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- Tropical Diseases
- Musculoskeletal Injury

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Journal of Military and Veterans' Health

Australian Military Medicine Association

STATEMENT OF OBJECTIVES

The Australian Military Association is an independent, professional scientific organisation of health professions 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.

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Inside this edition

The Commonwealth Heads of Government Meeting (CHOGM) has just completed successfully in Perth with the joint assistance of the Australian Government, Australian Defence Force (ADF) and the Western Australian State Government. While the considerable capabilities of the ADF did not need to be seriously tested, the planning from all agencies ensured a smooth and trouble-free meeting. What is not necessarily highlighted in the media and elsewhere is that the large amounts of planning, liaison and exercising, which is required to make such meetings happen, does not just spontaneously occur, but is the result of the application of good Defence, police and health planning principles. While I am grateful that we did not need to access the skills and expertise of ADF colleagues, it was very reassuring to know that the reach-back capability was there should we have needed it.

CHOGM also highlighted the ongoing issues with infectious diseases and tropical diseases in many of the member countries. In this issue, we are looking particularly at tropical diseases of operational importance, with original articles on the impact of rickettsial disease and influenza on deployed forces. We also look at other environmental hazards, from pesticides to injury patterns in various groups of soldiers. All the articles are intended to challenge, educate and broaden the operational and strategic viewpoint of our members. We would particularly welcome continuing discussion on the issues of current military operations, current military and veterans health issues, military health history and military-civil interactions.

As we head into 2012, we will have further themed issues and ask prospective authors to consider whether they may have suitable articles for those themed issues. 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.

Dr Andy Robertson, CSC

Editor-in-Chief

President's message

Welcome to the latest edition of JMVH focusing on topical disease. Recently the association conducted its annual conference in Melbourne with over 450 delegates and 36 trade exhibitors it was magnificent occasion and a great opportunity to catch up with old and new friends and hear the latest advances in military medicine. I like to thank all those who contributed to ensuring the conferences success; our 90 presenters, the organising committee and, the association's secretariat.

Congratulations, too, to the award winners;

- Weary Dunlop Award – Glen Mitchell and Bronte Douglas,
- JMVH New Author's Award – Nevin Colgrave,
- JMVH Editor's Award – Robin Orr,
- Patron's Award – Peter Peters and,
- Foundation Park Award (Best Veteran Paper) – Samantha Crompvoets

Next year the conference will be our 21st and will be held at the Brisbane Conference and Exhibition Centre.

During the conference the Association's annual general meeting was held and two councillors resigned due to their work commitments, Scott Kitchener and Kerry Clifford. I would like to take this opportunity to thank them for their contributions and dedication to ensuring the Association success. Their resignations created vacancies in the council which were filled by Ross Mills and Stewart Robertson and I and all the other council members look forward to their participation in council business in the future. Importantly, during the meeting the council and the membership reaffirmed their commitment to the Journal as an important component of the Association's activities.

Wishing all members and readers a merry Christmas 2011, happy New Year and may 2012 be the best of years.

Greg Mahoney

President AMMA

Epidemiology and prevention of tropical diseases of military importance: a special issue

Professor Peter A. Leggat, MD, PhD, DrPH, FAFPHM, FFPH RCP(UK), FACTM

Historically, tropical diseases have remained a significant threat to military operations in tropical zones,[1-4] especially in the developing country environment, which are often areas characterized by extremes of poverty, environment, endemic disease, and inadequate public health resources. In the past decade, military deployments to war-like areas, such as Iraq and Afghanistan, has seen an increased focus on trauma; however recent literature suggests that tropical diseases remain issues for deployed troops. An overview of tropical infectious diseases of military importance has been published elsewhere.[5]

Of particular concern for military deployments have been vector-borne diseases, such as malaria. Malaria countermeasures, such as malaria chemoprophylaxis and personal protective measures, have become integral to military operations in malaria endemic areas of the world.[5]

In theatres of operation in the Middle East this decade, other vector-borne diseases, such as, leishmaniasis, have also become increasingly important. Cutaneous leishmaniasis (CL) presents with skin sores, usually one or more chronic skin lesions where sandflies have fed. It has been coined the "Baghdad boil" reflecting the areas of operation where it is currently being encountered, including southwest and central Asia,[6] although leishmaniasis is widely distributed in other locations around India, the Mediterranean basin, central Africa and South America. Skin lesions usually develop within a few weeks of being bitten and are unresponsive to antibiotics or steroids.

In recent years, Rickettsial diseases have been a perennial problem, especially in deployments in northern Queensland. In particular, outbreaks of scrub typhus have been reported in military deployments to training areas such as Cowley Beach.[7,8] It is also one of the most prevalent infectious diseases of rural eastern and southern Asia.[9] The vector is the larval stage (chiggers) of Trombiculid mites. The limited range of the host animals and the chiggers means that the areas of transmission are highly focal.[10] Complications and even death can ensue in severe cases. Stephen Frances provides further information on rickettsial diseases in his paper "Rickettsial Diseases of Military Importance: An Australian Perspective" in this issue.

In addition, the importance of immunization in defence personnel has been demonstrated by outbreaks of various vaccine-preventable diseases in developing countries and the impact of seasonal and novel influenza viruses.[11,12] Dennis Shanks further discusses this concern in his paper entitled "The Ability of Seasonal and Pandemic Influenza to Disrupt Military Operations", also in this issue.

Less well known is the problem of military personnel being exposed to soil transmitted nematodes. From previous military campaigns, strongyloidiasis has been found to be the most common cause of chronic morbidity in former Australian prisoners of war and other veterans.[13] In investigations six weeks after British troops were deployed for several days to Sierra Leone, the most commonly identified parasitic infections identified were hookworm infection (26%) and strongyloidiasis (9%).[14] Half of these British troops had gastrointestinal symptoms and half had eosinophilia.[14] More recently, strongyloides was reported in personnel deployed as part of the Regional Assistance Mission to Solomon Islands (RAMSI).[15] Although albendazole has been widely used in treatment of soil transmitted nematode infections, single dose ivermectin has proved a superior alternative in the treatment of chronic strongyloidiasis.[16] Given that strongyloides can be a lifelong infestation and potentially fatal, information on preventive measures for soil-transmitted nematodes should be included in pre-deployment training and post-deployment screening recommended for military personnel returning from endemic areas.[15]

Author's affiliation: School of Public Health, Tropical Medicine and Rehabilitation Sciences James Cook University, Townsville, Qld, 4811 Australia

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CMDR McKenzie response to adverse letters in JMVH of October 2010 re: PTSD article

CMDR Douglas McKenzie

I acknowledge the impassioned responses to my contentious article on PTSD (JMVH- Apr 10) and I would expect nothing less from my mental health colleagues. Independent commentary by one with no vested interest in diagnosing and managing PTSD should be embraced as part of robust debate regarding this fashionable condition. I hasten to remind the respondents that my paper was submitted under the terms pertaining to the "View from the front" category, being a personal view of my experience investigating and co-managing PTSD patients over 16 years; it is not a formal research article. I note that the respondents have not addressed my concerns.

The increasing breadth of the diagnostic parameters that satisfy PTSD has enabled a large number of situations to qualify for the disorder. As for its dubious offspring – 'vicarious', 'late-onset' and 'suppressed' PTSD – these further confuse the situation. I am often astounded how, after one or two consultations, a diagnosis of PTSD can be made on the basis of an unverified story and alleged symptoms. All too often reports have conclusions such as 'this person has PTSD' whereas a more objective clinician might write 'this person states he has symptoms consistent with post-traumatic stress'.

I am encouraged by editorial opinion in a recent British Journal of Psychiatry (197, 2010) "Reflections on PTSD's future in DSM-V" which states, in part, 'the current proposal for DSM-V, in which 21 symptoms are grouped into four clusters, allows for 10,500 ways to meet minimum requisite criteria! This expansion is beyond anything experienced for other diagnoses' (editor's exclamation mark). Furthermore the editorial states ' continuing controversy over how to operationalize PTSD in DSM-V has led to the suggestion that the diagnosis might best be relegated to the manual's appendix for experimental criteria sets……this approach can also serve to remind clinicians that PTSD in its present form should not be reified to the status of a distinct disorder in nature….'. Dr. Summerfield, occupational psychiatrist, Institute of Psychiatry, King's College writing in the same journal in April (342, 2011) makes some interesting comments regarding the UK police, inter alia, " regarding treatment of PTSD , professionally directed attention to the past, sometimes years previously, and to emotion, seemed anti-therapeutic rather than curative" and " the medicalization of non-specific symptoms, allied to social rewards that create perverse incentives, reliably prolongs disability" and his final comment " But above all we need a culture change in mental health service practice". These insightful and perceptive commentaries are long overdue.

It appears to me that mental health specialists are on a diverging path from 'coal face' health practitioners (MOs, nurses and medics) from whom I have had significant support. I believe that the latter should have input into the diagnostic process as they are responsible for the day to day management of PTSD patients. The current ADF Health Directives 264 & 289 describe the mental health management responsibilities of ADF primary care physicians, who are the designated Clinical Case Managers, and are held 'ultimately responsible'. My private Medical Defence Organization has advised me that this implies ultimately responsible for any adverse outcome and thus medico-legally liable.

To reiterate the thrust of my original paper I am convinced, from my personal observations, that PTSD is excessively diagnosed and that there should be a paradigm shift in the way this popular condition is diagnosed, managed and rewarded. A good starting point would be to conduct an accurate, holistic assessment of the patient with less emphasis on counselling and self-pity but with a more rapid return to normal duties.

Review of physiotherapy records to characterise musculoskeletal injury in Australian soldiers in the 16th Air Defence Regiment

Rolf Sellentin [1]. B. App. Sc. Physiotherapy, M. App. Sc. Manipulative Physiotherapy and Dr Penny Sanchez [2] PhD

Abstract

Background: There is scant information on the types of musculoskeletal injuries, their causes and injury patterns that are sustained by Australian garrison soldiers (a permanent military post or place where troops are stationed). Rigorous physical training, manually emplacing weapon systems and daily military duties carried out by soldiers of the 16th Air Defence Regiment reflect the types of injuries observed in this study. It defines the injury patterns for trained soldiers and addresses those aspects of injury and mechanism of injury, forming the basis for further research targetted at injury prevention.

Purpose: To identify the predominant musculoskeletal injuries sustained by soldiers of the 16th Air Defence Regiment and to explore the relationship between the type of injury and subunit as well as the relationship between type of injury and cause. This is important so that remedial measures can be engaged in an attempt to reduce the incidence of musculoskeletal injury to Australian soldiers, to maintain the regimental fighting strength and deployable status and to reduce the financial burden of rehabilitation and compensation borne by the Australian Defence Force and the Federal Government.

Materials and Methods: All patients were trained serving soldiers of the 16th Air Defence Regiment and were referred by the Medical Officer for physiotherapy treatment. On conclusion of a course of treatment, a physiotherapy patient discharge summary (PM 528) was written and it is from these summaries that the demographic data for this study was extracted, which included the type of musculoskeletal injury (diagnosis), cause of that injury and the subunit that the soldier belonged to in the 16th Air Defence Regiment during the years 2008 to 2010.

Tests of significance based on the chi-square test statistic were carried out at the 0.05 significance level using Minitab 16 statistical software. When the chi-square test of independence was significant, then the source of the dependence was investigated by analysis of standardised residuals for each cell.

Results: Five predominant types or areas of injury sustained by Australian soldiers of the 16th Air Defence Regiment were identified to be neck, low back, ankle, patella and knee ligament. The frequency of low back injuries was found to be significantly higher than the other types of injury (chi-square goodness of fit test, $p < 0.001$, then analysis of standardised residuals with Bonferroni adjustment).

There was insufficient evidence of a relationship between type of injury and subunit (chi-square test of independence, $p = 0.33$).

Five predominant causes of musculoskeletal injury were identified to be biomechanical, work, running, sports and physical training.

Evidence of a relationship between type of injury and cause was found to be statistically significant (chi-square test of independence, $p < 0.001$) in the cause 'sports', which is associated with a relatively higher frequency of ankle inversion injuries, and 'running', which is associated with a relatively higher frequency of patella-femoral joint injuries ($p < 0.002$).

Conclusion: This is the first full review of data on musculoskeletal injuries sustained by Australian soldiers of the 16th Air Defence Regiment. Types of musculoskeletal injuries and causes were analysed and patterns of injury were identified. Measures can now be drawn up with the aim of injury prevention.

Introduction

The 16th Air Defence Regiment (16th AD Regt) is part of the Royal Australian Artillery Corps and the garrison is based at Woodside Barracks, South Australia. The Regiment consists of four subunits: Head Quarters (HQ), 110 Battery (110 BTY), 111 Battery (111 BTY) and Combat Services Support (CSS). The Regimental Aid Post (RAP) is part of the CSS located at Woodside Barracks.

The path to become an Australian Army soldier requires two phases; recruit training and garrison training. Garrison training and activity is different from recruit training in Australia. Garrison soldiers at 16th AD Regt conduct intensive physical conditioning to maintain their physical fitness and strength, play competitive sports, and perform manual handling that is specific to their trade. Recruit training, on the other hand, is focused on teaching the new soldier how to conduct themselves in a military environment and the emphasis on physical training is much less. This current study is therefore important to demonstrate what effect training and military duties have on fully trained Australian soldiers in a garrison.

The 16th AD Regt RAP provides the regiment a morning sick parade, and as required, health checks (performed by medics), medical assessments and reviews (performed by the Medical Officer (MO)), dental, psychological support, physiotherapy assessment and treatment (performed by the physiotherapist), and gym rehabilitation (performed by the physiotherapist and the Physical Training Instructor (PTI)).

The main purpose of the 16th AD Regt physiotherapy service is to provide a medical capability to maximise the number of fully fit soldiers for deployment by providing physiotherapy treatment and rehabilitation. This service not only is a force multiplier (an attribute which makes a given force more effective than that same force would be without it) but also reduces the morbidity of soldiers and the fiscal cost to the ADF. Strowbridge and Burgess (2002) have stated that rehabilitation is a cost effective method of treating soldiers with musculoskeletal injuries. Referred patients to 16th AD Regt physiotherapy are treated as outpatients and are normally able to continue in their job within the regiment but often with restrictions as dictated by the Medical Officer.

Injury prevention and maintaining high levels of fitness is an important factor in a unit such as 16th AD Regt as it bolsters its operational effectiveness. Strowbridge and Burgess (2002) suggest that there are five steps in injury control; "surveillance to determine the scale of the problem; determination of the cause of injury; studies to ascertain if the proposed method of intervention is effective; implementation of the intervention and audit of effectiveness". It is with this in mind that this study has been conducted, to ascertain the scale, type and cause of musculoskeletal injury that was occurring at 16th AD Regt so that preventative intervention strategies could be initiated and directed.

Soldiers who require physiotherapy treatment and rehabilitation are referred by the Medical Officer. All physiotherapy and rehabilitation occurs on site, as there is a well equipped physiotherapy treatment room, gym and hydrotherapy facilities. There is a close liaison between the physiotherapist and the PTI in regards to transitioning patients from direct physiotherapy injury rehabilitation to Battery physical training programs. In addition, the physiotherapist conducts physical assessments on all new members entering the unit, as well as Physical Employment Assessments to determine if a rehabilitated injured member is physically able to return to his trade without restrictions.

The key objectives of this study are:

- To investigate the predominant injuries sustained by 16th AD Regt soldiers;
- To investigate whether there are any patterns of injury among the Regimental subunits; and
- Whether there is any association between type of injury and cause of injury.

This study was conducted because there is a lack of information about the types of injuries and injury patterns in relation to Australian garrison soldiers. Moreover, there is scant information about injuries sustained by garrison soldiers internationally that explores patterns such as the association between type of injury and cause. One study by Strowbridge and Burgess (2002) does focus on types of injury and some injury patterns sustained by British garrison soldiers. More generally there are some studies of association in other parts of the military setting, such as Cox et al. (2000) which focuses on the association between one particular type of injury and the history of injury for recruits.

It is envisioned that, following this current study, future strategies can be developed in an attempt to reduce the occurrence of injury and thus to enhance the operational readiness of the 16th AD Regt. Once formulated and tested, preventative programmes could ultimately be rolled out to other units of the Australian Defence Force.

Materials and methods

The 16th AD Regt consists of four subunits: Head Quarters (HQ), 110 Battery (110 BTY), 111 Battery (111 BTY) and Combat Services Support (CSS). It has a nominal roll of 338 personnel (HQ = 43, 110 BTY = 120, 111 BTY = 100, CSS = 75) with 98% being male and

2% being female. The soldiers had all completed basic training, the majority having been in the Australian Army for many years. The average age range per subunit was as follows: HQ = 36 years (range 23-50); 110 BTY = 26 years (18-54); 111 BTY = 25 years (19-43); CSS = 33 years (19-56).

The inclusion criteria for this study were all physiotherapy patients diagnosed with a musculoskeletal injury from 01 January 2008 to 31 October 2010, and subsequently discharged from their treatment after their condition resolved. The condition was either acute or chronic in nature and was assessed and treated by the physiotherapist on site. Patients were referred to physiotherapy by the Medical Officer.

Presented conditions were assessed using the Australian physiotherapy criteria of Subjective, Objective, Assessment and Plan (SOAP), in which Subjective identifies the area and cause of the injury and the Objective examination identifies the injured structure through a range of movement and palpation.

Upon discharge from physiotherapy treatment, the date of the first and last assessment, number of treatments received, the diagnosis, treatment method used, the mechanism of injury (cause), outcome, and the member's subunit were recorded on the Specialist Report (PM 528) 'physiotherapy discharge summary' and filed in the patient's medical records. It is this data from the PM 528 that has been used in the conduct of this study.

Analysis of the data will be based on chi-square tests of independence to test the relationships between variables and the chi-square goodness of fit test to test the equality of frequencies at the 0.05 significance level (see, for example, Triola and Triola, 2005). When the chi-square test of independence is significant, then the cause of the dependence is investigated by analysis of standardised residuals for each cell with Bonferroni adjustment of the significance level by dividing 0.05 by the number of standardised residuals to be examined. Minitab 16 statistical software was used to carry out statistical analysis.

Results

A total of 430 physiotherapy discharges were made over the three years 2008 to 2010 following the treatment and/or rehabilitation of the patient's condition. These discharges represent 99% of all new referrals made to physiotherapy over the three years of this study, and the remaining 1% being new referrals that failed to attend physiotherapy, so therefore, could not be assessed or treated by the physiotherapist. Discharged patients rather than new referrals to physiotherapy were used for this reason.

The scope of this study is limited to injury type, number and cause and has limitations in regards to the small sample number,and use of the valid outcome measures and reliability of those measures.

After considering the physiotherapy discharges, five main types or areas of injury were identified: neck, low back, ankle, patella, and knee ligament. While other types of injury were recorded, these five types were chosen for analysis because they are the types for which thirty or more injured soldiers were observed over the period 2008 to 2010 – totalling 242 injured soldiers for those five types. These five types or areas of injury are defined as;

- 'Neck': an injury to the cervical spine involving a ligament or facet joint sprain or dysfunction;
- 'low back': an injury to the lumbar spine involving a facet joint sprain or dysfunction or paravertebral muscular strain or disc tear/bulge;
- 'Ankle': an inversion sprain injury involving the lateral ligament structures of the ankle (anterior talofibular ligament and calcaneofibular ligament and possibly strain to the peroneus longus and brevis);
- 'Patella': patella-femoral joint inflammation; and
- 'Knee ligament': a strain injury to the medial or lateral collateral ligaments or the cruciate ligaments.

An investigation was first conducted to assess if there was any evidence of a relationship between the type of injury and the year, that is, whether the type of injury differs in frequency in relation to the year. Statistical analysis found there was insufficient evidence of a relationship between the type of injury and year (based on a chi-square test of independence, $p = 0.32$). Given that we found there is no relationship between the type of injury and year, the physiotherapy discharge data can be aggregated to consider the total over the three years (2008 to 2010) when considering other variables in the subsequent analyses.

Next to be considered was whether each type of injury was equally likely to occur, that is, whether the frequency of neck, low back, ankle, patella and knee ligament injuries are the same. The data to be analysed is presented in Table 1.

Type of injury	
Neck	0.18
Low back	0.36
Ankle	0.14
Patella	0.16
Knee ligament	0.16
Total injuries	**242**

Table 1: Frequency data for type of injury

Statistical analysis, using a chi-square goodness of fit test, found there was evidence that the frequency of injury is not the same for each type of injury ($p < 0.001$). Thus it is appropriate to further investigate which particular types of injury are observed to be significantly different to what would be expected if the frequency of each type of injury was assumed to be equal. To do so, analysis of standardised residuals, using a Bonferroni adjustment, was used.

Based on a significance level of 0.05 and that 5 standardised residuals are to be examined (one for each type of injury), then the Bonferroni adjustment results in a significance level of 0.01 and a critical value of 2.576. Based on this, the observed frequency of low back injuries was found to be significantly greater than expected. In other words, we found that there is a relatively higher frequency of lower back injuries compared to other types of musculoskeletal injury.

It was then investigated whether there was any evidence of a relationship between the type of injury and subunit, that is, whether the type of injury differed in frequency in relation to which subunit a soldier belonged (HQ, 110 BTY, 111 BTY or CSS). Statistical analysis found there was insufficient evidence of a relationship between type of injury and subunit ($p = 0.33$).

The final aspect of this current study was to investigate whether there was a relationship between the type of injury and cause. There are five types of injury under study, and it was found from the data set that there were five main causes of injury, described as follows:

- Biomechanical: where there was no known specific identifiable incident, but pain was brought on by a muscular-neural-skeletal dysfunction (an intrinsic factor).
- Work: where injuries arose from manual handling which is typically carried out by 16th AD Regt soldiers or from prolonged sitting while using a computer.
- Running: where an injury arose from long distance running greater than 2km on level and graded surfaces. Running is aimed at maintaining cardiovascular fitness and is a requirement to pass a basic fitness assessment requirement of the Australian Army.
- Sports: involves ballistic movement and changes in direction (such as in volleyball, touch rugby, basketball and soccer) that could contribute to injuries. Sport is aimed at developing qualities such as team building and fitness and is held periodically through out the year.
- Physical Training: where injuries arose from daily 1-hour circuit based exercise programs conducted each day by a Physical Training Instructor (PTI) or Combat Fitness Leader (CFL). The circuit consists of a variety of different types of exercises at varying levels of difficulty and effort designed to improve both cardiovascular endurance and strength and can involve lifting weights or repetitious movements under load.

Each of those five causes of injury consisted of a count of at least 20 injured soldiers over the duration of the study and other causes were excluded from further investigation. Thus the five main causes of injury are the only causes to be considered further, along with the type of injury. The corresponding total number of injured soldiers over the variables type of injury and cause is 185. We will investigate whether there is evidence of a relationship between type of injury and cause.

The results of statistical analysis found there was evidence of a relationship between type of injury and cause ($p < 0.001$). Thus it is appropriate to subsequently examine standardised residuals for each of the 25 combinations of a particular type of injury and cause as follows.

Based on a significance level of 0.05 and that 25 standardised residuals are to be examined (one for each combination of type of injury and cause), then the Bonferroni adjustment results in significance level of 0.002 and a critical value of 3.09. Based on this, the following statistically significant results are obtained:

- for the combination of ankle injury and sports, the observed frequency is significantly greater than expected and,
- for the combination of patella-femoral injury and running, the observed frequency is significantly greater than expected.

Put another way, the cause of injury 'sports' is associated with a relatively higher frequency of ankle injury. Running is associated with a relatively higher frequency of patella-femoral joint injury.

Furthermore, the following results, close to significance, may also be important:

- for the combination of neck and biomechanical, the observed frequency is greater than expected ($p = 0.012$),
- for the combination of neck and running, the observed frequency is lower than expected ($p = 0.033$),
- for the combination of low back and work, the observed frequency is greater than expected ($p = 0.006$),

- for the combination of low back and running, the observed frequency is lower than expected ($p = 0.019$),
- for the combination of lower back and sports, the observed frequency is lower than expected ($p = 0.004$),
- for the combination of patella and work, the observed frequency is lower than expected ($p = 0.01$) and
- for the combination of knee ligament and sports, the observed frequency is greater than expected ($p = 0.003$).

Those results that are close to being statistically significant could form the basis of a future study.

Discussion

This study has been approved by the Australian Defence Human Research Ethics Committee (ADHREC) with the designated research protocol number 628-11.

One of the major findings of our study was that there was a significantly higher frequency of low back injuries relative to other types of injury for 16th AD Regt soldiers. It is noteworthy that Strowbridge and Burgess (2002) found in their study that the most common type of injury observed among British soldiers was low back. However, unlike this current study, they did not support their finding with statistical analysis.

We found that work involving manual handling or long periods of sitting is associated with a relatively higher frequency of low back injury in Australian soldiers at 16th AD Regt, which was close to statistical significance. McGill (2007) states that "known tissue damage occurs with high magnitudes of load, repetition, and so on", and refers to studies in the epidemiological literature that have found that musculoskeletal injuries were twice as likely with compressive forces exceeding 6800 N, and in particular, cumulative loading, joint moments and spine shear forces are important as risk factors for low back disorders. Studies from Finland, Denmark and Switzerland (Ulaska J et al. 2001, Darre EM et al. 1999, Rohrer MH et al. 1994) have also outlined the impact of low back pain on military service and have concluded that the main factors in the aetiology of this condition were lifting, carrying, standing for long periods of time, twisting and heavy work. Furthermore, they also found from follow up studies that re-occurrence of low back pain increased during military service and was a major cause of time off work after discharge. Many of these same movements and often under loads of up to 45 kg individually or a combined two man lift of 65 kg are required to be performed routinely by Australian soldiers in their trade such as Ground Based Air Defenders, Craftsman, or in catering in 16th AD Regt and may explain the association between 'work' and low back injuries found in our study. McGill (2007) also states that an extended period of sitting is a factor in lumbar disc pathology, and cites Kelsey (1975) who discovered a specific link between prolonged sitting and the incidence of lumbar disc herniation. McGill (2007) further states that "more upright sitting postures, and the concomitant psoas and other muscle activation, impose additional compressive loads on the spine", that may provide a possible explanation for the association between long periods of sitting and low back pain found in our study. He recommends a variable posture whilst sitting as a strategy to minimise the risk of tissue overload.

However, McGill (2007) also states that "the majority of specific risk factors that are addressed in the epidemiological literature (which is surprisingly sparse) are really surrogate factors, or indirect measures, of spine load, [consisting of] static work postures; seated work postures; frequent bending and twisting; lifting, pulling, and pushing; and vibration (especially seated)". These indirect measures were used in our study since specific characteristics of the work and the risk of suffering low back injury, or direct tissue loads in an epidemiological study were beyond the scope of this study and this may therefore be a limitation to the study. Although McGill (2007) found that several studies have not been able to support a link between heavy work and the risk of low back disorders, he does state that "there is no question that damage to tissue can be caused by excessive loading, and damage causes pain". Further research in this area may help to clarify this vexed question, with this current study forming the basis of future investigation into core related muscle strengthening as a preventative strategy.

We found in this current study that the association between neck injuries and a biomechanical cause is a result that is close to statistical significance in Australian soldiers at 16th AD Regt. McGill (2007) states from his literature review that with regards to spinal pain, low muscle forces result in a small motor error that causes rotation of a single spinal joint, thereby placing all the bending moment onto the passive tissues resulting in injury. He further states that "deficient motor control mechanisms heighten biomechanical susceptibility to injury or re-injury and that some biomechanical based studies, together with the chronic pain literature, are strongly convincing in their establishment of both association and causality". These factors could explain the biomechanical reason for the injuries suffered by Australian soldiers at 16th AD Regt. The study by Grob et al (2007) suggested that vertebral alignment was not a factor since there was no association between sagittal alignment of the

cervical spine (or its individual segments) and the presence of neck pain. Moreover, Grob et al (2007) found that "in the group with neck pain, there was no relationship between curvature and any index of symptom severity, such as pain intensity, disability, healthcare utilisation, etc". The nature of why biomechanical factors may be associated with neck pain found in our study remains unclear and it would be of interest to investigate this with a further study.

Our study found that the cause 'sports' is associated with a relatively higher frequency of ankle injuries in Australian soldiers at 16th AD Regt, and that this result is statistically significant. Ankle injuries to 16th AD Regt soldiers usually involve injury to the lateral ligament structures of the ankle in an inversion sprain. Strowbridge and Burgess (2002) commented that the ankle is the most common injury to occur as a result of sports in their study of British soldiers, although their finding is not supported by statistical analysis. The reason why sports is associated with ankle injury might be explained by Kofotolis et al (2007) who reported that most ankle injuries were from contact games, where there are high lateral or medial forces on the foot causing excessive musculoskeletal loading and inversion, rather than non-contact (landing, twisting, turning and running), and suggested that these movements are very frequent in sports, inducing high joint and musculoskeletal forces. These observations could offer an explanation as to why ankle injury occurs to Australian soldiers at 16th AD Regt while playing sports. They also found, upon reviewing the literature on ankle sprains, that there is little consensus with regard to whether variables such as age, height, weight, or limb dominance are risk factors for ankle sprains. If these variables are risk factors of 16th AD Regt soldiers then they were beyond the scope of this current study. A recommendation for increasing ankle support possibly by strapping or a brace was put forward by Strowbridge and Burgess (2002) to help reduce the incidence of ankle injury and is one measure that could be instigated in the 16th AD Regt.

We also found that the cause 'sports' being associated with a relatively higher frequency of knee ligament injuries in Australian soldiers at 16th AD Regt is a result that is close to significance. The study of ACL injuries made by Krosshaug et al (2007) found that these injuries can be attributable to involved joint kinematics, playing situation and player behaviour. In their study they found that although injuries can be through contact with the opponent, the majority of injuries did not involve contact at the assumed point of injury and that many players' movement patterns were also influenced by perturbations by an opponent (being pushed or in a collision) before the time of injury. They also observed that injuries occurred during landing with knee flexion angles at the assumed point of injury. An explanation as to why knee ligament injuries occur during sports in 16th AD Regt Australian soldiers could possibly be attributed to these same observations.

Our study found that running is associated with a relatively higher frequency of patella-femoral injury to 16th AD Regt soldiers and this is a statistically significant result. Buist et al (2008) state that most running related injuries to the lower extremity is from overuse and are related to lack of running experience, previous injury, running to compete and excessive weekly running distance. They also state that 60% of these can be attributed to running too much too soon. However, although they state that the knee and lower leg were the most injured body parts in their study they do not specify what structure in the knee is injured as their focus was on how a graded running programme affected such injuries and was conducted on novice runners.

Australian soldiers of the 16th AD Regt perform regular running programmes to both maintain their cardiovascular fitness and in order to pass a basic fitness assessment (BFA), which incorporates a 2.4 km distance running component and is an Australian Army requirement. What is too much running to cause knee injury and what is enough to effect a beneficial change to the knee to tolerate such stressors is still undetermined and is likely to be highly variable between individuals. Buist et al (2008) states that "more research is needed on the relationship between intensity, frequency, and the duration of training and injury risk, and other potentially possible risk factors and when there is inadequate time between stress applications, an overuse injury can occur". Further research is required in running as performed by Australian soldiers, to assess the relationship between these four variables.

Conclusion

This is the first full review of data on musculoskeletal injuries sustained by the Australian soldiers of the 16th Air Defence Regiment. Types of musculoskeletal injuries and their causes were analysed and patterns of injury were identified. From this study it is recommended that further research is conducted into ways of reducing the risk of musculoskeletal injuries in Australian soldiers. This could be achieved by core muscle activation and strengthening programmes and regular breaks from long periods of sitting with a range of movement exercises to reduce low back injuries, the use of ankle supports during sporting activities to reduce ankle injuries, and the optimum distance: time ratio to reduce knee injuries. This

study may form the basis of further research in the hope to reduce the rate of musculoskeletal injuries to Australian soldiers.

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Authors affiliations: [1]Department of Defence, [2]University of South Australia
Corresponding author: Rolf Sellentin
Email: rolf.sellentin2@defence.gov.au

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The ability of seasonal and pandemic influenza to disrupt military operations

Prof G. Dennis Shanks MD, MPH [1, 2] and LTCOL Jon Hodge MBBS GradDipOccMed MHA FRACMA FACTM [3]

Abstract

Influenza is one of the few infectious diseases that is able to disrupt military operations quickly. Although the extreme mortality rates seen during the pandemic of 1918-19 when tens of thousands of soldiers died has never been repeated (for as yet unclear reasons), illness rates alone make influenza of great military importance. Seasonal influenza infection rates from 2-30% of a partially immunized force can still limit military activity and challenge the ability of medical facilities to cope with a sudden number of sick soldiers. Although social distancing and antiviral medications may have some role, in military practice the main preventive measure against seasonal and pandemic influenza is annual immunization with a current vaccine chosen to match the viruses then circulating.

Influenza causes an enormous amount of morbidity and mortality each year with the annual number of estimated deaths in Australia numbering in the hundreds, but it may contribute to thousands of deaths, particularly in the elderly. Influenza is the archetypical respiratory infection that can rapidly move great distances through large human populations based on its ability to evolve viral surface proteins with new antigenic characteristics. Its military significance derives from its ability to cause a large proportion of an otherwise well population of soldiers to suddenly become ill and thus unable to conduct their duties due to upper respiratory symptoms and fever. Seasonal influenza consists of the expected annual cold weather epidemics of influenza that vary from year to year usually with little direct mortality except for those otherwise compromised by age or immunosuppression. Secondary bacterial pneumonia following influenza virus destruction of the upper respiratory tract epithelium is the most common cause of mortality in otherwise healthy individuals.[1,2] Influenza pandemics result when a large shift in the antigenic nature of an influenza virus allows it to infect a large proportion of the population; mortality is variable but can represent several percent of the population in the absence of modern medical care as occurred in 1918-19.[3] Influenza is highly infectious largely through large droplets from the respiratory tract and can be spread by asymptomatic persons, thus severely limiting quarantine and isolation interventions. The development of inactivated influenza vaccine grown in eggs was largely due to the self-interest of the military in preventing epidemic influenza especially in large recruit populations. Although some military forces require their members to be vaccinated annually for influenza, the numbers actually vaccinated seldom reach a percentage sufficient to protect an entire unit. There is no decisive number for herd immunity, as it depends on the soldiers' background immunity, but at least the majority of a unit is required to be vaccinated to expect any population protection.

This review briefly describes previous military experience with influenza. It illustrates that influenza virus is one of the few infections able to stop military operations, even when its symptoms are rarely severe, due to the ability of respiratory infections to rapidly move through crowded groups of soldiers. For current information on influenza in the Australasian region see the Melbourne-based WHO Collaborating Centre for Reference and Research on Influenza (http://www.influenzacentre.org/).

Pandemic Influenza

The influenza pandemic of 1918-19 occurring at the end of the First World War remains the greatest single human mortality event ever closely observed (>40 million dead) and still has never been adequately explained.[4] Records of the influenza pandemic of 1890-91 in the UK military reports only a handful of deaths, indicating that the pandemic influenza itself was not necessarily lethal. During the 1918-19 pandemic it is estimated that 32,000 US soldiers, 28,000 French soldiers, 10,000 British soldiers, 4000 US Navy sailors, 1700 Royal Navy sailors, 1200 Australian soldiers and 800 New Zealand soldiers died of influenza.[4-6] Mortality due to influenza was very unevenly distributed, varying greatly between apparently identical units. Soldiers new to the military were particularly at risk of lethal outcome and the greatest number of deaths occurred in recruit camps, particularly those in the USA.[7] Interestingly, those most exposed to influenza, the medical and nursing officers, consistently had the lowest mortality despite having very high illness rates.[8] Death due to acute respiratory failure was uncommon; most men died in the second week of

Figure 1. Australian War Memorial D00297 copyright on photo expired. Influenza vaccination has progressed greatly since these Australian soldiers in UK 1919 paraded to be immunized prior to returning to Australia at the end of the First World War.

their illness with secondary bacterial pneumonia.[1,2] The markedly increased lethality of the influenza pandemic compared to previous experience with influenza had little effect on the war's outcome as the decisive fighting had largely already ceased by the time that the pandemic peaked in October 1918.[9] The militarily significant effect of the 1918-19 influenza pandemic actually occurred during mid 1918 prior to the lethal second wave of late 1918. In March 1918, a German offensive and the subsequent collapse of the British Fifth Army in France brought the eventual outcome of the war into doubt. During mid 1918 when reinforcements were desperately needed to stop the German advance, all available Allied manpower was threatened by an apparently mild form of influenza that spread rapidly, but killed very few men. Nearly fifty thousand British soldiers were hospitalized in a single week with influenza in June 1918.[10] Entire offensive operations such as the attack on La Becque by the 29th British Division on 20 Jun 1918 had to be postponed due to the lack of sufficient numbers of functional soldiers affected by influenza.[11] Influenza compromised both sides equally, contributing to the inability of the German offensives to achieve victory on the Western Front which led to the German Army's eventual collapse.

Subsequent influenza pandemics (1957, 1968, 2009) have all been much less lethal than that observed in 1918-19 especially in young adults of military age. Air Forces have been particularly concerned with influenza, not because they are more susceptible than other military groups, but because large numbers of flight personnel can suddenly become unable to fly during an influenza outbreak.[12,13] This was demonstrated when bombing missions over Vietnam were temporarily suspended when the bases used by the air crews in Thailand were involved in the 1968 H3N2 influenza pandemic.[14] US Air Force recruits were studied for viral respiratory illness over decades and their experience suggests that hospitalization rates up to 30% of all unvaccinated personnel are possible, as seen during the 1957 H2N2 pandemic.[13] The influenza pandemic of 2009 largely affected those younger than 60 years, thus focusing the disease on schoolchildren and young adults. For the military, this primarily concerned recruit populations who experienced illness rates of about 10% but little if any mortality.[15] Naval ship board epidemics were also described during 2009, but even under such close quarters, attack rates were in the range of 10-20% in highly immunized US Navy ships with some exceptional outbreaks such as up to 30% attack rate in sailors between 18-25 years of age on a Peruvian Navy ship.[16, 17] The symptomatic rate in the general USA population was estimated at 20% ,which was heavily weighted towards persons <40 years of age.[18]

Seasonal Influenza

The expected annual epidemics of seasonal influenza during the cooler months of the year are often of similar military impact to a new influenza pandemic in terms of the numbers of soldiers made sick and unfit for duty. Seasonal influenza varies from year to year and since its impact is dependent on antigenic evolution, it is largely unpredictable.[13, 19] Military land forces are typically most at risk of influenza when crowded into camps, particularly recruit camps. Longitudinal observations on military recruits show them to be a particularly vulnerable population as they are immunologically inexperienced and are suddenly crowded together with persons from many different areas under stressful conditions.[13, 20] A policy of immunisation of all recruits as soon as they arrive at the reception camp has been adopted regardless of season, in order to limit influenza in this very vulnerable population.

Acute respiratory disease often caused by influenza was a major cause of non-battle injury and disease in the US Army during the Vietnam War.[19] Estimated rates ranged from 2-11% per year which was similar to that caused by diarrhoeal diseases and are comparable to rates seen in 2009. Although the respiratory illness rate increased markedly when the H3N2 pandemic of 1968 struck, there was no measurable increase in hospitalizations or mortality in this otherwise healthy military population.[19]

Naval forces have to deal with the particular problem of ship board influenza epidemics given the crowded conditions on board most warships. During the 1957 H2N2 pandemic a US Navy carrier battle group experienced a 16% attack rate despite having received recent immunization and having had influenza outbreaks earlier in the same year. One destroyer

had 50% of its crew affected which severely limited its ability to remain at sea.[21] Troop transports in 1918 experienced extreme mortality with up to 7% of the entire complement dying[6] This was, however, not observed during the 1957 H2N2 outbreak on a US Naval transport where 22% of the 1228 persons aboard contracted influenza without any deaths.[22] Attack rates of symptomatic respiratory disease on the same ship can vary greatly between different categories of crew and passengers. This may be due to asymptomatic infections occurring in a large number of older persons as occurred when H1N1 influenza returned in 1977 having last been commonly circulating in 1956-7.[23] Even highly vaccinated naval crews can suffer high attack rates as was observed in 1996 when the influenza vaccine used for a US Navy cruiser was a sub-optimal match to the surface antigens of the H3N2 virus then circulating. The attack rate of 42% required the ship to return to port as it was unable to function with so many sick sailors aboard.[24]

Air Force personnel, especially flight crew, can be quickly incapacitated by influenza which essentially means that flight operations can be suspended if sufficient numbers of people are infected over a short period of time. Flight personnel often undertake international travel extensively, thereby increasing the risk of early introduction of new influenza viruses into Air Force installations. Clinical manifestations in air force personnel are not different from what would normally be expected from influenza, but inflammation of mucus membranes can produce specific problems with air crew functioning at altitude, with the air pressure differences across sinuses and tympanic membranes.[13, 25] During seasonal influenza epidemics, it is not unusual for 10% or more of air force personnel under surveillance to be off-duty due to influenza for >48 hours.[13, 25, 26] Influenza will often first be noticed in flight crew arriving from other geographic areas which limits the usefulness of any preventive measures other than annual influenza vaccination.[12, 14]

ADF Experience

The ADF experience with influenza has been well recognized and documented. Upon the outbreak of the Second World War, the prospect of an influenza pandemic was quickly recognized. As a result, extensive efforts were put into research (including a possible vaccine), particularly at the Walter and Eliza Hall Institute in Melbourne. Significant influenza outbreaks were recorded at Puckapunyal in the early winter of 1940, and at several Victorian camps in the late autumn of 1942.[27] No fatalities were recorded in relation to these, although certainly there would have been a significant impact on training activities. This trend was noted to continue during the conflict in Vietnam, when an influenza outbreak in August 1965 among RAAF transport personnel caused the temporary grounding of aircrew.

In more recent times, the Talisman Saber exercises of 2004 and 2005 were both affected by H3N2 seasonal influenza outbreaks. Influenza incidence, confirmed by rapid diagnostic testing for influenza A as collected by medical personnel deployed during the exercises, is shown in figure 2, unpublished data). In 2004 at least 82 hospitalizations occurred within the multiple

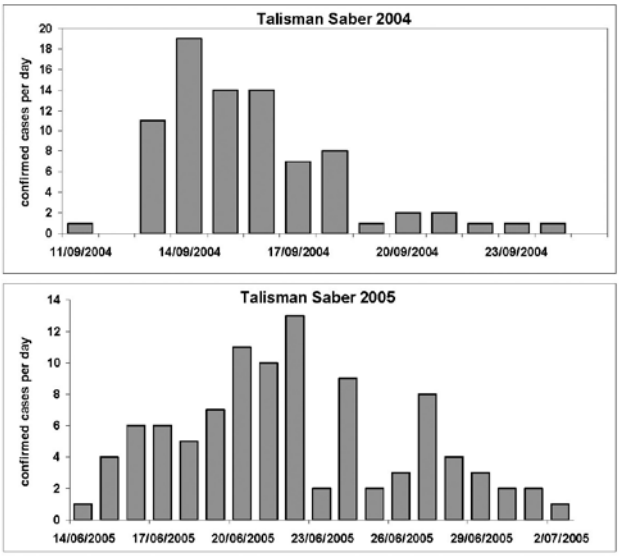

Figure 2. Laboratory positive (rapid immuno-chromatographic test for influenza A) influenza cases during Talisman Saber 2004 and 2005 exercises in Townsville, QLD during which H3N2 influenza epidemics intervened.

military units participating in the exercise in northern Queensland, with a peak of 19 admissions in a single day. In 2005 among the approximately 5000 ADF personnel involved in the exercise, a 2.2% influenza attack rate was observed of which >100 cases were confirmed as being caused by H3N2 influenza virus. The actual number of soldiers infected would probably involve at least twice this number due to the insensitivity of rapid diagnostic tests for influenza.[28] This outbreak significantly challenged the military medical resources available and directly impacted the conduct of the exercise. Had it been five times larger, which is quite conceivable given ordinary infection rates, it is likely that the exercise would have had to have been suspended for lack of functional soldiers and medical support. The most critical limitation was medical and nursing staff to take care of soldiers too ill to be left in their unit in the field but at no great risk of severe disease. Since most military missions involve multiple units traveling throughout the general population, seasonal influenza must be expected during military operations coinciding with cooler months when viral transmission is favoured by its extended environmental survival.

This recent ADF experience has also guided the development of appropriate policies and procedures to reduce the risk of influenza outbreaks impacting on operations and exercises. Immunisation with the influenza vaccine has been strongly encouraged, and is also now mandated for operational service. Immunisation for influenza has now been mandated for a number of operations, including any deployments to the Middle East Area of Operations (MEAO), as well as for any deployments to the Solomon Islands or East Timor in excess of 14 days (Health Support Order – MEAO Ops, Health Support Plan – Op Anode, and Health Support Order – Op Astute, accessed via Joint Health Command webpage, 10 Oct 2011).

Avian Influenza

Avian influenza especially H5N1 remains largely a veterinary public health problem although the extreme mortality rates seen in the few persons infected is of great concern should the virus manage to ever efficiently cross the species barrier from birds to man.[29] Although not generally perceived as a military mission, it should be noted that the Royal Thai Army was called on in the recent past to "depopulate" large chicken farms when avian influenza struck and no other group could be found that would do this difficult and dirty work which apparently had little risk of subsequent human infection.

Prevention Measures

Although the public health measures associated with isolation and quarantine are often discussed when influenza outbreaks occur, these are often of only theoretical application in modern military units especially those in urban areas with mobile populations. Such public health measures can limit influenza in military units, but the amount of administrative and medical resources to accomplish this must be instituted prior to the disease becoming apparent and is not to be underestimated.[30] Careful epidemiological studies in the Singaporean Army show that the mass use of the antiviral drug oseltamivir can limit the impact of influenza in military units, but even in the face of the 2009 pandemic when no vaccine was yet available, this was an extraordinary effort that would have been very difficult to recreate under field conditions.[31] Isolation of sick individuals can slow disease spread, but as influenza-infected persons are contagious prior to becoming symptomatic, such public health measures have little application in military units.

Prevention of influenza in military units remains largely dependent on vaccination. Immunization remains the single most practical method to decrease influenza's impact on a military unit.[12, 13, 20] In groups such as military recruits which can be reliably immunized with vaccines well-matched to the circulating viruses, this can achieve very good control of illness but not infection. Unfortunately vaccination is a problematic process involving informed selection of probable viral strains, industrial scale-up and rapid delivery. This process can go wrong when the selected vaccine viruses are poorly matched to the strains which cause symptomatic disease or they grow too slowly to produce adequate antigen for mass vaccination prior to the peak of influenzal disease. In established military groups it is rarely possible to achieve the high levels of vaccination necessary to protect an entire population unless specific command emphasis directs such a program such as in deployed air crews. Influenza immunization programs depend on pre-planning and excellent execution. The difficulties of such programs, particularly as the activity has to be done prior to illness being evident in the community, should not be underestimated and requires command emphasis as well as medical expertise.

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Authors affiliations: [1]Australian Army Malaria Institute, Enoggera [2]School of Population Health, University of Queensland, Brisbane [3]School of Public Health and Tropical Medicine, James Cook University, Townsville
Corresponding author: Prof G Dennis Shanks, Australian Army Malaria Institute, Enoggera, QLD 4051, Australia
Email: dennis.shanks@defence.gov.au or george.d.shanks@us.army.mil

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DDT and *Silent Spring*: Fifty Years After

Cristóbal S. Berry-Cabán PHD

The impact of DDT on human health received worldwide attention from the general public, political and scientific communities, with the publication of Rachel Carson's *Silent Spring*.[1] In *Silent Spring*, Carson described a series of harmful effects on the environment and wildlife resulting from the use of DDT and other similar compounds. Fifty years later the book and the issues raised remain controversial. DDT, which had been effectively used to eradicate malaria carrying mosquitoes, continues to be a major public health problem and effective treatment and prevention efforts are still necessary.

One day in January, 1958, Rachel Carson received a long, angry letter from her friend Olga Huckins, describing the deadly effect of DDT spraying for mosquito control over the Huckins' private two-acre bird sanctuary at Powder Point, in Duxbury, Massachusetts. Not long afterward Carson was a house guest at Powder Point when, late in the afternoon, a spraying plane flew over. The next morning she went through the estuary with the Huckins in their boat. She was sickened by what she saw — dead and dying fish everywhere, crayfish and crabs dead or staggering as their nervous systems appeared destroyed. She then realized she would write about DDT.[1]

Dichlorodiphenyltrichloroethane, DDT, is one of the most effective and best known of all of the synthetic insecticides. While DDT was first synthesized in 1874, it was not until the 1930s that scientist Paul Hermann Müller, working for a Swiss chemical company, discovered its insecticidal properties. Though he held no medical degree and had never engaged in medical research, Dr. Müller was awarded the Nobel Prize in Medicine in 1948 "for his discovery of the high efficiency of DDT as a contact poison against several arthropods."[2]

A chemist, Dr. Müller worked for J. R. Geigy as a laboratory technologist, where he developed synthetic tanning substances. In 1936 Müller turned his attention to pesticide research. He was looking for an insecticide to protect woollens against moths. In 1939 Müller synthesized the chlorinated hydrocarbon dichlorodiphenyltrichloroethane.

Müller's research technique was to coat the inside of a glass box with whatever chemical he was testing and fill it with houseflies. He took some DDT home with him one day and powdered a small amount into a container and noted that it killed flies. He wiped the container clean with an acetone solvent and added more flies; these also died. Müller soon realized he had a powerful insecticide.

As World War II began in Europe, DDT was successfully tested in Switzerland initially as a dusting powder against potato beetles and later against lice and fleas. These successes, however, convinced Geigy that DDT was a powerful synthetic insecticide — fatal on contact in extremely minute quantities to a wide range of insects, yet apparently wholly nontoxic to humans. In 1940, Geigy patented the formula as a general insecticide and began marketing the substance in two forms: Gesarol, a spray insecticide principally for use against potato beetles and Neocid a dust insecticide for use as a lousicide.[3]

A U.S. Military Attaché at Berne, Major A. R. W. de Jonge, noticed that Neocide shipments were going to Germany. . He persuaded Geigy to send samples to the United States and England and these were received by the Geigy offices in New York and London in November 1942.

British and American entomologists reviewed the patents with a mixture of hope and some scepticism. Of immediate concern to them, because of the millions of Allied army and navy personnel deployed around the world, was the possible use of DDT for the control of several insect borne diseases: malaria (carried by *Anopheles* mosquitoes), typhus (carried by body lice) and dysentery and typhoid fever (both carried by houseflies). With growing desperation they had been searching for a substitute for pyrethrum, a contact insecticide extracted from *Chrysanthemum* flowers that was imported chiefly from Japan. War with Japan had cut off the major source of supply just as the demand for pyrethrum soared.[4]

Studies conducted by U.S. Department of Agriculture entomologists demonstrated beyond question that this new insecticide had tremendous possibilities not only against lice but also against several other noxious insects, such as mosquitoes and houseflies.[5] With the help of the War Production Board, DDT was quickly put into large scale production. It seemed a panacea. It was easy to produce and safe to handle. Soon DDT production was approaching three million pounds a month by the time it was placed on Army supply lists in May 1943, and on Navy lists in January 1944.[6] All

DDT was allocated to the armed services save a few hundred thousand pounds used for further research. Among research tests conducted were field tests in which powered DDT was successfully used to arrest several small typhus epidemics in Mexico, Algeria and Egypt.

Egyptian research was supervised by Brigadier General Leon Fox, a field director of the Typhus Commission. Several months later General Fox was summoned to newly captured, refugee-swollen Naples where, in the wake of the German army, Allied medical authorities identified a potential typhus epidemic. New typhus cases in the city approached sixty a day and people were dying by the score. In mid-December Fox began systematically dusting the entire Neapolitan population with DDT. Dusting involved having people tie their garments at the ankles and wrists, and then using a dust gun similar to that used in gardening, the DDT powder was blown down the collar, creating a balloon effect. While a tedious procedure, Neapolitans were dusted as they exited the railway stations and dusted in the grottoes that served as bomb shelters beneath the streets.[7]

New cases began declining; by mid-February there were no new cases at all. For the first time in history, typhus, which thrives in cold, filthy, overcrowded conditions, was not only arrested but totally eliminated.[8] This was but the beginning of DDT's march to glory.

In August 1943, DDT was first tried against mosquitoes that carried malaria.[9] Malaria, a parasitic disease, has plagued humans for perhaps 50,000 years. Almost half of the world's population lives in areas where they are exposed to risk of malaria. Until the 1950s, malaria was widespread in Europe and North America, and epidemics were even recorded above the Arctic Circle.

In 1898, Ronald Ross, a physician stationed with the British army in India, discovered that mosquitoes transmit malaria. For this discovery Ross was awarded the Nobel Prize in Medicine in 1902. Elsewhere, Giovanni Battista Grassi, a leading Italian zoologist, identified the specific genus of mosquito (*Anopheles*) responsible for transmitting the malaria-causing parasite. Soon public health officials were targeting mosquitoes.

The principal methods of eradicating mosquitoes that carry malaria have been drainage — especially when followed by cultivation — and insecticides. Insecticides, notably pyrethrum, had been used in malaria control prior to DDT. This was sprayed on the inside walls of houses where the *Anopheles* mosquito rests after feeding. The mosquito takes up the insecticide while resting on walls and its toxicity kills her.

In August 1943, the Army began spraying the interior of buildings and found the procedure effective. DDT lasted for over six months and as a result a malaria control team could cover many more houses and protect far more people. In the spring of 1944, they began spraying in the town of Castel Volturno, north of Naples and later in the Tiber River Delta area.[10] These highly successful efforts proved the practical usefulness of DDT in malaria control.

Soon, soldiers and sailors by the millions were carrying small cans of DDT powder to protect themselves from bedbugs, lice and mosquitoes. They came to love the stuff, especially in the tropics. Millions of DDT aerosol bombs were used to spray the interiors of tents, barracks and mess halls. Throughout European refugee camps, along the span of the Burma Road, across jungle battlefields of Southeast Asia, on Saipan and dozens of South Sea islands infested by stinging, biting insects, DDT spread its beneficent mist.

As DDT supplies became more abundant, other clinical trials were conducted in 1944 and 1945. These trials led directly to the concept in the United States of a "nationwide malaria eradication" campaign. While DDT no doubt would eventually have found its place in malaria control, war requirements greatly accelerated its acceptance and use.

Even before the war and the advent of DDT, malaria had been declining in the United States because of improved standards of living, proliferation of window screens and other methods of protection from mosquitoes. In urban areas, better drainage and larviciding improved mosquito control that in turn led to fewer cases of malaria.

With the war's end, the U.S. Public Health Service (PHS), along with the Tennessee Valley Authority and the Rockefeller Foundation, began funding the large scale use of DDT for malaria control. Mosquito control officers in the United States used DDT in two ways: as a residual insecticide on the walls of houses and as a larvicide. The results were dramatic. By 1952, there were only 437 cases of malaria transmitted domestically, in contrast to the million of cases just a few years earlier.[11]

In the early 1950's the World Health Organization launched the Global Malaria Eradication Program.[7,11] South Africa was one of the first countries to use the insecticide in 1946 and within several years, malarial areas had decreased.[12] India's malaria control program saw similar decreases. Between 1953 and 1957, morbidity was more than halved from 10.8 percent to 5.3 percent of the total population, and malaria deaths were reduced almost to zero.[13] After DDT was introduced in Ceylon (now Sri Lanka), the number of malaria cases fell from 2.8 million in 1946 to just

110 in 1961.[14] Taiwan also adopted DDT for malaria control shortly after World War II; in 1945, there were over 1 million cases of malaria on the island; by 1969, however, there were only nine cases, and shortly thereafter the disease was permanently eradicated from the country. Similarly spectacular decreases in malaria cases and deaths were seen everywhere DDT was used.[15]

By the 1950s DDT had become the most publicised synthetic chemical in the world. One American newspaper clipping service accumulated nearly 21,000 items about it in an eighteen-month period between 1944 and 1945.[16] Most were glowingly enthusiastic; only a few questioned the mixed blessings of this new miracle compound. Dr. Clarence Cottam, Director of the Fish and Wildlife Service urged forethought in 1945 when he stated "caution in its use is essential because of our incomplete knowledge of its action on many living things, both harmful and beneficial."[17]

Other cautionary direction came from Fred Bishop who reported the following year in the *American Journal of Public Health* that "DDT must not be allowed to get into foods or to be ingested accidentally"[6] and American naturalist Edwin Way Teale who warned, "a spray as indiscriminate as DDT can upset the economy of nature as much as a revolution upsets social economy. Ninety percent of all insects are good, and if they are killed, things go out of kilter right away." Rachel Carson wrote to *Reader's Digest* in 1945 proposing an article about a series of tests on DDT being conducted not far from home outside the nation's capital in Silver Spring, Maryland.[18] The magazine rejected the idea.

Carson's interest in DDT did not wane and DDT's demise began with the publication of her 1962 book *Silent Spring*.[1] By the time Silent Spring was published she was a renowned nature author and a former marine biologist with the U.S. Fish and Wildlife Service. A native of rural Pennsylvania, she had grown up with an enthusiasm for nature matched only by her love of writing. In 1936, the Bureau of Fisheries (now the U.S. Fish and Wildlife Service) hired her as a full-time biologist and over the next 15 years, she rose in the ranks, becoming chief editor for all publications. The educational brochures she wrote for the Fish and Wildlife Service, as well as her published books and magazine articles, were characterised by meticulous research and a poetic evocation of her subject.[19-21]

Silent Spring took Carson four years to complete. In it she detailed how DDT entered the food chain. A single application on a crop, she wrote, killed insects for weeks and months, not only the targeted insects but countless more, and remained toxic in the environment even after it was diluted by rainwater. Carson concluded that DDT had irrevocably harmed birds and animals and was contaminating the entire world's food supply. The book's most haunting and famous first chapter, "A Fable for Tomorrow," depicts a nameless American town where all life - from fish to birds to apple blossoms to children - have been "silenced" by the insidious effects of DDT.

Carson recognized that the direct kills were by no means the worst effect of DDT. More widespread and disastrous by far, were the delayed kills, coupled with the inhibition of reproductive processes. Entire species of birds were threatened with extinction. *Silent Spring* describes an early instance that occurred on the campus of Michigan State University. Annual spraying of elm trees with DDT began there in 1954 to control the beetle that spreads Dutch Elm disease. For the first year or so, there were little visible side effects, but people began noticing that robins had disappeared from the campus. The cyclic silencing that Carson had described was occurring: earthworms feeding on elm leaves contaminated with tiny amounts of DDT accumulated the chemical in their body fat until a level toxic to robins was reached. Robins that ate contaminated worms died, even robins unfortunate enough to visit the campus two years after spraying ceased.

"Like the robin, another American bird seems to be on the verge of extinction. This is the national symbol, the eagle," Carson wrote. She suggests that DDT's increasingly massive invasion of the food chain was largely responsible for the fact that bald eagles were ceasing to breed on the East Coast (large concentrations of DDT residues were found in the brains of prematurely dead eagles) and that eagles in the Great Lakes region faced extinction because their egg shells were growing too thin (the physiological mechanism by which DDT inhibits calcium production had yet to be discovered).

Carson never argued that all pesticides should be banned entirely, but that "control must be geared to realities, not to mythical situations, and that the methods employed must be such that they do not destroy us along with the insects."[1] Neither did she call for DDT to be banned for the purpose of fighting malaria (nor indeed has it been banned for that purpose by the United States or the World Health Organization). Carson argued that the widespread use of DDT as an agricultural pesticide was harmful for three reasons:

First, its indiscriminate application had repercussions on the ecosystems that range far beyond the intended effect, resulting in the death of fish and birds, and population drops in species that depend on specific insects. Additionally, the deaths of predators cause population explosions in other pests. Carson cites the example of the spider mite that "has become practically a worldwide pest as DDT and other insecticides have

killed off its enemies." Widespread DDT spraying in Montana and Idaho in 1956 caused "the most extensive and spectacular infestation of spider mites in history."[1]

Second, allowing DDT to soak into the soil, the drinking water and the skin has health repercussions for humans. Carson sounded an initial alarm in *Silent Spring*, but at that time little was known about cancer, its causes and it relationship with DDT and other similar pesticides.[22]

Third, overuse of DDT in agriculture allows malaria-spreading mosquitoes to develop resistance to DDT and other pesticides. Once this happens, small-scale malaria spraying becomes useless and the problem worsens, forcing public health officials to resort to more dangerous pesticides that often have worse health effects on humans and their ecosystems.

Resistance to insecticides by mosquitoes…has surged upward at an astounding rate, being created by the thoroughness of the very house-spraying programs designed to eliminate malaria. In 1956, only 5 species of these mosquitoes displayed resistance; by early 1960 the number had risen from 5 to 28! The number includes very dangerous malaria vectors in West Africa, the Middle East, Central America, Indonesia, and the Eastern European region.... Agencies concerned with vector-borne disease are at present coping with their problems by switching from one insecticide to another as resistance develops. But this cannot go on indefinitely.[1]

She began the book with the working title — "The Control of Nature," but changed to "Man Against the Earth," then "Dissent in Favor of Man." It was her editor Paul Brooks that suggested using "Silent Spring." Carson's work first appeared as a series of three articles in the *New Yorker* magazine.

Even before publication, Carson was violently assailed by threats of lawsuits and derision, including suggestions that she was a "hysterical woman" unqualified to write such a book. A huge counterattack was led by Monsanto, Velsicol, and American Cyanamid, supported by her former employer the U.S. Department of Agriculture. In their heated campaign to silence Carson, the chemical industry only increased public awareness. *Silent Spring* soon became a runaway best seller.

Silent Spring was on the New York Times bestseller list for 31 weeks. Subsequently it appeared on The Modern Library's "Best 100 Non-fiction Books of the Century" (#5); Boston Public Library's "100 Most Influential Books of the Century"; and New York Public Library's 100 "Books of the Century." Rachel Carson was one of only twenty "scientists and thinkers" recognised in Time's 100 most important persons of the 20th century.

Two years after her best seller was published— in April, 1964 — Rachel Carson, aged fifty-six, died of cancer. (Dr. Paul Müller died in October of the following year, at the age of sixty-six.)

The most important legacy of *Silent Spring* was a public awareness that nature was vulnerable to human intervention. Carson had made a radical proposal — that, sometimes, technological progress is fundamentally at odds with the natural processes and it must be curtailed. The threats Carson had outlined — the contamination of the food chain, cancer, genetic damage, the deaths of entire species — were too frightening to ignore. For the first time, the need to regulate industry in order to protect the environment became widely accepted and environmentalism was born.

Many believe that DDT was banned after 1972. In fact it continued to be used for pest control, for which exemptions were granted by the federal government and it is still available for public health use today. In January 1979, DDT was used to suppress fleas that carried typhus in Louisiana. That same year, the California Department of Health Services used DDT to suppress fleas that carried bubonic plague. Texas got an exemption to control rabid bats in October 1979. Between 1972 and 1979, DDT was used to combat the pea leaf weevil and the Douglas-fir tussock moth in the Pacific Northwest; rabid bats in the Northeast, Wyoming, and Texas; and plague-carrying fleas in Colorado, New Mexico, and Nevada. State governments, with the permission of the federal government, continued to use DDT to protect public health and agriculture.[23]

Malaria continues to threaten military forces. In 1993, over 200 US Marines and Soldiers participating in Operation Restore Hope in Somalia developed malaria. Noncompliance with personal protective measures and chemoprophylaxiscontributed to this largest outbreak of malaria in US military personnel since the Vietnam conflict.[24, 25]

DDT is neither a panacea nor a super villain. In many places DDT failed to eradicate malaria not because of environmentalist restrictions on its use but because it simply stopped working. Carson showed that insects have a phenomenal capacity to adapt to new poisons; anything that kills a large proportion of a population ends up changing the insects' genetic composition so as to favour those few individuals that manage to survive due to random mutation. In the continued presence of the insecticide, susceptible populations can be rapidly replaced by resistant ones.

By 1972, when the DDT controls went into effect in the United States, nineteen species of mosquitoes capable of transmitting malaria, including some in Africa, were resistant to DDT. Genes for DDT resistance can

persist in populations for decades. Spraying DDT on the interior walls of houses led to the evolution of resistance half a century ago. In fact, pockets of resistance to DDT in some mosquito species in Africa are already well documented. There are strains of mosquitoes that can metabolize DDT into harmless by-products and other mosquitoes have evolved whose nervous systems are immune to DDT.[26] There are even mosquitoes that avoid the toxic effects of DDT by resting between meals not on the interior walls of houses, where chemicals are sprayed, but on the exterior walls, where they don't encounter the chemical at all.[27]

And if public health officials have learnt anything since the rise and demise of DDT about the million-plus species of insects in the world, it's that there is no such thing as an all-purpose weapon when it comes to pest management. DDT may be useful in controlling malaria in some places, but it's essential to determine whether target populations are resistant; if they are, then no amount of DDT will be effective.

Silent Spring is credited for the fact that public, governmental, and scientific attention was focused on the threat of DDT. In 1963, in direct response to the public concern aroused by Silent Spring, President John F Kennedy's Science Advisory Committee recommended an immediate reduction of DDT use with a view to its total elimination as quickly as possible, along with other "hard" pesticides. In November 1969, acting on the recommendation of a special study commission on pesticides, Robert H. Finch, Secretary of Health, Education, and Welfare, announced that the federal government would "phase out" all but "essential uses" of DDT within two years.

Silent Spring, both as a work of literature and a clarion for the scientific scrutiny of the use of pesticides, shows every evidence of enduring as one of the most read and most revered books on science addressed to a general audience.

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Author's affiliation: Womack Army Medical Center, Fort Bragg, NC. Contact author: Cristóbal S Berry-Cabán, PhD, Clinical Researcher/Epidemiologist, Womack Army Medical, Center Department of Research, Fort Bragg, NC 28310-5000, USA Email: cris.berrycaban@us.army.mil

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Rickettsial Diseases of Military Importance: An Australian Perspective

Stephen P. Frances

Abstract

The threat of rickettsial diseases to Australian Defence Force (ADF) personnel is reviewed, focusing on the historical impact and epidemiology of these diseases. Scrub typhus, a mite borne disease caused by *Orientia tsutsugamushi* is historically the most important rickettsial disease, and continues to cause morbidity in ADF personnel today. The historical occurrence of tick typhus, murine typhus, epidemic typhus and Q fever has been limited, and modern diagnostic tools and antibiotic therapy mean that their impact is minimal. Deployment of troops to endemic areas, bioterrorism and exposure during humanitarian missions mean that rickettsial diseases will remain a threat to ADF personnel.

Several rickettsial diseases have the potential to impact on military deployments. This article is a review of the information concerning the ecology, epidemiology and historical impact of rickettsial diseases on the Australian Defence Force (ADF) personnel in peace and in wartime. Probably the most widespread and important rickettsial disease is scrub typhus, while diseases such as tick typhus, murine typhus, epidemic typhus and Q fever have been of lesser importance.

Scrub typhus

Scrub typhus, an important rickettsial disease of humans, is widespread in central, eastern and southeast Asia, and the southeastern Pacific region.[1] It is transmitted to humans by the bite of larval trombiculid mites, known as chiggers, infected with *Orientia (formerly Rickettsia) tsutsugamushi*, and causes significant morbidity and mortality. The epidemiology of scrub typhus is complex, involving the causative bacteria, vector chigger mites, vertebrate hosts that maintain the chigger mites, and humans, who by modifying the environment influences the ecology of maintenance hosts and is an occasional victim of the disease.[2] The vectors of scrub typhus all belong to the genus *Leptotrombidium*. The main vector is *L. deliense*, which occurs in a wide area including southeast Asia, Pakistan and Australia, while *L. akamushi, L. pallidum* and *L. scutellarae* are found in Japan and Korea, and *L. fletcheri* and *L. arenicola* in Malaysia.[1] A number of other genera of trombiculid mites have been found with *O. tsutsugamushi* in their tissues using direct fluorescent antibody tests, but their role as vectors of scrub typhus has not been confirmed.[3, 4]

Scrub typhus was a significant disease among allied troops operating in the south west Pacific region during World War II. In Papua New Guinea there were approximately 2,840 cases reported in the Australian Army between March 1942 up to December 1945 (39 months), of which 2,100 cases were reported before the end of 1943, with a case mortality rate of 9%.[5,6] Studies on control measures against scrub typhus were facilitated by the isolation of the Karp strain of *O. tsutsugamushi* at Queensland Institute of Medical Research in 1943 from an American soldier (Karp) who had been wounded at Buna (on the north coast of Papua New

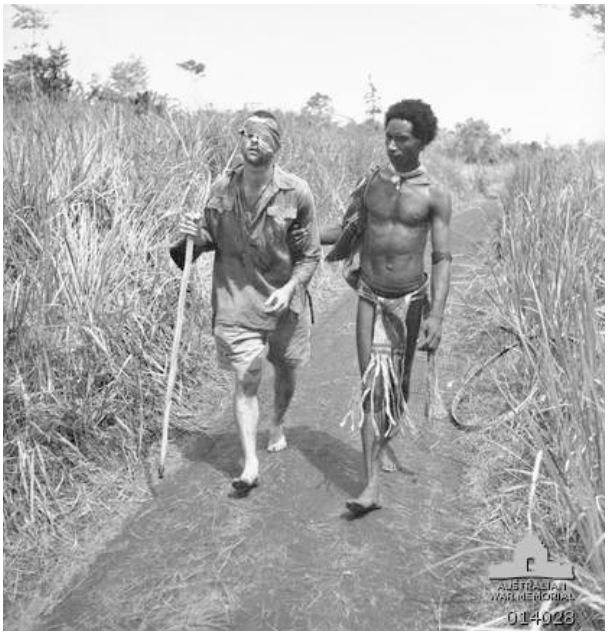

Figure 1. An iconic photo of Private George C. Whittington being helped along a track near Buna, Papua New Guinea on Christmas day, 1942, towards a field hospital at Dobodura. The Papuan native is Raphael Oimbari. Whittington had been wounded the previous day in the battle for Buna Airport. He recovered from his wounds, but died of scrub typhus at Port Moresby on 12 February 1943 (War memorial photo 014028).

Guinea) and evacuated to Brisbane.[7] An Australian soldier, also wounded at Buna in December 1942 was photographed being taken to a field hospital by a New Guinea native (Figure 1), and although the soldier survived his battle injury, he unfortunately died from scrub typhus infection in February 1943.

The use of personal protection measures against mite vectors of scrub typhus were investigated in Australia and the USA in 1942-43. In 1942, American workers found that dimethylphthalate and other new mosquito repellents applied to military clothing were effective against chiggers.[8] The Australian Army found dibutylphthalate was less toxic to mites than dimethylphthalate, but was more readily available in Australia and more resistant to washing and was introduced at the end of 1943 as "anti-mite" fluid. The introduction of dibutylphthalate as an antimite fluid was responsible for a 90% reduction in scrub typhus infections among Australian soldiers.[9] This is one of the few examples where the use of personal protection measures resulted in a significant recorded reduction in vector borne disease.

During World War II, soldiers feared scrub typhus more than malaria, as there were drugs available for malaria treatment.[6] Development of tetracycline antibiotics for the treatment of scrub typhus was begun during World War II, and gained impetus after the end of the war. The work of the US Army was significant, and resulted in the use of chloromycetin as a treatment for scrub typhus.[10] A combination of successful antibiotic treatment and clothing treatment resulted in confidence that the disease could be managed successfully.

After World War II, the next time that scrub typhus was a problem for Australian soldiers was during the emergency in Malaya between 1955 and 1959. In 1956 only 4 cases of scrub typhus occurred in a battalion of soldiers, but 8 cases occurred in March 1957 after an operation in which the battalion traversed a mite infested area. The use of dibutylphthalate treatment of military clothing was the only preventative method of protection, and the use of "anti-mite" fluid was re-enforced. Despite this, 13 cases of scrub typhus were recorded between July and September 1957. A total of 27 cases were subsequently reported in a battalion group in Malaya between 1957 and 1959.[11]

Scrub typhus was also an important disease among soldiers during the Vietnam conflict. There were sporadic cases of scrub typhus among Australian soldiers in South Vietnam. Australian soldiers were issued with dibutylphthalate for protection against vector mites. In 1962, there was a small team of advisors in South Vietnam, and there were few cases of scrub typhus. In May 1965, a battalion group of soldiers was in the Ben Cat region and 2 cases of scrub typhus were observed in soldiers who did not use anti mite fluid. Australian medical staff thought that scrub typhus did not occur in the region, but following the two cases in 1965, they actively recommended the application of dibutylphthalate to clothing and boots to provide some protection against trombiculid mites. In September 1967, a soldier died from scrub typhus, having originally being diagnosed as having Japanese Encephalitis virus. This fatality highlighted the need for diagnostic services and reinforced the danger of scrub typhus to troops. A study in Phuc Thuy province, Vietnam, found 17% of 94 soldiers with fevers of unknown origin (FUO) were suffering from scrub typhus infection.[11] The incidence of scrub typhus in French and American personnel during conflicts in Vietnam was also significant. Pages et al.[12] reported between 20-30% of FUO's among French and American troops were due to scrub typhus.

Studies conducted in Malaysia showed that the antibiotic doxycycline could be used as a prophylactic agent against scrub typhus.[13] Doxycycline is currently the first line malaria prophylaxis used by the Australian Defence Force[14] and is effective against rickettsial diseases, as well as some sexually transmitted diseases. The use of doxycycline as a malaria prophylaxis provides protection against infections such as scrub typhus in personnel deployed to endemic regions in southeast Asia.

Scrub typhus is endemic in northern Australia, and is found in the wet tropics of Queensland and the Northern Territory. The disease was first recognized in the 1920's, and was one of the most important health problems in the region. Cases of the disease occurred in areas of Queensland with high rainfall and humidity, and were associated with rainforest habitats on the wetter side of the 60 inch (1524mm) isohyet.[15] The incidence of scrub typhus in Queensland has been low during the last 4 decades, with only a few published reports of cases.[16,17] In the early 1990's a new focus of disease was reported at Litchfield National Park in the Northern Territory. Five cases of scrub typhus occurred in a remote rainforest region, with 2 near fatal due to multisystem involvement.[18] The mite vector, *Leptotrombidium deliense*, was found on rodents collected near the human cases.[19] A subsequent death from scrub typhus was reported from a worker in Litchfield National Park in 1996.[20] Cases have also been reported in Torres Strait islands[21] and a single case in Western Australia.[22]

Personal protection against mites has also improved. In 1995, it was recommended that military uniforms be treated by dipping in a 0.6% water emulsion of

Figure 2. The larva of a scrub itch mite, Eutrombicula hirsti.

permethrin (Perigen Defence®) to protect the wearer from mosquito-borne diseases malaria, dengue and other arboviruses. Permethrin treatment of clothing was shown to be effective against the scrub itch mite, *Eutrombicula hirsti* (Figure 2), during studies at Cowley Beach Training Area.[23] There have been sporadic cases of scrub typhus among Australian soldiers in northern Queensland, and many of these have been reported from soldiers training at Cowley Beach.[16,17] The occurrence of cases in soldiers training at Cowley Beach (Figure 3) in 1996 prompted the recommendation that doxycycline prophylaxis be used by all ADF personnel training at Cowley Beach. This antibiotic is also recommended for prevention against leptospirosis.[16]

Figure 3. Cowley Beach Military training area, 1991.

This disease is one of the few vector borne diseases that still causes a loss of manpower in Australia among ADF personnel, and members on operations or training in rainforest habitats will be adversely affected.[24] *Orientia tsutsugamushi* occurs in a large area in southeast Asia and the south west Pacific region, and will continue to be a concern for deployed forces into the future.

Tick typhus

The occurrence of tick-borne typhus is worldwide and is dependant on the species of tick present in a region. In Australia, two main species occur, *Rickettsia australis*, which is the causative agent of Queensland tick typhus,[25] and *R. honei*, the cause of Flinders Island spotted fever. Queensland tick typhus was recognized as a new illness among Australian soldiers training on the Atherton Tableland during World War II.[26,27] The disease was subsequently recognized in areas as far south as Victoria.[28] The vector of *R. australis* is the Australian scrub tick, *Ixodes holocyclus*. This tick occurs along the eastern seaboard and ticks may remain attached to humans for several days while taking a large bloodmeal. *R. australis* causes a vesicular rash in humans, and is usually mild, although a single fatal case has been reported.[29]

Flinders island spotted fever was first described in 1991,[30] and is caused by *Rickettsia honei*.[31] The disease is characterised by fever, headache, myalgia, transient arthralgia, maculapapular rash and sometimes cough. The disease is also transmitted to humans by ticks.[32] The finding of a new strain of spotted fever group rickettsia by Unsworth et al.[32] suggests that more genetically distinct strains may be discovered in the future. The new strain was designated the "marmionii" strain of *R. honei*, in honour of Australian physician and scientist, Barrie Marmion.[32]

Ticks are a nuisance for patrolling troops, but the occurrence of tick attachments in defence personnel is rarely reported in the scientific literature. Problems with tick attachment (*Amblyomma triguttatum*, kangaroo tick) to military personnel in Western Australia are an example where military training was adversely affected.[33] The occurrence of *R. australis* in military personnel is minimal, although two cases were reported from soldiers training in the Cowley Beach Training area in 2005.[17] Contact with ticks is enhanced by military activities, which include patrolling, resting and sleeping in forest habitats. These activities increase the likelihood of contact between military personnel and the tick vectors of typhus. The use of chemoprophylaxis for protection against Queensland tick typhus is not recommended, but the use of topical repellents and permethrin treated uniforms is thought to provide enhanced protection against tick attachment.[34]

Murine typhus *(Rickettsia typhi)*

Murine typhus has world wide distribution and is transmitted between rats by rat fleas (*Xenopsylla cheopis*). The mode of transmission of *R. typhi* to the vertebrate host was thought to be by infected flea faeces, and laboratory experiments showed transmission by the bites of fleas.[35] The disease was first described by Dr Hone as occurring in Adelaide

in Australia in 1922, In 1926 and 1960, cases of murine typhus were reported in Toowoomba, Queensland, associated with mouse plagues.[36] Murine typhus has been subsequently reported in Mossman, Queensland[36] and Western Australia,[37] suggesting that the disease is found Australia wide. Murine typhus caused infection in allied personnel during World War II and the Vietnam conflict. During World War II, the disease was not significant, but cases were identified in widely different areas, including north Queensland and Port Moresby, PNG.6 In Vietnam, murine typhus was rarely a serious illness, and the disease was treated with tetracycline. The disease was considered a threat before the first Gulf war when soldiers were deployed into endemic areas within Kuwait.[12]

Murine typhus is treated with a variety of antibiotics, with doxycycline being the most commonly used. This disease is rarely reported in Australia, with rural people most at risk, particularly during rat or mice plagues.

Epidemic typhus *(Rickettsia prowazekii)*

Historically, epidemic typhus caused by *Rickettsia prowazekii* has occurred in times of social unrest, war and famine. The disease is spread by the human body louse, *Pediculus humanus*. Lice become infected after ingesting blood containing rickettsia, which then enter the cells of the gut wall. Rickettsiae multiply until the cell bursts and rickettsiae are passed in the faeces of the louse. Transmission to humans occurs when louse faeces are scratched into the skin.[38] Vigorous scratching of the area where lice have bitten allows rickettsiae to enter the body through the broken skin.

R. prowazekii caused major outbreaks of disease in many conflicts up to World War I. During World War II, due to advances in diagnostics, therapeutics, louse control methods and vaccine development, there were few cases of epidemic typhus. The disease can re-emerge due to the breakdown of social conditions as has occurred in some locations in Africa and the Middle East in the last 20 years.[12] This disease does not occur in Australia, and environmental conditions in Australia limit the development and spread of body lice among people.[28] The disease occurs in impoverished colder countries, often at high altitudes.

Q fever

Q (Query) fever is a zoonosis with worldwide distribution. The disease was first described as a febrile illness in Brisbane abattoir workers.[39] The causal agent was isolated from guinea pigs inoculated with patient blood by Dr Edward H. Derrick,[40] and was originally called *Rickettsia burnetii*. The pathogen was re-named as *Coxiella burnetii*. The infection in humans is often non-specific and can be asymptomatic. Common symptoms include fever, fatigue, chills, myalgia, sweats and cough. The disease is transmitted to people in airborne droplets from infected cattle, sheep, rodents and cats. Although the organism is found in a number of tick species, human disease is acquired primarily through inhalation of aerosol droplets. Q fever is normally found in abattoir or dairy workers, but there have been recent incidental cases in military personnel, including British soldiers disposing of animal carcasses in the United Kingdom,[41] Argentinean police working in Kosovo,[42] and a small number of US soldiers in the middle east.[43]

Rickettsial agents as bioterrorist weapons

The biological characteristics of rickettsiae and *C. burnetii* have allowed them to be weaponised for use as bioterrorism agents.[44] The use of *C. burnetii* as a biological weapon would cause a disease similar to that of naturally occurring Q fever. The high infectivity rate means that only a small number of organisms would be needed to cause disease. The use of *C. burnetii* as an aerosol would be possible due to its resistance to desiccation, heat and persistence on wet and dry surfaces for a long time. There are limitations to the use of rickettsiae as biological weapons, including the need to produce highly purified, virulent, weapon quality rickettsiae that retain survival and virulence. The availability of counter-measures against bacteria may also limit their use as weapons.[44] Despite these limitations, bioterrorism can instill fear into a society, devastate economies and cause diseases within the community.[45]

The serology of rickettsial diseases is the mainstay for diagnosis. This may involve collection of convalescent sera to confirm the diagnosis. All rickettsial diseases are treated with antibiotic therapy. Doxycycline is the drug of choice and chloramphenicol may be used as an alternative. The increased contact between soldiers and the vectors of rickettsial diseases, primarily ticks and mites, means that their risk of exposure to disease is increased. This is currently moderated by the use of personal protection measures against vectors and the use of antibiotics, which should provide good protection against disease. However, in some circumstances, these measures are not followed, cases of scrub typhus have occurred periodically, and so it is likely that rickettsial diseases will cause concern for military personnel in the future. The current frequency of deployments to warlike and humanitarian missions mean that rickettsial diseases will remain a threat to ADF personnel.

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Author's affiliation: Australian Army Malaria Institute, Enoggera, Qld
Contact author: MAJ Stephen P. Frances, Australian Army Malaria Institute, Gallipoli Barracks, Enoggera Qld 4051
Email: steve.frances@defence.gov.au

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Therapeutic guidelines: Rheumatology*

Rheumatology Expert Group.

**Version 2. xxiii+315pp, ISBN 978-0-9804764-8-4. Melbourne, Therapeutic Guidelines Limited, AUD39.00, 2010 (2011 eBook also available).*

Apart from major textbooks, there have been few handbooks published specifically on rheumatology guidelines. This second eBook Version of *Therapeutic Guidelines: Rheumatology*, part of a collection of 14 in the series of the popular and respected Therapeutic Guidelines series in Australia, is a significant step forward in filling this gap. *Therapeutic Guidelines: Rheumatology* has a table of Contents, list of Tables, Boxes and Figures, a list of the members of the Rheumatology Expert Group, Acknowledgments, Endorsements and support, About Therapeutic Guidelines Limited and their Board of Directors, a Preface, 19 Chapters, two Appendices, a useful Glossary, a comprehensive Index, and a Request for comment on guidelines proforma. It also includes 19 Tables, 11 Boxes and eight Figures.

As is usual in this series, the handbook is compact and, if consistent with others in the series, the reader will expect that updated guidelines would be released every few years; in this case approximately 4 years since the First Edition. The front cover has a basic but functional design with an image of an oil can dripping oil (suggestive of improving lubrication of joints). The back cover is virtually blank, except for the ISBN and barcode, and an opportunity has been missed to include a fast find contents list or an overview of the publication; however all of the Therapeutic Guidelines' handbooks seem to take this minimalist approach. Similarly, it may be interesting to explore making better use of the inside front and back covers, as has been done in other series, such as the Oxford Handbooks, by listing for example major emergencies and the page references to find information to manage them. Each chapter has a useful highlighting strip on the edges of the pages, which importantly helps to identify the various chapters, although they are not staggered, which defeats their purpose somewhat. It is also important to note that the handbook is also available electronically and this would make it very easy to print out patient information sheets, for example.

As an Australian based publication, it is inevitable that the writing group would be predominantly Australian. It is interesting however that all 16 members of the Rheumatology Expert Group are Australian based. None-the-less, many of these experts would be well known in the rheumatology field. Apart from the field of rheumatology, there are experts from the fields of general practice, sports medicine and clinical pharmacology.

Therapeutic Guidelines: Rheumatology is well researched, concise and consistent in its presentation. Chapters include "Getting to know your drugs"; "Assessment of the patient with peripheral musculoskeletal symptoms"; "Joint aspiration and injection"; "Management of chronic rheumatological diseases"; "Osteoarthritis"; "Crystal deposition disease"; "Rheumatoid arthritis"; "Spondyloarthritides, including psoriatic arthritis"; "Inflammatory connective tissue disease"; "Generalised noninflammatory chronic pain syndrome (including fibromyalgia)"; "Polymyalgia rheumatica and giant cell arteritis"; "Vasculitis and other inflammatory syndromes"; ":Assessment of spinal pain"; "Neck pain"; "Low back pain"; "Upper limb conditions"; "Lower limb conditions"; "Rheumatological disorders in children and adolescents"; and "Musculoskeletal conditions in pregnancy". There are also two Appendices, namely "Resources" and "Pregnancy and breastfeeding". By far, the largest chapter is Chapter 1 "Getting to know your drugs" (pages 1-33). There is no consistent approach to the discussion of individual drugs or drug groups; however dosage, side-effects and toxicity are amongst the sub-headings inconsistently used. The drugs covered include Analgesics, Corticosteroids,

Disease-modifying antirheumatic drugs and immunosuppressants, Cytokine modulators, Drugs used for the treatment of gout, Fish oil (omega-3 long chain polyunsaturated fatty acids), Vasoactive drugs used in rheumatology and Complementary medicine. There is no particular set pattern to the structure of the chapters and sections in the guidelines.

Version 2 is a major update of *Therapeutic Guidelines: Rheumatology*. There is a new chapter on assessment of peripheral musculoskeletal disorders, including clinical features (red flags) that indicate potentially serious pathology and a summary table to help determine rheumatological causes of inflammatory musculoskeletal symptoms (Ch. 1). There are updated recommendations concerning drug treatment of

rheumatological pain, particularly for low back pain, osteoarthritis, acute neck pain and shoulder pain. There is an increased emphasis on the role of non-pharmacological therapy, including patient self-management, where appropriate. There is a new chapter on polymyalgia rheumatica and giant cell arteritis (Ch. 11). There are new sections, which provide information on non-inflammatory musculoskeletal pain in children and practical points for paediatric prescribing. There is also an increased emphasis on the importance of monitoring for adverse effects of drugs, such as for disease-modifying anti-rheumatic drugs and corticosteroids.

From the Australasian perspective, it is hard to fault the guidelines, although a more obvious multidisciplinary approach could have been adopted. One possible area for those interested in tropical medicine would be a chapter on issues connected with viral arthropathies associated with diseases such as Ross River virus infection or Barmah Forest virus infection, which are only briefly mentioned in a table (page 36) and in the corresponding main text (page 40). Another possible omission is that there is no special compilation of the rheumatological side-effects surrounding acute or chronic poisoning, such as with lead (mentioned on page 36), which might be found in a larger textbook. None-the-less, it is a very useful rapid therapeutic guidelines reference.

Therapeutic Guidelines: Rheumatology is not a substitute for training and experience in rheumatology or indeed related areas, such as sports medicine. It is also not meant to be a comprehensive textbook, especially as there have been several good textbooks published recently.[1,2] The handbook does however provide an exceptionally useful and fairly comprehensive clinical reference on most aspects of rheumatology for the informed health professional, particularly those who are working or will be working professionally in rheumatology, sports medicine, occupational medicine, hospital practice and general practice. The book will also appeal to general physicians and other health professionals, who have an interest in rheumatology, as well as students and academics involved in psychotropic training courses. *Therapeutic Guidelines: Rheumatology* has little competition in the guidelines field and is an important guidelines reference handbook in Australasia.

Reviewed by: Peter A. Leggat, MD, PhD, DrPH, FAFPHM, FFPH RCP(UK), FACTM, FACRRM, Professor and Deputy Head (Campus Head), School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University, Townsville, Queensland, Australia.
E-mail address: peter.leggat@jcu.edu.au

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Toxicology Handbook

*Lindsay Murray, Frank Daly, Mark Little and Mike Cadogan**

**2nd edn, xii + 529 pp, paperback with illustrations, ISBN: 978-0-7295-3939-5. Sydney, Churchill Livingstone (Imprint of Elsevier), RRP: $69.95, 2010.*

There are many excellent toxicology textbooks available internationally, including the recently published 9th edition of *Goldfrank's Toxicologic Emergencies*.[1] These are wonderful resources for those seeking a full and detailed understanding of toxicology but don't always meet the needs of the clinician at the bedside. They are often large texts, difficult to access quickly and written from a US perspective. Clinicians faced with managing an overdose, poisoning or envenomation need a resource that is easy to access, easy to navigate and offers practical solutions to problems in the Australasian context. The *Toxicology Handbook*, now in its 2nd edition, and written by Australian authors, provides this and is establishing itself as one of the leading reference manuals in Australasia in the fields of both toxicology and toxinology.

The 2nd edition of the *Toxicology Handbook* is a small (A5) 529-page publication that is portable and easy to use. It includes a table of Contents, Foreword, Preface, list of Authors, Contributors and Reviewers, six Chapters, 166 Sections, six Appendices, and an Index. There is no bibliography although references are provided in each section, which is more useful for the reader. Importantly the 2nd edition has online support, with searchable full text able to be activated via a PIN provided on the inside cover of the manual.

While the 2nd edition of the *Toxicology Handbook* now forms part of the "Student Consult" series, both its described primary target audience and usefulness extend far beyond this. The stated target audience is "hospital-based doctors at all levels", presumably in Australasia, with suggestions that it would also be a useful resource for paramedics and pharmacists. Community practitioners could equally be added to this list, especially those in rural practice while some aeromedical retrieval services have already adopted the text as a core resource. Its utility is best summarised by the fact that it is now the core reference for Australian Poisons Information Centres.

The Chapters are grouped and colour coded and include in order "Approach to the poisoned patient"; "Specific considerations"; "Specific Toxins"; "Antidotes"; "Envenomings"; and "Antivenoms". The largest chapter is that on specific toxins, which discusses 78 toxins listed alphabetically from Alcohol to Warfarin. The colour coding of chapters and alphabetical listing are examples of the practical nature of the manual.

The structure of each toxin section has also been well thought out to promote ease of use. Inclusions such as the bold font summary of the toxin at the start of each section and the very useful "Handy Tips", "Pitfalls", and "Controversies" are of particular note. The separation of the Paracetamol section into acute and repeated is helpful, while the clinical experience of the authors is evident in the practical nature of a number of their recommendations. These include stating the lack of indication for blood tests in children in certain overdoses (e.g. rodenticide) and geographical differentiation based on risk for 'big black spider bites', which also reveals a dry sense of humour in a reference text.

The chapters on Envenomings and Antivenoms have been updated significantly in line with new evidence and are essential reading for most clinicians in Australian practice. While there is a lack of information on envenomation syndromes from overseas this should not be an issue in a predominantly Australasian text. While Australia has exported redbacks overseas, fortunately the favour has not been returned. Updated sections include a major review of snake bite management and snake antivenoms; new chapters on mushroom poisoning, plant poisoning, amphetamine abuse and solvent abuse; new chapters on poisoning with newer anticonvulsant drugs, barbiturates, button batteries, chloral hydrate, local anaesthetic agents, quinine and tramadol; and a new antidote chapter on intravenous lipid emulsion.

The Appendices include "Poisonings Information Telephone Numbers", "Example ECGs", "Conversion factors and therapeutic ranges for important toxins", "Alcohol Pathways", "Therapeutic Over-warfarinisation", and "Management of Allergic Reactions to Antivenoms". A note for future editions might be an additional appendix on the use of a Venom Detection Kit for those seeking a 'one stop shop'.

The only suggestions for improving this text really represent the esteem the text is held in rather than failings of the text itself. A new edition is inevitable as new agents are developed and future research, particularly in the field of envenomation, is conducted. There is also the question of the inclusion of herbal remedies and substances such as hazardous materials and radio-active isotopes. The increasing use of this text as a 'go to' resource also suggests the possible

inclusion of side effect and toxicity management for hospital based therapeutic agents such as heparin and thrombolytic agents. The challenge for the authors will be to keep future editions of the manual to a manageable size.

The authors are all Emergency Physicians active in clinical practice in Australia. Lindsay Murray is also a Clinical Toxicologist at Sir Charles Gairdner Hospital in Perth; Frank Daly is Director of the Emergency Department and Consultant Clinical Toxicologist at Royal Perth Hospital; Mark Little, who has recently moved to Cairns is listed in his previous role as Consultant Emergency Physician and Clinical Toxicologist, Royal Perth Hospital. All of these three also contribute to the on call Consultant Toxicologist support to the Australian Poisons Information Centre. Mike Cadogan completes the Western Australian connection and is also from Sir Charles Gairdner Hospital.

The 2nd edition of the *Toxicology Handbook* is highly recommended. It has been well thought out and well structured with a practical focus. It is these characteristics that have seen the *Toxicology Handbook* rapidly becoming the pocket resource in toxicology for Australasian clinicians. The new 2nd edition with on line support is likely to cement that role. At $69.95 it is affordable and good value, to the point that we would suggest a copy should be available in all Emergency Departments and acute care facilities. It is so good that it almost makes us want to go out and buy a white coat again, just so we can carry one around!

Reviewed by: Peter Aitken, MBBS, EMDM, MClinEd, FACEM, Associate Professor, School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University, and Senior Staff Specialist in Emergency Medicine, The Townsville Hospital, Townsville, Queensland, 4811, Australia.
Peter A. Leggat, MD, PhD, DrPH, FAFPHM, FFPH RCP(UK), FACTM, FFTM ACTM, FFTM RCPSG, FACRRM: Professor and Deputy Head (Campus Head), School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University, Townsville, Queensland, 4811, Australia.

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Better health outcomes for OSA using the Flinders Chronic Disease Management Program

Antic, NA, Garner S, Harris M, Heatley E, McEvoy RD, Battersby M

Introduction: Obstructive Sleep Apnea (OSA) is a chronic disease with long term complications. OSA is a disease more prevalent in men and seen in higher prevalence amongst Veteran populations. Medical management of OSA includes CPAP to maintain airway patency. An additional program targeting factors contributing to OSA, comorbidities and lifestyle factors, including weight loss as a goal, could reduce excessive daytime sleepiness and improve other health outcomes. The intent of this pilot project was to evaluate the feasibility and acceptability of using the Flinders Program to target risk factors, as well as manage chronic disease in patients with OSA

Methods: Adelaide Institute for Sleep Health Physicians recruited patients with moderate to severe OSA (AHI≥30) between 09/2010 and 11/2010. At the initial appointment they were asked to complete baseline questionnaires (demographics, HADS, ESS, PACIC) and then they commenced the Flinders program with a trained clinician: this included jointly creating a care plan and identifying and setting goals with the intention of improving tenacity and motivation with OSA therapies as well as other problems and comorbidities. Referrals were provided to a commercial meal replacement program and health resources as required. Contact was maintained by a clinician to support behaviour change and participants attended two additional appointments at six weeks and four months later.

Results: Eleven patients agreed to participate and nine patients completed the study. At Baseline: mean weight 116.0 kg (SD 33.1); mean BMI 39 (SD 8.2); mean waist circumference 126 cm (SD 18.7); mean ESS 8.5 (SD 4.6); mean HADS Anxiety 7.5 (SD 2.8) and Depression 5.5 (SD 3.2); mean PACIC 2.44 (SD 0.77). At the 4 month follow up the average weight change was -8.8 kg (SD 8.8) with an average change of 3 in BMI (SD 2.2). Patients also reported being less sleepy with an average change of -2.9 points (SD 4.1) in ESS and more satisfied with their chronic illness care with an average increase of 1.4 (SD 0.7) measured by PACIC. Their scores for depression and anxiety also improved (HADS Anxiety -3.1 SD 3.6, Depression -4.2 SD 3.9).

Conclusions: Most patients completed the program and there were notable improvements in weight, sleepiness and satisfaction with chronic disease care. The pilot project showed the Flinders Program to be a feasible and acceptable program to target risk factors as well as lead to better health outcomes in OSA

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Corresponding author: A/Prof Nick Antic, Adelaide Institute for Sleep Health
Email: nick.antic@health.sa.gov.au

Implementing Strategies To Reduce Sedative And Anticholinergic Load Among Older People With Dementia: The Veterans' Mates Program

J Simon Bell, Tammy Leblanc, Natalie Blacker, Christopher Eaton, Elizabeth E Roughead*

Purpose: People with dementia are susceptible to cognitive impairment associated with sedative and anticholinergic medicines. Recognising that sedative and anticholinergic medicines are widely prescribed, the Australian Government Department of Veterans' Affairs (DVA) Veterans' Medicines Advice and Therapeutics Education Services (Veteran's MATES) implemented an Australia wide intervention in December 2010. The objective of this study was to explore prescriber experiences in relation to sedative and anticholinergic medicines.

Method: The intervention comprised (1) patient-specific feedback for 5,084 general practitioners (GPs) supported by a therapeutic brief highlighting key clinical issues, and (2) an educational brochure for 3,076 veterans taking sedative or anticholinergic medicines. In conjunction with the intervention, GPs were encouraged to complete a one-page survey in relation to their prescribing experiences. Survey items related to consideration of cognitive impact prior to prescribing a new medicine, whether addition of a sedative or anticholinergic medicine causes cognitive decline, and ease of being able to avoid sedative or anticholinergic medicines. The face-validity of the survey instrument was pre-assessed by the Veterans' MATES Editorial Committee. No reminders or repeat mailings were sent. All responses were analysed using SAS (Version 9.2, NC, USA).

Results: Among the 310 GP respondents, 250 (80.7%) reported that they always consider the cognitive impact prior to prescribing a new medicine to a patient with dementia. However, 165 (53.2%) respondents reported that in their experience addition of a sedative to the medicine regimen resulted in mild or no cognitive decline. Correspondingly, 202 (65.2%) of GPs reported that addition of an anticholinergic to the medicine regimen resulted in mild or no cognitive decline. GPs who reported that it was not easy or slightly easy to avoid prescribing sedative or anticholinergic medicines to their veteran patients were more likely to report that sedatives ($x2$=10.85, p=0.001) or anticholinergics ($x2$=9.84, p=0.002) caused only mild or no cognitive decline.

Conclusions: Many GPs do not perceive a high likelihood of cognitive decline associated with sedative and anticholinergic medicines. In keeping with behavioural theories, education to raise awareness of these adverse events may be required prior to or as part of interventions to improve practice.

Corresponding author: Simon Bell Project Director: Veterans' MATES, Quality Use of Medicines and Pharmacy Research Centre, Sansom Institute, School of Pharmacy and Medical Sciences, University of South Australia, Adelaide Email: simon.bell@unisa.edu.au

Molecular characterization of the dipeptidyl peptidase 10 (dp10) short Isoform: its pathological link to alzheimer's disease

Tong Chen[1], Wei-Ping Gai[2], Catherine Abbott[1]*

Background: Dipeptidyl peptidase 10 (DP10) is a type II transmembrane protein with a short cytosolic N-terminal segment and a large extracellular C-terminal domain. DP10 belongs to the dipeptidyl peptidase IV family of atypical serine proteases, however extensive molecular characterization has revealed it is inability to function as a protease. Since its initial discovery it has been found that DP10 is a critical component in the expression and modulation of the Kv4 channels accounting for a large portion of the somatodendritic inactivating current in neurons in regulating firing frequency and signal processing in dendrites[1]. Recently an increasing number of publications suggest that potassium channels or their associated proteins might be involved in stepsleading to the neurodegeneration observed in Alzheimer's disease[2]. Here we examine the short isoform of this protein (DP10-s) expression in human brains and its involvement in Alzheimer's neurofibrillary tangles and plaques.

Methods: Rabbit antibodies were raised against the N-terminal sequence of DP10-s and affinity purified. Antibody specificity was confirmed by antigen absorption and blocking. Immunocytochemical and immunoblot analysis were conducted in 20 aged human brains affected with or without Alzheimer's and other neurodegenerative diseases.

Results: Immunocytochemical analysis revealed predominantly neuronal staining of DP10-s throughout the neocortex and subcortical grey matters with high expression in the pyramidal cells in normal brain tissue. In Alzheimer's brains, robust DP10-s reactivity was detected in neurofibrillary tangles and plaque-associated dystrophic neurites. Confocal microscopy revealed colocalisation of DP10-s with tau protein – one of the pathological hallmarks of Alzheimer's disease in most tangles and dystrophic neurites, but some DP10-s positive neurons with relatively normal morphology were tau negative. Occasional DP10-s positive neurons were seen in some aged normal brains. This suggests DP10-s may mark early cellular changes of the dementia. Western blots revealed that DP10-s ran as full length about 100kD, as well as the 37kD and 50kD in homogenised brain samples. The 37kD and 50kD forms increased significantly in AD brains compared to normal brains, suggesting the truncated DP10-s forms might be involved in the formation of neurofribrillary tangles and dystrophic neurites. Transient transfection of DP10-s into Tau stable expressing SH-SY5Y cells results in a degenerative phenotype including DP10-positive inclusions often colocalizing with phosphorylated tau, cellular vacuolization, nuclear outline blurring or irregularity, fragmentation or shrinkage. Over expression of both DP10789aa and Tau40 proteins in 293T cells resulted in Tau phosphorylation. Conclusion: DP10-s is highly expressed in human brain, its robust presence in tangles and dystrophic neurites suggests its involvement in pathology of Alzheimer's disease.

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Authors'affiliations: [1]School of Biological Sciences, and [2]School of Medicine, Flinders University, South Australia, Australia Corresponding author: Dr Tong Chen, Flinders University Email: tong.chen@flinders.edu.au

A Randomised Controlled Trial To Evaluate A Simplified Model Of Care For Obstructive Sleep Apnea In General Practice

Ching Li Chai-Coetzer, Nick A Antic, L Sharn Rowland, Richard L Reed, Adrian Esterman, Norman Vowles, Helena Williams, Sandra Dunn, R Doug Mcevoy*

Introduction: Obstructive sleep apnea (OSA) is highly prevalent in the Veteran population, with its major risk factors being male gender, increasing age, obesity and excessive alcohol intake. There has been growing interest in ambulatory models of care for OSA involving screening questionnaires, portable home monitors and/or auto-titrating continuous positive airway pressure (CPAP). With appropriate training and provision of simplified management tools, general practitioners (GPs) are ideally positioned to take on a greater role in the diagnosis and treatment of OSA. The aim of this randomised controlled study was to compare a simplified model of care for OSA in the primary care setting versus the usual standard of care in a specialist sleep centre.

Methods: Patients with symptomatic, moderate-to-severe OSA were identified by GPs using a 4-item screening tool, the Epworth sleepiness scale (ESS) and home oximetry (ApneaLink, ResMed). Eligible patients were randomised into either one of two models of care: (1) General practice-based care, with management led by their GP and a

community-based nurse, involving home auto-titrating CPAP, or (2) Usual care in a specialist sleep centre, involving sleep physician management and laboratory-based testing. Outcome measures included the change in ESS, change in functional outcomes of sleep questionnaire (FOSQ) and CPAP compliance after 6 months of follow-up.

Results: 155 patients were randomised into the study. For the primary outcome measure, the mean change in ESS score at 6 months, GP-based care was not inferior to Specialist-led management (4.9 vs 5.1; adjusted mean difference -0.5 [lower bound of one-sided 95% confidence interval {CI}: -1.6], p=0.47) using an a *priori* noninferiority margin of -2.0. Similar results were also seen for the mean change in FOSQ score at 6 months (2.3 vs 2.7; adjusted mean difference -0.06 [lower bound of one-sided 95% CI: -0.6], p=0.87) using an a *priori* noninferiority margin of -1.0. CPAP compliance at 6 months was comparable in the two treatment arms, with mean (± SD) daily use of 4.8 (± 2.1) hours in the GP-led group versus 5.4 (± 1.8) hours in the Specialist group (p=0.1).

Conclusions: Outcomes for patients with symptomatic, moderate-to-severe OSA managed in primary care using a simplified, ambulatory approach which utilises the skills of appropriately trained GPs and community-based nurses are not clinically inferior to usual management in a specialist sleep centre. A model of care for OSA based in the general practice setting has the potential to reduce waiting lists for sleep services and to minimise the burden of disease for Veterans and the wider community.

Corresponding author: Ching Li Chai-Coetzer, Respiratory & Sleep Physician, Adelaide Institute for Sleep Health, Repatriation General Hospital
Email: chingli.chai-coetzer@health.sa.gov.au

An Examination Into The Positive Psychological Outcomes Of An Intervention To Promote Forgiveness Through Written Disclosure

Mai Dao and Dr Adam Gerace**

A thesis submitted in partial fulfilment of the requirements for the degree of Bachelor of Psychology (Honours) at the University of South Australia October 2007.

Purpose of the study: The aim of this study was to examine the extent to which an expressive writing exercise promoting forgiveness would be associated with improvements in the psychological health of war veterans. The study also examined one of mechanisms of change proposed to assist in the resolution of trauma experiences, cognitive processing. It was hypothesised that:

Hypothesis 1: A forgiveness intervention will lead to decreases in depression, anxiety and stress and increases in forgiveness.

Hypothesis 2: A forgiveness intervention will lead to increased cognitive processing about a stressful experience, as measured by the increases in number of cognitive mechanism words used to describe a forgiveness situation and the Cognitive Processing of Trauma measure.

Hypothesis 3: That increases in cognitive processing will be related to decreased depression, anxiety, stress and increased forgiveness.

Method: Seventeen adult male participants from the Returned and Services League of Australia (RSL) in Adelaide, Australia participated in an uncontrolled pre-test/post-test study over a period of five weeks. Participants were asked to spend twenty minutes each week for fives weeks, journaling about a stressful war experienced using guided instructions which promoted forgiveness. Participants also completed self report pre-test and post-test measures examining psychological wellbeing (depression, anxiety and stress), dispositional forgiveness, state forgiveness and cognitive processing of a trauma. Specialised computer software designed to measure cognitive processing by characterising the grammatical linguistic and psychological features of text documents was used to examine the participants' journal entries to obtain objective measures of cognitive processing.

Summary of results: Changes following the intervention were observed on a range of measures of psychological wellbeing, including depression, anxiety and stress, forgiveness and cognitive processing.

Conclusions: It is thus concluded that although further controlled evaluations are required, the written disclosure intervention may provide a useful adjunct to war veteran treatment.

Corresponding author: Mai Dao, Clinical Psychologist, Eastern Mental Health Service- Adelaide Health Service
Email: Mai.Dao@health.sa.gov.au

Aeromedical disposition of aircrew medical employment classification reviews, 2000-2009

Adrian Smith, Vishnu Jaganathan, Joanne Marshall, Jessica Gehlert*

Purpose: The RAAF Institute of Aviation Medicine is responsible for the aeromedical disposition of all ADF aircrew, performing 519 Aircrew Medical Employment Classification Reviews (AMECRs) during the 10-year period 2000 to 2009. The casemix and outcomes of ADF aircrew undergoing medical board have not been explored to date. This paper describes the first structured review of the casemix passing through AVMED for medical board review, in an effort to inform

the aircrew-health training AVMED provides and to help shape preventative health measures relevant to the preservation of the ADF's aviation capability.

Method: The database of Central and Institute AMECRs was reviewed. First-listed clinical information was grouped into diagnostic categories, and described in terms of the casemix for the aircrew presenting for review, as well as those who were 'grounded' permanently. The data was further evaluated in terms of pilot and non-pilot aircrew.

Results: During the period January 2000 to December 2009, AVMED reviewed 519 AMECRs, comprising 435 individuals. The majority were pilots (44%), followed by Air Combat Officers (4%) and Loadmasters (12%), and Navigators (7%). The five conditions most commonly listed first as the reason for requiring AMECR were: back pain (9%), mood disorder (8.5%), migraine (4.5%), PTSD (3.5%), and neck pain (3%). Of the first-listed conditions, musculoskeletal injuries accounted for 23% and mental health issues accounted for 17% as reasons for AMECR. The five conditions most commonly listed first as the reason for permanent disqualification from flying were: back pain (12%), mood disorders (6%), migraine (5%), knee pain (4%), and leg pain (4%). Pilots accounted for only 44% of all AMECRs, but accounted for 70% of neck pain, and 60% of knee injuries. Conversely, loadmasters accounted for only 13% of all AMECRs, but 30% of all back pain cases, 20% of mood disorders, and 20% of shoulder injuries. When compared to pilots, loadmasters appear to be 2.5 times more likely to have AMECR because of back pain, and 3 times more likely to have AMECR because of a mood disorder. Overall, 60% of pilots and loadmasters were permanently grounded because of medical and surgical conditions, and 20% for back pain. Mental health accounted for 15% of loadmasters but only 5% of pilots who were permanently grounded, and musculoskeletal injuries (excluding back and neck) accounted for 30% of permanently-grounded pilots but no loadmasters.

Conclusions: This research suggests that musculoskeletal injuries and mental health disorders are the two most common reasons for bring aircrew to MECR, and are also the most common reasons for permanent grounding. The research also suggests that different aircrew roles may have a different injury/illness pattern, and this may inform future research or health education initiatives.

Corresponding author: Adrian Smith, Specialist Aviation Medical Officer (Army), RAAF Institute of Aviation Medicine
Email: adrian.smith14@defence.gov.au

Abdominal Compression Increases Obstructive Sleep Apnoea Severity

Daniel Stadler*, R Doug Mcevoy, Denzil Paul, Naomi Deacon, Peter Catcheside

Purpose of study: Obstructive sleep apnoea (OSA) is the most common pathological breathing disorder in sleep and is characterised by repetitive periods of upper airway collapse and often severe oxygen desaturation. These respiratory events are frequently associated with arousals that disrupt sleep, such that OSA patients commonly report excessive daytime sleepiness, which increases the risk of motor vehicle and work-related accidents. OSA is common in the general population and in the Veteran community[1, 2] and is likely on the rise along with population trends in obesity. Male gender and obesity are the main risk factors for OSA, but the underlying mechanisms remain poorly understood. One mechanism promoting airway collapse in obese males may be increased intra-abdominal pressure, due to abdominal obesity, which leads to diaphragm elevation and reduced tracheal "stretch" on the upper airway. The aim of this study was to test the hypothesis that raising intra-abdominal pressure, via external abdominal loading, increases OSA severity measured during sleep from the apnoea-hypopnoea index (AHI) in male OSA patients.

Methods: Overweight-to-obese (body mass index [BMI] 25-40 kg/m2) males with mild-to-moderate OSA (AHI 15-45 events/hr), between the ages of 18-65 years were recruited. Patients wore a nasal mask fitted with a pneumotachograph to measure nasal airflow and volume. Posture remained fixed within each patient. Two balloon catheters were used to assess gastric and oesophageal pressure (Pga and Poes), while transdiaphragmatic pressure (Pdi) was calculated as Pga-Poes.

Abdominal compression was achieved via inflation of a pneumatic cuff wrapped around the abdomen. Three cuff conditions were examined; deflated, intermediate (mid) and maximum inflated level believed tolerable during sleep. Cuff condition was changed in random order every 10 minutes during sleep. AHI during stage 2 sleep was calculated as the total number of respiratory events divided by total stage 2 sleep time. End-expiratory Pga and Pdi were calculated breath-by-breath for each cuff state during periods of stable stage 2 sleep. End-expiratory pressures and AHI were compared between cuff conditions using ANOVA for repeated measures.

Results: 14 OSA patients successfully completed the study. The mean±SEM age, BMI and diagnostic AHI for the fourteen patients were 51.1±2.9 years, 31.3±1.0 kg/m2 and 27.2±2.6 events/hr respectively. Abdominal compression increased end-expiratory Pga

(deflated; 11.1±1.5, mid; 15.5±1.7 and max; 18.6±1.9 cmH2O, cuff effect, p<0.001) and end-expiratory Pdi (deflated; 4.5±2.2, mid; 7.5±2.7 and max; 9.9±2.8 cmH2O, cuff effect, p<0.001). Stage 2 AHI increased with abdominal compression (deflated; 34.3±7.3, mid; 36.9±9.0 and max; 50.2±6.4 events/hr, cuff effect, p=0.031).

Conclusion: This is the first study to show a direct effect of abdominal loading on OSA severity. These data further support that effects of central/abdominal obesity importantly influence upper airway function in sleep.

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Corresponding author: Dr Daniel Stadler,
Adelaide Institute for Sleep Health
Email: daniel.stadler@health.sa.gov.au

Delivery of mental health services to rural veterans using home videophones: a pilot study

Dr Victoria Wade, Mr Jeremy Hamlyn and Prof Alexander McFarlane*

This work was supported by a grant from Foundation Daw Park

Purpose: The purpose of this study was to determine the feasibility, acceptability and perceived clinical usefulness of delivering mental health services by home videophones to veterans living in rural South Australia. Previous research has shown that video communication is as accurate as in-person assessment for psychiatric review[1], and Porcari has shown that Post Traumatic Stress Disorder (PTSD) can be effectively assessed in a veteran group by videoconferencing[2]. A randomized controlled trial showed that combat-related PTSD can be effectively treated by telepsychiatry, with high satisfaction in recipients[3]. It was anticipated that a telehealth service may improve veterans' access to care and enhance the capabilities of the RGH Psychiatry Service.

Methods: *Participants* Outpatients of the RGH Psychiatry Services who lived in rural South Australia.

Intervention Participants received a home videophone enabled by 3G connectivity for four months, and RGH staff delivered clinical care delivery by this medium, tailored to each veteran's requirements.

Data collection Staff, veterans, and the technical provider were interviewed, with thematic analysis conducted on the interview transcripts.

Results:

- Five veterans were recruited for the study, and three clinical staff participated.
- The videophone system was judged to be very easy to use, and the call quality was good for four veterans but problematic for one.
- Initial apprehension about video communication resolved rapidly, and at interview some veterans preferred the videophone over face-to-face services because they felt less anxious at home. Veterans repeatedly mentioned that they preferred to avoid travel.
- Staff thought that the videophone was much better than telephone calls but not as good as in-person contact. Clinically, it was reported to enhance case management and improve functioning for three clients with chronic, disabling mental health issues, and staff judged that two hospital admissions had been prevented. One veteran commenced CBT via the videophone and found that he could not obtain the intensity of the therapeutic relationship he felt that he needed to make progress.
- One ethical issue raised was the importance of considering privacy at home.

Conclusions: This small pilot study suggests that home video service delivery has a useful place in case management of rural veterans who are significantly impaired by their mental health conditions. Further implementation and evaluation with a larger group of clients is warranted. The introduction of new telehealth consulting items funded by the Department of Veterans Affairs from July 1st 2011 offers a possible means of sustaining such a service.

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Corresponding author: Dr Victoria Wade,
Email: Victoria.wade@adelaide.edu.au

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