. Art can be a method of reframing one's experience and bringing the experience out in a concrete form. Overall, Ochberg's philosophy is to 'create a collaboration with the trauma survivor, travelling alongside one another, walking back to the scene together, re-experiencing it together, encouraging a sense of shared humanity during that walk. Post-traumatic therapy should be individualized, not routinized'.[5] Art in various forms can be part of individualised therapy.

At 80 years young, Dr Ochberg's over 50-year career continues with no loss of energy and enthusiasm and desire to help those with PTSI. He offers a unique perspective on the treatment of combat trauma. I spoke with him in September 2019, as part of a larger project on trauma and the arts.

Larry Abbott: You've noted that PTSD therapy was in contrast to other therapies in that it's about making the all too conscious memories into tolerable, manageable memory that can be accepted, carried, shared, respected. Can you develop that thought?

Frank Ochberg: Yes. There are psychoanalysts whose theories and whose practice is derived from Freud and from others from that era. And what they're accustomed to doing, and doing rather well, is help neurotic people who might be compulsive, might be depressed, might be anxious. These people have wounds from childhood that weren't necessarily what we would call traumatic, but they're stuck in those places. The analysts work by bringing dreams to light, by assuming that certain feelings end up getting projected onto the analyst. It's a long process

with free association, to get past the defences that suppress painful memory. Patients end up recovering repressed memories that happened decades and decades ago. But what we're talking about are more recent and blatant traumas, major, obvious traumatic events and their impact is very different. As I visualise it, the brain is shocked. It goes into a very different mode, and it doesn't come out of that mode for at least a month. And it could be much, much longer than that. My job, as the psychiatrist working with people who have PTSI injury symptoms, is not to go back to their childhood. That's really irrelevant.

My job is to help them come to terms with what happened and with the lingering effect of what happened and have them develop an ability to have normal memory, rather than trauma memory; to turn off their alarm system, and to recover a certain ability to have positive emotions, which they've lost. And when they begin to recover from one part of PTSI, the other parts start coming back and they are free to have friendships. They can come to their daughter's christening, or their son's bar mitzvah, or a family holiday and not feel as though they are bringing a black cloud onto everybody else.

So it's really is a different theory. It's a different approach. As you know, I've written about the way I do treatment for this condition. It's not that of a formula, but it does mean paying attention to all the dimensions.

LA: Let me ask you this. Are there biological and physiological aspects to combat trauma?

FO: Absolutely. When we first created a diagnosis back in the late 70s and published it in 1980, we had no idea how the science would illustrate what we were finding. But since then, we've learned some things about brain anatomy and brain physiology. For example, there is the part of the brain, the amygdala, that is like a power station that sends out signals to get the whole body into alarm mode.

It helps change the blood flow and the effectiveness of the large muscles and the ways your eyes work to focus on what's right in front of you and let the background blur. You are moved into a situation where you can fight for your life, or you can flee for your life. We know that when you are stuck with this condition for months and months, you have an erroneously hot amygdala. It's placing you in a state of lethal alarm, and it doesn't do you any good to be in that state.

By the way, the Special Forces, the people who are very good at handling lethal threats, their bodies bring them back to normal very quickly. It's been shown in scientific experiments that the people who are highly adapted to handling high stress have a capacity to have these brain changes and body changes that equip them for lethal encounters. But then they come back to normal very, very rapidly.

LA: Are you saying that the biological or physiological effects can be reversed?

FO: Well, I'm saying that as the condition improves, these anatomical and physical components are restored to normalcy. In a way, it's the chicken and the egg. It's a circular thing.

A person going through recovery from their circumstance has their brain normalise as a sense of their self normalises. It goes together. There's another very significant part here, and that is that the frontal part of the brain, which is where our reflexes for being socially appropriate lie. That part seems to detach from the central parts of the brain that are placing us into a fight or flight mode.

There's another part of the brain called the hippocampus. It's a small structure near the amygdala, and that part seems to actually get smaller in most cases of this condition. If it's somewhat smaller to begin with, you have a greater chance of developing PTSI.

There's more and more data that gets discovered as this highly scientific research goes on. What I keep pointing out is that PTSI is real. This is not just in somebody's head. It's as real as having diabetes or having atrial fibrillation. There is an organic change. We're learning more and more about it. It helps to have medical doctors appreciate the condition and treat it.

LA: You're not in favour of the term PTSD. You are for renaming that PTSI. Can you explain that a little?

FO: Yes. I did write an essay for one of the military journals about this.[6]

Several Vietnam Veterans convinced me. I joined their campaign. I'm the medical advisor of Honor For All. We've been successful in getting a majority of the states of the United States to raise the flag and have a ceremony on what these states are now calling PTSI Awareness Day instead of PTSD Awareness Day.

The term 'disorder'—maybe it shouldn't be—but the term 'disorder' is stigmatising. Who wants to say 'I am disordered', when you can say, 'I'm injured. I have an injury, and it's an honourable injury'? In Canada, you can get a medal, a Sacrifice Medal, for this very same combat stress injury that we call PTSD. So they've gone a little bit further to get it considered

an honour rather than an insult by calling it an OSI, operational stress injury. Of course, I'm for that.

LA: Are you connecting this, or is this related to, moral injury that Nancy Sherman writes about, for example?

FO: I know Nancy, and she's written a good book explaining moral injury. But we really ought to credit Jonathan Shay, because Nancy did pick it up from Jonathan Shay. According to Shay, moral injury goes back to the Peloponnesian Wars. It's something that Achilles experienced when he was betrayed by his king. You need a sense of support and honour to risk your life for something you believe in. And when what you believe in has been dirtied and damaged and insulted, the result isn't PTSI. It's something else that's even more profound. It's a loss of a sense of meaning. It's beyond a physical or a psychological wound. It's worse than that because it destroys what you're all about and what you're going to risk your life for.

There's a different definition of moral injury, developed by Brett Litz, and this is when you, yourself, do something that conflicts with your deepest beliefs. So the sergeant orders you to drive like hell from one place to another. And there's a civilian in the road, and you have no choice. You run that person over not because the sergeant was being unethical, there was just a higher value on doing what the military unit had to do. But in doing it, you violated your own sense of what is right. It's a different kind of a moral injury.

LA: You've worked with Vietnam Veterans and the veterans of today. Do you see a difference between the Vietnam Veteran and the current Iraq/Afghanistan Veteran?

FO: Not really. I mean, they're a different generation, but what I'm tuned into are the similarities. I try to help that person explain his or her situation to me and articulate it in a way that they believe has gotten across to me, and I just have a conversation with them about it. I am helping them find their way back from feeling diminished, violated, having violated their own principles. And I don't do it in some glib way like saying, 'Oh, it's not that bad'. I never do that. But I do give them a chance to figure out why they are punishing themselves, and a chance to work on very straightforward things like insomnia. You know, solving that problem is terribly important. People in my field learn various ways to do that. Some do involve medication.

Sometimes, it's just as important to keep a little journal when you're falling asleep. And rather than stay awake ruminating about what's going to keep you awake, you're going to deal with it in the morning. You've written it down before you fall asleep. You get into the habit of handling your obsessive thoughts or your anxious thoughts in the morning, rather than in the evening. It helps. There are a lot of tricks of the trade, and they're important, too. But I really want to get into what brings us together now. It's the ghost, the idea that something haunts you. There may be a way of dealing with what haunts you that has far more to do with poetry and art than with psychiatry.

LA: You mention in your essay that you want to reframe the traumatic memory and minimise or eliminate the discomfort from those memories. Do you see that art and writing are methodologies or ways to reframe or transform traumatic memory?

FO: To reframe it, but also to explain it and to bring it to somebody else. I've written a few poems, and I do want to share them with you. Maybe not right during this conversation. One of them has been put to music recently by a colleague who is a singer/songwriter and a therapist. It was premiered at a dedication at a veterans' park a few weeks ago. I feel like I'm in this with you where we really have to use every tool in the box. The historic tools involve art and poetry much more than psychiatry.

The artists put into some form an experience so that others can see it and resonate with it. They do not do this in a dry, academic way. Sometimes the experience that's being transmitted from the veteran to the civilian who needs to know is shocking. And it's meant to shock. The soldier who has been so deeply aggrieved by the death of his friend in arms, that soldier needs to find a way of having somebody else appreciate and understand it.

Let me tell you about the Marine Veteran who I've worked with just last month. His high school friend and he were in the unit together. The friend died and he happened to have the same first name as I do. Ben was calling for air evacuation as he's holding Frank, and Frank is screaming. And Ben's last words to Frank are, 'Shut the fuck up, Frank'. We can chuckle at it now, but imagine dreaming, night after night, of yourself saying, 'Shut the fuck up', to someone whose life you're trying to save. However, it all happened between Ben and me, I know that he got his feelings across to me and that mattered a lot to Ben, and it helped his nightmare to stop.

LA: It seems to me that art is a way to objectify the experience, take it out of the mind where it might be tormenting the person. I thought of TS Eliot's idea of the objective correlative, bringing thoughts and

feelings out into 'the public', like with trauma masks. Melissa Walker works with veterans to create masks which express their experience that they could not express in words. The masks are like a doorway into further discussion. The veteran can then talk about the mask as an objective item, and then explore how the mask came about, what the masks represent. The mask reveals those mental states.

FO: Sometimes, those masks can be horrifying. What is it about a mask? It's an altered face that you can put on your own face. I'm not sure that objectifying is the right word, but it might be. The mask is an object, but what's going through your brain is not an object. It's a lot of horrifying distortions.

LA: The distortions can be transformed into the artwork, whether it be a mask or a painting or a poem. Regina Vasquez takes old uniforms and turns them inside out and writes her story on the uniforms and hangs them up in a gallery. She calls them 'Fatigues Clothesline'. The viewer walks through the exhibit, reading her story on the old fatigues. There are different formats that veterans are using to deal with their experiences.

FO: I'm thinking as we're talking. Is it a distortion if what it really is something from inside the machine of the mind? We create and recreate reality out of our neurons and our brain biochemistry. What is a thought? It's so complicated. Ten billion neurons and so many different connections. That's our brain, and the brain can do strange things.

LA: The neurons have been disturbed by the trauma?

FO: Yes. Yes, absolutely. Now, it's a different, very literal kind of injury when you have a bullet fragment in the brain. If it doesn't kill you, it's a shock and your brain is shaken and damaged, that's a TBI. That's a traumatic brain injury. That's not a PTSI. They overlap, and we are talking about injuries, and then recovery from that injury, sometimes not full recovery, but you can have a wonderful adaptation to an injured brain, just like Max Cleland had a wonderful adaptation to being a triple amputee.

He becomes the Secretary of the VA and a fantastic senator. I'm privileged to have met that man. Maybe it's also that the gifted veteran poet and the gifted veteran artist can make something out of what is inside them, and they pass it on for our benefit. We appreciate their service, their suffering, their resilience, and the fact that they're still part of us collectively. I had a phrase in one of the essays that I wrote, I didn't realise that it would have an impact, but it's that some of us keep horror alive for the rest of us. That's important. And if you can put it into a poem, as Sassoon and Owen and Brooke did for World War I, that's alive for the rest of us.

LA: I think of some of the artists from that time, like Claggett Wilson and George Bellows, and a hundred years later, writers and artists are doing the same thing.

Ron Whitehead is a Desert Storm Veteran who's an art teacher in New York State. He told me 'I put into my photographs what I cannot say in words'.

Art and literature, maybe more the visual arts, are ways that the veteran is trying to explain or show his or her 'condition', let's say.

FO: Well, yes. And in addition, what it can do is it can evoke something in the receiver. We're not all going to look at a piece of art the same way. I don't think we're going to respond to a poem in exactly the same way. That's the beauty of it. If it's good enough to be curated and in a major museum, or it's good enough to find its way into an anthology, that means it is reaching thousands if not millions of people. It's causing us to have a profound experience. It's encouraging to think about combat vets who become artists and teachers and honest purveyors of difficult truths. It is one thing to tell a personal experience. It is another and more difficult task to evoke accurate understanding when words are not enough. That's the irony of PTSI. It fills a person with experience that begs to be given to others at the same time that it freezes feelings and silences speech. It's not the same as a dictionary definition of 'trauma' by a longshot.

I like to think of myself as having a slightly different non-traditional academic place in this field. I've written my share of academic articles, but that's not what I'm invested in doing anymore in my life. I love that I have a chance to interact with journalists, with women veterans, with artists, with you. Look at what we're talking about. We're going to reach people in a different way. Our goal is to increase public understanding. Even more than that, an appreciation for the impact of these events on people who've suffered through them.

LA: In an interview with Jon Stephenson, you talked about the idea of alienation.7 I think that art and literature can reduce that sense of self-alienation.

FO: Absolutely. That's so important. But let's think a little bit about why that alienation happens. There's often been that moral injury. It's so profound when a piece of you that has been hurt… it's hard to put into words. It's your core sense and beliefs. Those can get shaken. It's a loss of self.

I worked with Terry, a Vietnam Vet, for a long time. Terry was very, very religious. I am not religious in a traditional sense. I'm poetic and spiritual perhaps, but Terry and I were going through his loss of ability to have positive feelings. We're talking about feeling God's love, and he wasn't feeling that. And then all of a sudden, he realises it's not that God isn't loving him, it's that he has PTSI, so he can't feel the sensation of love. And he leaps up, and he gives me a big hug, and he said 'Frank, you restored my faith and you don't even believe in my faith'.

It wasn't that I restored it, but we got into it together. I'm just beaming thinking about this. He's dead now, but in his world, he's in a happy place. He learned how to love, and he learned how to feel loved. That was part of what we were working on. I helped him have a colour wheel of positive emotion. It wasn't artwork, but it was related in a way. It was giving colours and symbols for all the different ways of feeling good, from a very bright joy to a very mellow, blue tranquillity to red for love and purple for spiritual love.

LA: So you would say, just to wrap up, that you see hopeful signs in the treatment of PTSI?

FO: Absolutely. Oh, very hopeful signs. And it's from all different parts of our human community. It's not that only the doctors are doing it. We don't do it alone because, my goodness, trauma, shattering trauma, humiliating trauma, devastating trauma, individual trauma, group trauma, you don't get through life without some of that. And you don't get restored to your own humanity by pills alone.

References

1. Ochberg F. An Injury, Not a Disorder. Dart Center for Journalism and Trauma. 2012 Sept; p. 1. https://dartcenter.org/content/injury-not-disorder-0
2. Van Nuys D. An Interview with Frank Ochberg, MD, on Post-Traumatic Stress Disorder (PTSD). Gulf Bend Center/Methodist Health Care Ministries of South Texas, Victoria, TX, p. 1. https://www.gulfbend.org/poc/view_doc.php?type=doc&id=28780
3. https://www.giftfromwithin.org/
4. http://www.honorforall.org/home/
5. Personal communication with Dr Ochberg, February 13, 2020.
6. Ochberg F. An Injury, Not a Disorder, Military Review, 2013 March–April. https://www.armyupress.army.mil/Portals/7/military-review/Archives/English/MilitaryReview_20130430_art014.pdf
7. Stephenson J. Veterans and Traumatic Stress Disorder: A Conversation with Dr Frank Ochberg. PsychCentral, 2018 Oct; pp. 1–2. https://psychcentral.com/lib/veterans-and-post-traumatic-stress-disorder-a-conversation-with-dr-frank-ochberg/

Training War-Time General Surgeons in a Peace-Time ADF

K Bender, A Pearson

Introduction

Until as recently as the second Gulf War, the skill sets of civilian general surgeons were readily transferrable into military surgical practice. The modern Australian Defence Force (ADF) faces an evolving issue where this is no longer the case. Civilian surgical practice has evolved rapidly, with newly qualified general surgeons possessing a skill set that is largely incongruent with the ADF's requirements. As senior surgeons retire from military service, the ADF must explore avenues to recruit suitable clinicians and ensure they are adequately trained in the technical operative skills required for military service. This 'view from the front' outlines a problem that has developed outside of the ADF's control and proposes a variety of possible solutions.

Civilian training

Training of general surgeons in Australia is governed by the Royal Australasian College of Surgeons (RACS) and delivered by General Surgeons Australia (GSA). College requirements of general surgery trainees must be met before receiving a Fellowship of the College (FRACS). These requirements include completing:

- the Generic Surgical Sciences Examination and Clinical Examination (required to enter training)
- eight six-month rotations through various surgical disciplines
- 800 'major' operative cases, being the primary operator for 335
- 100 gastroscopies and 50 colonoscopies
- prescribed courses and research
- the fellowship examination.

Through these requirements, RACS and GSA achieve their respective missions to be 'the leading advocate for surgical standards, education and professionalism in Australia and New Zealand', and 'to ensure the provision of high-quality, comprehensive General Surgical services, including emergency and planned services, to the Australian community'.

This training continuum is highly effective at meeting its self-identified mission. The result being a well-qualified general surgeon who is suitable for civilian surgical practice.

The problem

The core problem facing the ADF general surgical capability is a progressive divergence of the civilian surgical skill set from that required on deployment. While evidence shows that injury patterns have changed in modern conflicts, the basic skills required of the military surgeon remain unchanged. A military general surgeon must be capable of managing major bleeding, trauma of the head, thorax, abdomen, pelvis and limbs, and severely contaminated wounds. Furthermore, they must also manage the breadth of non-traumatic emergency surgical presentations without the aids of laparoscopic or endoscopic equipment, interventional radiology or the assistance from a range of subspecialists available in civilian tertiary centres. This is especially true when the general surgeon is deployed to a Role 2 or forward surgical facility.

In the civilian sector, the recently qualified general surgeon specialises in minimally-invasive approaches, endoscopy and surgical oncology. There is an appropriate reliance on subspecialty and multidisciplinary teams for patient management in both elective and emergency situations. Diagnostic tools have become cheaper, faster and more readily available. Surgical trainees are now accustomed to using, and often relying on, advanced diagnostic imaging, which may not be available when deployed, especially in more forward locations.

Essentially, the pool of general surgeons available for recruitment and deployment are clinically less suitable than they have ever been in history. Civilian healthcare is under constant evolution to improve outcomes and decrease morbidity. The presentation of surgical disease has also changed with earlier detection of cancers allowing less, or non-invasive, curative interventions. Medical treatment of disease has resulted in fewer patients relying on surgery for cure, peptic ulcer disease being a prime example.

Advances in civilian surgical care have resulted in the skill sets required of civilian general surgeons diverging dramatically from those required in the deployed setting.

In order to achieve its aims, RACS has actively assessed and adapted to the changing environment. The ADF must adapt accordingly. Since federation, the ADF has been able to rely on general surgeons from civilian hospitals who are clinically suitable for military service. The general surgical workforce trained in the open era is now retiring and being replaced by surgeons trained almost exclusively in a laparoscopic, minimally invasive and subspecialist environment. Unfortunately, the ADF can no longer rely on the GSA training pathway to provide suitably trained general surgeons for military service.

The ADF has traditionally understood the requirement for bespoke training to acclimatise predominantly civilian trained professionals to the military system. Accordingly, basic officer training and preparatory exercises take place prior to deployment on war-like operations. The ADF has not previously endeavoured to institute a training continuum to address technical skill deficiencies faced by the general surgeon. Historically, this has not been required as the clinical skills of recruited surgeons closely mirrored those required by the ADF on deployment. Unfortunately, a significant gap between the product of civilian surgical training and the demands of military practice has developed. In order to continue to deliver high-quality battlefield surgery to sick and injured ADF members, the ADF must develop robust mechanisms to address general surgical skills deficiencies. Lateral thinking and an innovative approach are required to achieve this aim.

Possible solutions

Six different strategies available for training general surgical specialists in the ADF are presented and summarised in Table 1.

1. Domestic courses

ADF general surgeons must complete the Early Management of Severe Trauma (EMST), known internationally as Advanced Trauma Life Support (ATLS). The Definitive Surgery Trauma Care (DSTC) course is recommended, however, not mandated. The Anatomically Based Surgical Exposures for Trauma (ABSET), known in the USA as the Acute Surgical Skills for Exposure in Trauma (ASSET), is a valuable course and new to Australia. These courses are a good starting point for developing a basic trauma surgical skill set, and the DSTC offers a valuable additional military module.

2. International courses

The Surgical Training for Austere Environments (STAE) Course is a civilian course offered by the Royal College of Surgeons that would help bridge the gap between civilian and military practice for ADF surgeons. Both the British and US military have developed specific courses for health specialists to aid in addressing the training deficiencies outlined previously. The US Emergency War Surgery Course (EWSC) and the UK Military Operational Surgery Training (MOST) are valuable courses potentially available to ADF general surgeons. It may prove worthwhile to develop relationships with these courses to increase ADF participation.

Table 1: Strategies for training health specialists in the ADF

	Training Courses	Civilian Placement	Military Activities
Domestic	EMST DSTC ABSET	College Training Programs Skill Maintenance CPD	Exercises War
International	STAE (UK Civilian) EWSC (USA Military) MOST (UK Military)	USA UK South Africa South Pacific	Deploying with allies at war

EMST = Early Management of Severe Trauma, DSTC = Definitive Surgical Trauma Care, ABSET = Anatomically-Based Surgical Exposure for Trauma, CPD = Continuous Professional Development, STAE = Surgical Training for Austere Environments, EMSC = Emergency War Surgery Course, MOST = Military Operational Surgical Training

Alternatively, the ADF may consider developing a bespoke program domestically, using these courses for inspiration. The economics of such a venture on an ADF scale would need to be considered and compared to utilising courses that already exist overseas.

3. Domestic civilian clinical placement

The domestic civilian workload is a mainstay of the current ADF model for preparing general surgeons for deployment. The ADF relies on the civilian sector to train and maintain currency in deployable general surgeons. All ADF full- and part-time specialists maintain their skills and accreditation through civilian practice and CPD programs.

The main advantage of this model is that it is widely available and carries minimal cost to the ADF. The main disadvantage, outlined above, is that the civilian sector exists to meet civilian demands, not those of the military.

4. International civilian clinical experience

ADF general surgeons would likely benefit from clinical experience in international high-volume trauma centres. Australian general trauma surgeons often aspire to work in the USA; however, recent reports and first-hand anecdotal accounts suggest that there are not enough opportunities for the USA's own military surgeons to prepare for combat in these centres.

Countries such as South Africa may offer a significant opportunity to operate on penetrating trauma cases; however, issues surrounding accreditation and personal risk to ADF members would need to be addressed.

Closer to home, there may be opportunities to engage with our near neighbours. The Pacific Islands potentially provide mutually advantageous clinical opportunities that may also have strategic benefits in keeping with the Pacific Step-Up policy. Ethical and logistical challenges would need to be addressed to ensure suitability and sustainability; however, these issues are not insurmountable.

5. Australian military activities

While war itself is the best preparation for military general surgeons, in peacetime, military exercises provide important training. Participation in exercises provides our surgeons with familiarity with field hospital equipment, the field environment and basic military skills. Important training for the hospital system and its staff during HospEx and other simulation-based activities is also achieved. However, it must be emphasised that there is limited technical clinical training of our medical specialists during these activities. The individual services have begun to address this issue. Exercise Abbeville conducted by 3HSB is designed to enhance the knowledge base of specialist clinicians. The RAAF's proposed funding model, allowing reservists to attend clinical activities to enhance their military capability and the Navy's Project HELM (Health Education Learning Matrix) to train teamwork skills, also demonstrate a willingness to address the problem we have articulated.

6. International military activities

Our deployed allies, especially the USA, are regularly reporting issues with burn-out and over deployment of their surgical specialists. Opportunities to augment their teams with ADF surgeons may present themselves. Ongoing participation in war-like operations is probably the best way to avoid the so-called 'Walker Dip', named after Surgeon Vice Admiral Alasdair Walker RN. Vice Admiral Walker described the natural tendency to forget the lessons of each conflict during peacetime, only to have to learn them again the next time around. Of significant concern is that the next generation of general surgeons may possess a skill set that is simply too far removed from that required in the deployed environment. It is feared that this cohort will be unable to learn these lessons rapidly enough to prevent catastrophic outcomes for our next cadre of wounded warriors.

Conclusion

The issues identified in this article have occurred outside the ADF's control. Despite this, the ADF must look for solutions and work towards addressing the aforementioned training deficiencies identified. Previously, the ADF has relied on individual specialists rectifying relatively small deficiencies in their skill set to complete their clinical repertoire prior to deployment. These deficiencies have become systemic and significant, and a modern, professional ADF must work towards their resolution. The ADF would never allow civilian pilots to fly fast jets having upskilled themselves in their own time and declared themselves ready to go. It is unacceptable to allow general trauma surgeons, ultimately responsible for the lives of our injured troops, to use that model in the future.

The solution may involve specific high-yield clinical placements, a portfolio of courses and/or coordinated

rotation of specialists through worthwhile military activities with training value for specialists' clinical skill development. As clinicians, we must help the ADF develop a robust training system aimed at bridging the civilian-military divide. In doing so, the ADF will be able to recruit, retain and better prepare our military general surgeons and other specialist craft groups. Consequently, the ADF will be able to provide the care that our wounded soldiers, sailors and airmen expect and deserve.

Corresponding author: K Bender
Authors: K Bender[1,2], A Pearson[1,3]
Author Affiliations:
1 ADF Medical Specialist Program
2 2GHB, Australian Army
3 Health Services Wing, Royal Australian Air Force

Disparities in Cigarette Use and Heavy Episodic Drinking Among Older Veterans and Nonveterans

J McDaniel, D Albright, M Torabi

Abstract

Background: Little assessment data on cigarette use (CU) and heavy episodic drinking (HED) among older military veterans is available for local health education program planning.

Purpose: The purpose of this study was to estimate the prevalence of CU and HED among older veterans and nonveterans at the local level, as well as to determine if local area urbanicity was associated with CU and HED prevalence.

Material and methods: Small area estimation methodology was used with 2017 Behavioral Risk Factor Surveillance System (BRFSS) data to estimate the prevalence of CU and HED among veterans and nonveterans older than 64 in 136 metropolitan and micropolitan statistical areas (MMSAs).

Results: Across 136 MMSAs, older veterans had higher CU rates compared to nonveterans (Mveteran = 9.56%, 95% CI = 9.15–9.97; Mnonveteran = 9.24%, 95% CI = 8.84–9.63; Cohen's *d = 0.13) and higher HED rates (Mveteran = 4.68%, 95% CI = 4.52–4.84; Mnonveteran = 4.08%, 95% CI = 3.94–4.22; Cohen's d = 0.67), although variation was observed across MMSA types.*

Conclusion: Health educators should consider geographic disparities when developing and implementing health education programs for older veterans.

Keywords: cigarette smoking; heavy drinking; veterans; health education

Conflict of Interest: The authors have no conflicts of interest to disclose.

Introduction

Nicotine and alcohol constitute the two most heavily used substances among United States military veterans.[1] The rate of heavy episodic drinking (HED) among older (aged ≥ 65 years) veterans (i.e., individuals who have served on active duty in the United States Armed Forces) is higher than among older nonveterans (approximately 5% vs 3%, respectively).[2] Similarly, the rate of cigarette use (CU) among older veterans (approximately 21%) is higher than among older nonveterans (approximately 17%).[3] CU and HED are associated with early mortality.[4, 5] Knowledge of differences in these outcomes among veterans across local areas—below the national level—is limited.

We hypothesised that health-harming behaviours are more prevalent among veterans than nonveterans at the local level. The aims of this paper are threefold: (1) to model the prevalence of CU and HED among older veterans and nonveterans at the local level; (2) to validate modelled rates for CU and HED; and (3) to determine whether CU and HED rates differ between metropolitan and micropolitan areas (MMSAs). A better understanding of where CU and HED are most prevalent could assist in the development of geographically targeted interventions leading to use reduction of cigarettes and alcohol and subsequent lifespan increases for veterans.

Methods

Data collection

We obtained data from the 2017 Selected Metropolitan/Micropolitan Area Risk Trends (SMART) Behavioral Risk Factor Surveillance System (BRFSS) dataset (i.e., the most current dataset at the time of writing), which provides health information for participants in MMSAs with samples ≥500.[4] A metropolitan statistical area is an area of 50 000+ inhabitants, while a micropolitan statistical area is an area of 10 000–49 999 inhabitants. Metropolitan

divisions include ≥2 500 000 inhabitants. Appendix A provides a list of areas included in the dataset. The dataset contained 230 875 observations upon download. After removal of missing data on the measures described below, the final sample included 202 739 individuals. We also obtained population data from the US Census Bureau for each of the MMSAs included in the SMART BRFSS dataset.[5] Details regarding how these two datasets were combined are given below.

Measures

Dependent variables of the present study are CU and HED. Current CU was determined by a BRFSS calculated variable (0 = no CU, 1 = current CU). HED was determined with the following question: 'Considering all types of alcoholic beverages, how many times during the past 30 days did you have 5 or more drinks for men or 4 or more drinks for women on an occasion?' Respondents who reported at least one HED episode were categorised as a current heavy episodic drinker.

The following covariates were selected for our analysis: age (0 = 18–64; 1 = 65+), sex (0 = male, 1 = female), race (1 = white, 2 = black, 3 = other) and military status (0 = no military experience, 1 = military experience). We obtained unique MMSA codes so as to discern the geographic location of each respondent. Each respondent's MMSA was further defined thusly: (1) metropolitan division; (2) metropolitan statistical area; and (3) micropolitan statistical area.

Data analysis

This study was considered exempt from review by an institutional review board because the data were deidentified and publicly available. In order to accomplish Aim 1, we employed small area estimation (SAE) methodology[6]—that is, probabilities from BRFSS predictive models were post-stratified onto Census demographic population counts to derive area-specific prevalence estimates. Our unit-level models were estimated with survey-weighted, generalised linear mixed regression equations, each of which contained MMSA random effects. Fixed effect covariates in these models were selected to match Census pre-tabulated population count categories. To the extent that we were interested in the health behaviours of older veterans, we included an interaction term for age and military status—allowing us to discern the unique probability of senior citizen CU and HED. Empirical best predictor (EBP) probabilities of CU and HED for older veterans and nonveterans were applied to Census population counts in each MMSA in order to develop modelled rates.

To accomplish Aim 2, we estimated Pearson correlation coefficients of relationships between modelled estimates and direct survey estimates. Direct survey rates, that is, prevalence rates based on observed survey data, were developed for MMSAs with at least 50 individuals who exhibited the following characteristics: aged 65+ years and military experience. Our screening of MMSAs revealed that 19 of 136 MMSAs did not meet the inclusion criteria. These MMSAs were dropped from the validation analysis.

To accomplish Aim 3, we calculated the average modelled CU and HED rates among older veterans and nonveterans, separately. We categorised these estimates by MMSA type. We developed 95% confidence intervals for each of these point estimates.

Results

The weighted rate of CU for the entire sample was 14.90%. The weighted rate of HED for the entire sample was 6.16%. Results pertaining to our first aim are shown in Table 1. In the CU and HED models, older individuals were less likely to respond in the affirmative to the dependent variable. While females were less likely than males to report CU, no sex differences were observed for HED. Veterans were more likely to smoke and engage in heavy drinking than nonveterans. While no racial differences were observed in the CU model, blacks and other race individuals were more likely than white individuals to report HED.

Probabilities of CU and HED were computed from the models presented in Table 1. All modelled prevalence rates for each MMSA are given in Appendix A. Modelled older veteran CU rates ranged from 2.3%–16.6% and HED rates ranged from 1.6%–7.3%. For older nonveterans, modelled CU rates ranged from 2.2%–16.1% and HED rates ranged from 1.4%–6.5%. Across 136 MMSAs, in the aggregate, older veterans had higher CU rates compared to nonveterans (Mveteran = 9.56%, 95% CI = 9.15–9.97; Mnonveteran = 9.24%, 95% CI = 8.84–9.63; Cohen's *d* = *and higher HED rates (Mveteran = 4.68%, 95% CI = 4.52–4.84; Mnonveteran = 4.08%, 95% CI = 3.94–4.22; Cohen's d = 0.67).*

Modelled rates of CU and HED in 117 MMSAs were similar to direct estimates (Aim 2), indicating that the modelled rates were reliable. Regarding CU, correlations between modelled and direct estimates were as follows: total older adult prevalence (r = 0.73, 95% CI = 0.63–0.80), veteran prevalence (r = 0.44,

Table 1 Results of weighted generalised linear mixed models of current cigarette use (CU) and heavy episodic drinking (HED), SMART BRFSS 2017, N = 202 739

	Current cigarette use				Heavy drinking			
Variable	b	AOR	95% CI Lower	95% CI Upper	b	AOR	95% CI Lower	95% CI Upper
Fixed intercept	-1.42	0.24	0.23	0.26	-2.55	0.08	0.07	0.08
Age	-0.75	0.47	0.46	0.50	-0.56	0.57	0.54	0.61
Sex	-0.21	0.81	0.79	0.83	-0.01	0.99	0.95	1.03
Military status	0.17	1.18	1.13	1.24	0.19	1.20	1.12	1.30
Race								
White	Ref				Ref			
Black	0.03	1.03	0.99	1.08	-0.58	0.56	0.52	0.60
Other	-0.04	0.97	0.92	1.01	-0.40	0.67	0.62	0.72
Age x Military status	-0.27	0.76	0.70	0.84	-0.07	0.94	0.82	1.07
Random effects								
MMSA Intercept variance	0.10				0.07			
MMSA Intercept SD	0.32				0.26			

Note. Ref = Reference category. AOR = Adjusted odds ratio.

Table 2 Mean prevalence rates for current cigarette use (CU) and heavy episodic drinking (HED) among older veterans and nonveterans by metropolitan and micropolitan statistical area (MMSA), SMART BRFSS 2017, N = 202 739

	Current cigarette use prevalence				Heavy drinking prevalence			
MMSA	M	95% CI Lower	95% CI Upper	Cohen's d*	M	95% CI Lower	95% CI Upper	Cohen's d*
Metro division (n = 17)								
All older adults	7.41	6.44	8.37		4.08	3.77	4.39	
Veterans	7.62	6.63	8.62		4.58	4.22	4.94	
Nonveterans	7.36	6.40	8.32	0.13	3.98	3.68	4.27	0.87
Metro area (n = 113)								
All older adults	9.54	9.11	9.97		4.23	4.06	4.39	
Veterans	9.80	9.36	10.25		4.70	4.52	4.88	
Nonveterans	9.47	9.04	9.90	0.14	4.10	3.94	4.26	0.64
Micro area (n = 6)								
All older adults	10.23	9.16	11.31		4.18	3.47	4.89	
Veterans	10.52	9.42	11.63		4.60	3.82	5.37	
Nonveterans	10.16	9.09	11.22	0.27	4.07	3.38	4.76	0.58

* Cohen's d comparing veteran and nonveteran cigarette use or heavy drinking within each MMSA type

95% CI = 0.28–0.57) and nonveteran prevalence (r = 0.65, 95% CI = 0.54–0.75). Regarding HED, correlations between modelled and direct estimates were as follows: total older adult prevalence (r = 0.65, 95% CI = 0.53–0.75), veteran prevalence (r = 0.29, 95% CI = 0.11–0.45) and nonveteran prevalence (r = 0.60, 95% CI = 0.47–0.71).

Table 2 shows the results pertaining to our third aim. CU prevalence among older veterans was slightly higher than among older nonveterans in metropolitan divisions, metropolitan areas and micropolitan areas. Furthermore, for older veterans and older nonveterans, CU rates were slightly higher in micropolitan areas than in metropolitan areas and metropolitan divisions. HED rates among older veterans and older nonveterans were highest in metropolitan areas, followed by micropolitan areas and metropolitan divisions.

Discussion

We showed that slight disparities in CU and HED exist between older veterans and nonveterans. Specifically, we showed that older veterans had a higher prevalence of CU and HED than older nonveterans in 136 MMSAs. Following validation of our modelled prevalence rates with direct survey estimates, we showed that metropolitan divisions had the lowest rates of older veteran substance use.

Literature comparing CU and HED among older veterans and nonveterans is sparse. One national study showed that female veterans older than 50 years had a higher prevalence of CU than female nonveterans.[3] Regarding HED, another national study[7] found that veterans older than 55 had higher HED rates (4% vs 2%) than nonveterans; however, neither of these studies accounted for geography.

The proportion of veterans who are older than 65 will increase from 49% to 52% by 2024.[8] Given this demographic shift, and in light of the study results, targeted health education programs centred on smoking cessation and alcohol abstinence are needed. One intervention for substance abuse, which has been implemented in the Veterans Health Administration, is 'screening, brief intervention and referral to treatment (SBIRT)'. SBIRT is recommended by the US Preventive Services Task Force for CU and HED.[9,10]

Our study is limited to 136 MMSAs. Future studies would benefit from national coverage. Also, the question used to determine military service in the BRFSS did not distinguish between active duty and veterans. However, we assumed that any respondent who answered in the affirmative to the military service question and was older than 65 was a veteran.

In conclusion, we showed that rates of CU and HED were slightly higher among older veterans than among nonveterans in 2017 and that these disparities were accentuated in less urbanised areas. Interventions that screen older veterans for substance use and provide follow-up brief motivational interviews aimed at reducing adherence to adverse behaviours are needed.

Corresponding author: Justin T. McDaniel[1]
Authors: J McDaniel[1], D Albright[2], M Torabi[3]
Author Affiliations:
1 Southern Illinois University Carbondale,
2 University of Alabama, School of Social Work,
3 Department of Applied Health Science, School of Public Health

References

1. Hoggatt KJ, Lehavot K, Krenek M, Scweizer CA, Simpson T. Prevalence of substance misuse among US veterans in the general population. Am J Addict. 2017;26(4):357-365.
2. Bohnert ASB, Ilgen MA, Bossarte RM, Britton PC, Chermack ST, Blow FC. Veteran status and alcohol use in men in the United States. Mil Med. 2012;177:198-203.
3. Odani S, Agaku IT, Graffunder CM, Tynan MA, Armour BS. Tobacco product use among military veterans – United States, 2010-2015. MMWR Morb Mortal Wkly Rep. 2018;67(1): 7-12.
4. Gellert C, Schottker B, Brenner H. Smoking and all-cause mortality in older people: systematic review and meta analysis. Arch Intern Med. 2012; 172(11): 837-844.
5. Ortola R, Garcia-Esquinas E, Lopez-Garcia E, Leon-Munoz LM, Banegas JR, Rodirguez- Artalejo F. Alcohol consumption and all-cause mortality in older adults in Spain: An analysis accounting for the main methodological issues. Addiction. 2019; 114(1): 59-68.
6. Centers for Disease Control and Prevention. Behavioral risk factor surveillance system: SMART city and county survey data [web page]. 2019. Available from: https://www.cdc.gov/brfss/smart/Smart_data.htm

7. United States Census Bureau. American community survey. 2019. Available from: https://www.census.gov/programs-surveys/acs
8. Rao JNK, Molina I. Small area estimation (2nd ed.). Hoboken, NJ: Wiley; 2015.
9. Pemberton MR, Forman-Hoffman VL, Lipari RN, Ashley OS, Heller DC, Williams MR. Prevalence of past year substance use and mental illness by veteran status in a nationally representative sample. 2016. Available from: https://www.samhsa.gov/data/sites/default/files/NSDUH-DR-VeteranTrends-2016/NSDUH-DR-VeteranTrends-2016.pdf
10. Amaral EFL, Pollard MS, Mendelsohn J, Cefalu M. Current and future demographics of the veteran population, 2014-2024. Pop Rev. 2018;57(1):1-60.
11. United States Preventive Services Task Force. Alcohol misuse: Screening and behavioral counseling interventions in primary care. 2013. Available from: https://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/alc ohol-misuse-screening-and-behavioral-counseling-interventions-in-primary-care
12. United States Preventive Services Task Force. Tobacco smoking cessation in adults, including women: Behavioral and pharmacotherapy interventions. 2015. Available from: https://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/to bacco-use-in-adults-and-pregnant-women-counseling-and-interventions

AUSTRALASIAN MILITARY MEDICINE ASSOCIATION

JOIN NOW, AND YOUR NEXT RENEWAL WILL BE 30 JUNE 2021.

BECOME AN AMMA MEMBER TODAY

Further your knowledge of Military Medicine and Veterans' Health

Only $164 per year

*Full Membership (Student discount available)

Enter discount code JMVH for $40.00 discount

Join now, and your next renewal will be 30 June 2021

Other great Membership benefits:

- Interact with peers, community and the fellowship
- Stay connected with the Australian and New Zealand Army, Navy and Air Force
- Receive a copy of AMMA's publication, Journal of Military and Veterans' Health (JMVH) published four times annually. We welcome contributions from new authors and reviewers. Please visit www.jmvh.org
- As a member you are entitled to access reduced registration fees to attend AMMA education opportunities, include the Annual Conference and Workshops
- Take advantage of your membership to gain access to the Awards & Grants available. These are awarded annually and open to all members.
- Become more involved in AMMA – all members have the opportunity to nominate for the AMMA Council, when a vacancy occurs
- All new members receive a membership certificate and welcome pack, and will be acknowledged and welcomed at AMMA's Annual General Meeting held in conjunction with the annual conference
- AMMA membership entitles you to voting rights at the Annual General Meeting
- Opportunity to purchase AMMA Merchandise

Brogan Palmer
AMMA Secretariat
secretariat@amma.asn.au

To join, please view amma.asn.au/membership and enter the discount code JMVH

Notes

Notes

Notes

www.jmvh.org