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- Guilt and It's Relationship to Mental Illness and Suicide Attempts
- Antibacterial Warfare
- Self-reported liver disorders in Australian Vietnam War Veterans

The Journal of the Australasian Military Medicine Association

2021 AMMA CONFERENCE

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AMMA ADVANCING MILITARY MEDICINE FOR 30 YEARS

14-17 October 2021 Melbourne

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Cover Photo: Courtesy of Department of Defence
On 08-09 April 2021, the Royal Australian Air Force, in support of Operation PNG Assist, delivered critical COVID-19 medical supplies and Australian Medical Assistance Team members to Papua New Guinea from RAAF Base Darwin, Amberley and Richmond. This is part of a whole-of-Australian-Government response to a Papua New Guinea Government request for assistance, following increasing COVID-19 cases in the nation.

Journal of Military and Veterans' Health

Australasian Military Medicine Association

STATEMENT OF OBJECTIVES

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

- Promoting the study of military medicine
- Bringing together those with an interest in military medicine
- Disseminating knowledge of military medicine
- Publishing and distributing a journal in military medicine
- Promoting research in military medicine

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

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Editorial

Centenary of the Air Force

The medical service of the Royal Australian Air Force started in a small hut that served as the sick-quarters at Point Cook, Victoria. Its first doctor was Squadron Leader Arthur Poole Lawrence MC, a Melbourne graduate who had served with the Australian Army Medical Corps in France. Lawrence made the first observations of cyanosis in pilots after high-altitude flights without supplemental oxygen and included himself as a test subject.

In 1922 he was appointed Director of Air Force Medical Services at Air Force Headquarters, Victoria Barracks, Melbourne. The amalgamation of naval, military and air medical services was a live issue at this time. Neither the Director of Naval Medical Services nor Lawrence was enthusiastic about the plan of Major General Sir Neville Howse VC, DGMS (Army). At a conference in 1922, Howse believed that only one medical corps should provide medical services to all three Services. A further conference in 1925 recommended cooperation and coordination but with individual Service autonomy.

The Minister for Defence considered the report and ruled that the Director-General of Army Medical Services should be responsible to the Air Board for administering and controlling medical and dental services in the RAAF from 1 October 1927. Wing Commander Lawrence, now a member of the Citizen Air Force, became Deputy Director Medical Services (Air).

As can be imagined, Lawrence was a tenacious advocate for the Air Force, as a man who had survived his transport ship being torpedoed and sunk in the English Channel and having survived illness and active service on the Western Front leading to the award of the Military Cross.

As the Air Force gradually expanded in the years towards 1939, the medical service did so as well. The need for specialist expertise such as ENT and neurosurgery was recognised.

Group Captain R Fowler DDMS (Air) was appointed in 1936. He was foresighted and focused attention on the evacuation of casualties by air and the problems of operations in tropical areas.

The second great conflict of the century required a radical re-thinking of previously held positions. On 5 April 1940, the War Cabinet approved the recommendation

'that the DGMS (Army) relinquish his responsibilities in the control of the Air Force medical service; and that medical matters requiring coordination between the navy, army and Air Force be dealt with by a standing committee consisting of the permanent medical directors of the three services.' This was exactly the position advocated by Navy and Air Force in 1925.

In early 1940 Dr Thomas Ernest Victor Hurley CMG was a surgeon at the Royal Melbourne Hospital and dean of its clinical school. He had served in the Australian Army Medical Corps on the Western Front in the previous war. He was appointed DGMS Air Force with the rank of Air Commodore and was responsible for the rapid growth in the number of medical personnel and their effective utilisation. A sensible system of appointment of specialists and consultants to the Citizen Air Force enhanced the treatment of RAAF personnel. Medical Branch Technical Instructions were circulated regularly. A rational system of data collection for both operational and medical planning was introduced. Special attention was directed to the problem of malaria.

In July 1940, a RAAF Nursing Service was established with Matron-in-Chief (Group Captain) Margaret Irene Lang, who had served with the Australian Army Nursing Service during the First World War. The RAAFNS was a branch of the RAAF, and all members wore RAAF commissioned rank and embellishments. As well as serving in bases in Australia, Air Force nurses served in New Guinea and on troop convoy ships to the Northern Hemisphere.

In 1944 No. 1 Medical Air Evacuation Transport Unit was formed and staffed by Air Force nurses. These nurses exercised considerable clinical autonomy in the in-flight care of the sick and wounded, including liaising with aircrew about recommendations for the height and speed of flight. The care of returning prisoners of war from Japan, then casualties from Korea and Vietnam, has led to increasing sophistication in the aeromedical evacuation (AME) procedures. The current RAAF Military Critical Care AME Teams provide intensive care unit levels of care during strategic AME flights of great distances as well as humanitarian and disaster relief.

A Directorate of Dental Services was established, and in March 1943, Group Captain N H Andrews was appointed as Director of Dental Services and a part of the staff of the DGMS. Maintaining the dental fitness of aircrew was a particular concern to avoid the effects of barodontalgia. RAAF Dental officers also worked in the plastic surgery unit at No. 115 AGH in Melbourne.

During World War II, medical research concerning aircrew was directed by the Flying Personnel Research Committee in liaison with the physiology departments of Melbourne and Sydney Universities. Working independently and without knowledge of similar research being undertaken abroad, Prof Frank Cotton of Sydney University produced an air-inflated anti-G suit. On a visit to The USA in 1942, he found that the US Navy had been working on the problem. Cotton's design was made available to the Americans, and in 1944, a simplified version was being worn by US fighter pilots in the SW Pacific.

The introduction of high-altitude jet fighters to the RAAF led to the establishment of the School of Aviation Medicine at Pt Cook in 1956. The school contained a hypobaric chamber used both for the training of aircrew and for experimental purposes. The school became the RAAF Institute of Aviation Medicine in 1960, in association with the University of Adelaide.

Aviation Medicine Institute personnel were involved as medical monitors in the NASA Mercury project. RAAF Reservist Ophthalmologist Dr John Colvin designed special sunglasses for the Gemini 5 mission. RAAF Reserve medical officers have made significant contributions to the 5 Eyes Air Force Interoperability Council since 1964.

This brief review can only highlight some of the important developments of a dynamic and innovative Air Force health service and its people. At the start of its second 100 years, the RAAF Medical Branch is the inheritor of the compassion, skill, courage and selfless commitment of all personnel who have come before. This legacy will inform the Branch as it provides care for aviators now and into the future.

Then, Now, Always.

Air Commodore Rowan D Story AM,RFD (Retd)
Guest Editorial

Guilt and It's Relationship to Mental Illness and Suicide Attempts in an Australian Veteran Population with Posttraumatic Stress Disorder

K Kerr, M Romaniuk, S McLeay, S Walker, J Henderson, A Khoo

Abstract

Background Australian veterans have an increased risk of posttraumatic stress disorder (PTSD). Guilt is a common post-trauma reaction; however, research in this area is limited.

Purpose This study aimed to explore the relationship between guilt, PTSD severity, alcohol use, anger, history of suicide attempts and deployment period among Australian veterans with PTSD.

Material and Methods A retrospective analysis was conducted on 219 ex-service personnel diagnosed with PTSD who attended a Military Trauma Recovery Day Program. Veterans completed self-report questionnaires as well as a clinician-administered PTSD assessment tool. Demographic information and self-reported history of suicide attempts were also recorded.

Results Guilt scores were significantly correlated with PTSD severity (R=0.411), anger (R=0.373) and alcohol use (R=0.239). Guilt was most strongly correlated with the re-experiencing cluster of PTSD (R=0.420), although it was significantly correlated with all clusters (hyperarousal R=0.343, and avoidance R=0.327). Guilt scores were significantly higher in those who had attempted suicide and for contemporary veterans.

Conclusions In Australian veterans with PTSD, guilt was significantly associated with PTSD severity, anger, alcohol use, attempted suicide and being a contemporary veteran. The study highlights the importance of guilt identification and treatment by clinicians for improved outcomes.

Conflicting interests The authors declare that there are no conflicts of interest.

Introduction

Compared to the general population, Australian veterans have an increased risk of being diagnosed with posttraumatic stress disorder (PTSD),[1] a psychiatric condition characterised by symptoms of re-experiencing, hyper-arousal, avoidance and alterations in cognitions and mood following exposure to a single or multiple traumatic events.[2] The 2010 ADF Mental Health Prevalence and Wellbeing Study estimated that 8.3% of Australian Defence Force members had experienced PTSD in the past 12 months. In contrast, the incidence of PTSD in the general Australian community in the same time frame was 5.2%.[1] It is recognised that active service can result in witnessing, failing to prevent or committing acts during combat and peacekeeping missions that violate personal values and morals.[3] These experiences can trigger various emotions, and guilt is a common and significant reaction to trauma.[4]

Guilt is a retrospective emotion and can be conceptualised as a psychological state involving perceived moral transgressions linked to action (or inaction) or behaviour, whereby individuals feel a sense of regret or remorse.[5, 6] There is a lack of consensus within the literature regarding whether the emotional experience of guilt is adaptive or maladaptive to human functioning.[4] Some types of guilt, such as behavioural guilt, may serve a prosocial function by encouraging individuals

to change maladaptive behaviours.[7, 8] However, trauma-related characterological guilt (wherein an individual self blames and attributes the trauma or its consequences as arising from negative personal characteristics such as a direct result of them being a bad, defective or worthless human being) is associated with worse psychopathology.[7, 8] Certain types of guilt increase the risk of developing PTSD, depression and substance use disorders.[9, 10] Research has also shown traumatic guilt to have a strong correlation with general measures of PTSD severity as well as various symptom clusters of the condition.[5, 11, 12, 13]

A number of theoretical and statistical models have been developed to explain the relationship between guilt and PTSD. Individuals with PTSD often avoid negative memories, feelings and thoughts associated with the trauma they experienced, and this may consequently block their ability to process feelings of guilt.[14] Guilt can also emerge if a traumatic experience violates an individual's personal morals, values and standards, which can lead to intrusive thoughts and ruminative activity.[15, 16]

Trauma-related guilt has been found to partially mediate the relationship between PTSD and depression in veterans exposed to combat.[11, 17] Marx et al.[17] examined a sample of 1323 male Vietnam veterans in which combat-related guilt was found to partially mediate the association between exposure to violence in combat and PTSD symptomatology.

Furthermore, guilt completely mediated this relationship when the individual was directly involved in the violence.[17] This indicates that greater personal involvement in an event can influence guilt in the development of PTSD symptoms.[17] The amount of guilt an individual may experience after a traumatic event is also related to their perceived failures to prevent, or try to prevent, the event.[15, 18]

Using conditional latent growth mixture modelling, very high levels of guilt, combined with very high PTSD and depression scores, were found to predict the poorest treatment response in Australian veterans who completed a trauma recovery program.[19] However, for those who had very high PTSD scores but low guilt scores, large symptom improvement was found, highlighting the role that guilt plays in clinical treatment and outcomes of veterans.[19]

Guilt has also been found to be a strong predictor of suicidal ideation among veterans. Bryan et al.[6] studied 69 active service military personnel engaged in outpatient mental health treatment who completed self-report tools measuring shame, guilt, PTSD, depression and suicidal ideation. In those with a history of suicidal ideation, feelings of guilt were significantly higher.[6] Additionally, guilt was independently and significantly associated with increased frequency and severity of suicidal ideation, with this relationship stronger than that of depression and/or PTSD.[6] In a sample of Vietnam combat veterans, guilt about combat actions was the most significant predictor of suicidal ideation and attempts compared with depression, anxiety, PTSD and survivor guilt.[20] These findings were further supported in a study of Iraq and Afghanistan combat veterans whereby guilt was significantly correlated with suicidal ideation.[6]

Much of the research on guilt in veterans as a specific population has primarily occurred in a US context and has examined those who served during the Vietnam era. There is a lack of research using Australian veteran samples focusing specifically on traumatic guilt and its relationship with psychopathology and suicide attempts within this population.

The current study aimed to explore the relationship between guilt, PTSD severity, alcohol use, anger and service period (contemporary vs older conflicts) among Australian veterans with PTSD. Contemporary veterans were defined as veterans who had Australian military service from 1999 onwards[21] and were of interest due to the increased demands of contemporary service, including longer and more frequent deployments and potentially a more ambiguous enemy.[16] Furthermore, the study aimed to determine whether guilt was higher among those who had a history of attempting suicide.

Method

Participants

Data were available for 219 veterans, including 217 males (99%) and 2 females (1%) aged 24–86 years (52.9 ± 13.3). One hundred and forty-nine (68%) had served exclusively in the Army, 32 in the Navy (14.6%), 30 in the Air Force (13.7%), and 8 (3.7%) served in multiple branches. One hundred and forty veterans had served in conflicts or operations prior to East- Timor, and 61 had served in more recent operations. Of the total cohort, 110 veterans served in Vietnam, 34 served in Iraq and/or Afghanistan, 57 served in peacekeeping or peacemaking operations (e.g. East Timor, Somalia, Rwanda), and 18 did not have active service.

Descriptive demographics of the studied population are presented in Table 1.

Table 1: Summary demographics of studied population

Demographic	*n total n = 219*	%	Mean	SD	Range
Age			52.9	13.3	24-86
Sex					
Male	217	99.0			
Female	2	1.0			
Marital status					
Married	150	69.0			
De facto	11	5.0			
Separated/divorced	38	17.0			
Widowed	4	2.0			
Single	16	7.0			
Highest education level					
Primary	4	2.0			
Secondary	112	51.0			
Trade	41	19.0			
College	39	18.0			
University	23	10.0			
Employment status					
Full-time	53	24.2			
Part-time	14	6.3			
Retired	51	23.3			
Not working/unable to work/TPI	96	44			
Other	5	2.2			
Service branch					
Army	149	68.0			
Airforce	30	13.7			
Navy	32	14.6			
Multiple	8	3.7			
Conflicts served					
Pre-East Timor only	132	60.0			
Served from East Timor onwards	61	28.0			
Served in both periods (Pre-East Timor onwards)	8	4.0			
Not deployed	18	8.0			
Trauma from deployment	201	91.8			

Procedure

The study was a retrospective analysis of data collected as part of routine practice for Australian veterans who attended the Military Trauma Recovery Day Program (TRP) as outpatients at Toowong Private Hospital over seven years. A veteran was defined as a person who had served in the ADF at any time point. The TRP is a cognitive behaviour therapy (CBT) based program in which veterans attend four days per week for six weeks, then two days per fortnight for another six weeks, with two one day follow-up sessions at three and nine months. All veterans were diagnosed with PTSD by their referring psychiatrist.

Prior to the commencement of the TRP, they participated in a multidisciplinary pre-admission assessment with interviews by a psychiatrist, clinical psychologist and social worker to confirm their PTSD diagnosis and to assess their suitability for a group program.

A chart review was conducted to collect demographic and service data, including age, gender, education level, marital and employment status, conflicts served in, number of years in the military and roles in combat and/or peacekeeping missions (categorised according to the Australian War Memorial[22]). Formal measures were also completed as detailed in the measures section. Ethics approval for the study was obtained from the Department of Veterans' Affairs (E012/008) and Griffith University (PSY/17/12/HREC). Written consent was gained from participants as per the TRP protocol.

Measures

Participants completed several self-report questionnaires administered at intake to the TRP, which assessed symptoms of PTSD, anger, alcohol use and guilt. History of suicide attempts was assessed by asking the veterans, 'Have you made a previous attempt on your own life?' The Clinician-Administered PTSD Scale for Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM-IV) (CAPS-IV) was administered at pre-admission assessment (one week to one month before the commencement of the TRP). A brief description of each questionnaire is below.

The Clinician-Administered PTSD Scale for DSM-IV (CAPS-IV):

The CAPS-IV is a structured clinician-administered assessment tool containing 30 items corresponding to the DSM-IV-TR criteria for PTSD. The CAPS-IV has shown good psychometric properties across various clinical populations and research settings.[23] It has good sensitivity (0.84) and specificity (0.95) and has excellent test-retest and inter-rater reliability.[24]

The Alcohol Use Disorders Identification Test (AUDIT):

The AUDIT was developed by the World Health Organization and is a 10-item self-rated screening tool used to assess hazardous and harmful alcohol consumption. It contains questions on alcohol consumption and dependence, drinking behaviours and questions related to problems and consequences of drinking. Scores range from 0 to 40, with higher scores indicating higher risk. The test has shown good sensitivity (0.86) and specificity (0.89).[25]

Dimensions of Anger Reaction (DAR):

The DAR is a seven-item self-report questionnaire used to measure anger disposition, with scores ranging from 0–56. Higher scores indicate stronger anger reactions. In Vietnam veterans with combat-related PTSD, the DAR was found to be a reliable and sensitive measure of anger with an internal consistency of 0.91.[26]

Experiences of guilt:

Guilt was assessed using the associated features questions on the CAPS- IV, which consisted of two items. The questions included: 1. 'How much of the time in the past month have you felt guilty about anything you did or did not do during your military service?' 2. 'How much of the time in the past month have you felt guilty about surviving a traumatic event when others did not?' Clinicians rated each item from 0 (none of the time) to 4 (most of the time), and then assessed intensity by asking: 'How strong were these feelings of guilt?' Scores ranged from 0 (no feelings of guilt) to 4 (extreme, pervasive guilt). Total scores range from 0–16. The internal consistency has been cited as high (0.89), with item-total correlations ranging from 0.84-0.86.[19]

Data analysis

Statistical analyses were performed using R, version 3.13.[27] Continuous demographic and psychological data were described by their mean, standard deviation (SD) and range, and categorical data by count and per cent (%) of the total population. Correlations between continuous psychological data were assessed by generating scatterplots and determining the correlation coefficient (R) for each relationship. Strengths of correlations were considered to be very weak where $R < 0.2$, weak ($R = 0.2–0.4$), moderate ($R = 0.4–0.6$), strong (0.6–

0.8) or very strong where R >0.8.[28] Relationships between continuous psychological data and binary variables (history of suicide, conflicts served—pre-East Timor or East Timor onwards—and trauma from deployment) were assessed by non-parametric Mann-Whitney tests with data presented as box-and-whisker plots. Significance level was considered as $p < 0.05$.

Results

Summaries of CAPS-IV, DAR, AUDIT scores and history of suicide attempts are presented in Table 2, with 24.2% (n=53) of veterans having attempted suicide. Guilt scores were found to be significantly positively associated with all measures, being moderately correlated (R = 0.4–0.6) with CAPS-IV score, and weakly correlated (R = 0.2–0.4) with DAR and AUDIT. Plots of CAPS-IV, DAR and AUDIT scores against guilt scores are presented in Figure 1, with correlation coefficients and significance levels presented in Table 3.

The authors also explored if guilt was more strongly correlated with any of the CAPS-IV cluster scores (re-experiencing [cluster A], avoidance [cluster B], and hyperarousal [cluster C]). Guilt was most strongly correlated with the re-experiencing cluster (R = 0.420, moderate correlation). All other relationships showed weak (R = 0.2–0.4) but significant correlations (Table 2). Guilt scores were significantly higher in those who had a history of attempted suicide ($p = 0.00642$) and contemporary veterans who had served in conflicts post-East Timor ($p = 0.0410$) (Figure 2, left and centre panels). Guilt scores were not significantly different between those who had trauma from deployment and those who had guilt from non-active service.

Table 2: Summary statistics of psychological measures explored in the analysis and historyof attempted suicide, n=219

Psychological measure		*N*	%	Mean	SD	Range
Guilt				6.62	4.31	0-16
CAPS-IV total score				69.2	21.3	20-116
Cluster A:	Re-experiencing	17.7			8.88	0-39
Cluster B:	Avoidance	27.4			9.75	2-51
Cluster C:	Hyperarousal	24.0			6.10	5-36
AUDIT				14.9	9.31	0-40
DAR				30.6	14.2	0-56
History of attempted suicide		53	24.2			

Figure 2
Correlation betweeen guilt scores with CAPS, DAR and AUDIT scores

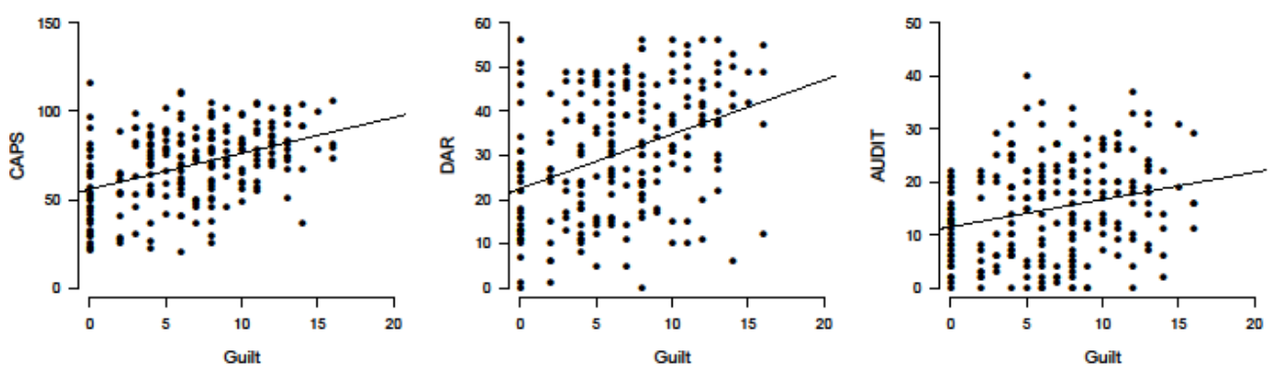


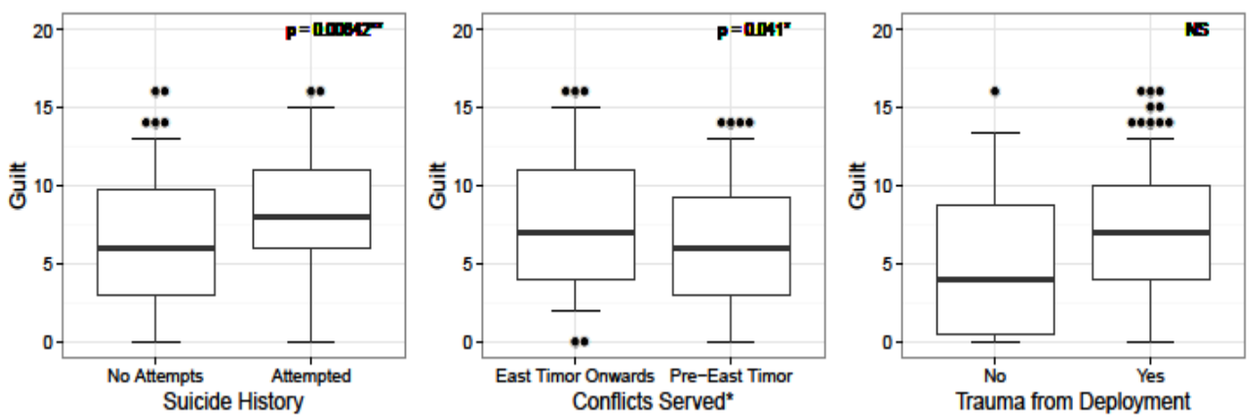
Table 3: Correlation between guilt scores with CAPS, DAR and AUDIT

	CAPS		CAPS Cluster A Re- experiencing		CAPS Cluster B Avoidance		CAPS Cluster C Hyperarousal		DAR		AUDIT	
	R	p-value	R	p-value	R	p-value	R	p-value	R	p-value	R	p-value
Guilt	0.411	2.42e-10***	0.420	8.91e-11***	0.327	7.37e-7***	0.343	1.89e-7***	0.373	1.18e-8***	0.239	0.000369***

*p < 0.05, **p < 0.01, ***p < 0.001.

Figure 2

Relationship between guilt scores with history of previous suicide attempts, contemporary veteran (defined as service post-East Timor) and deployment



NS, not significant, $p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Plots show the median and 25th-75th percentile range (box) and 5th-95th percentile range (whiskers). *Excluding veterans who served across both periods.

Discussion

The current study aimed to explore the relationship between guilt, PTSD severity, alcohol use, anger and period of deployment and to determine whether guilt was higher among those who had a history of suicide attempts. It was found that all these factors were significantly correlated with guilt. Additionally, being a contemporary veteran was significantly associated with guilt. To the best of the authors' knowledge, no previous research has investigated suicidality concerning guilt among Australian veterans with PTSD. In line with previous research, it was found that guilt was significantly correlated with PTSD severity. This suggests that patterns within the Australian cohort are similar to those reported from the US with higher levels of guilt associated with increased PTSD psychopathology.[5, 11, 12] For PTSD symptomology, guilt was strongly related to each of the symptom clusters, with the strongest association found for re-experiencing symptoms.

Henning & Frueh[12] also found the severity of guilt regarding combat situations was positively correlated with the re-experiencing of PTSD. Re-experiencing could be conceptualised as the brain replaying an event in an attempt to process a resolution or try to find alternative ways of thinking about the event.

Guilt was significantly positively associated with self-reported anger and alcohol use within the veteran population; however, this relationship was weak. The relationship between anger and PTSD severity in combat veterans has been well established in the

literature.[29, 30] In contrast, little empirical evidence exists regarding the relationship of guilt to anger, and the research that does exist demonstrates inconsistent findings; indicating further research is required to determine if the positive relationship can be replicated.[31] In regards to guilt being associated with higher alcohol use, this may be the first study to specifically examine the relationship between these variables among Australian veterans. A similar finding was found by Okulate and Jones,[32] with a significant association between survivor guilt and alcohol use among inpatient Nigerian military personnel who served as peacekeepers in the Liberian and Sierra-Leonean wars. This finding could indicate that veterans use alcohol to numb painful guilt cognitions and emotions; however, further research is needed to examine this specifically.

The study also determined that veterans experiencing higher levels of self-reported guilt were more likely to have previously attempted suicide. This is consistent with Bryan et al.'s[5, 6] results, which found guilt was significantly associated with more frequent and severe suicidal ideation in a sample of American combat veterans. Many veterans report direct culpability for their actions and/or inactions during deployment, which results in guilt.[16] Guilt is experienced as a sense of remorse and regret, which can be psychologically and physically painful and uncomfortable, especially when reparation cannot be made, which is often the case in active service situations.[31] Suicide is recognised as a way to escape painful emotions.[33]

The current study also found that contemporary veterans who had served in conflicts post-East Timor were more likely to experience traumatic guilt. A significant correlation between being an Australian contemporary veteran and suicide attempts has been previously established[34]. Litz et al.[16] stated there are increased demands on contemporary defence force personnel with longer and more frequent deployments resulting in more repeated exposure to tragedy and horror. They argued that contemporary veterans had had many unconventional threats in their theatres of war, such as unidentifiable enemy, the use of technology (drone attacks, improvised explosive devices) and civilian threats leading to more morally ambiguous situations, increased opportunity for collateral damage, more chance of acting outside of beliefs and value systems, and hence, increased chances of guilt.[16] It is also possible there is a time bias, where contemporary veterans have not had as much time to process their military experiences.

Limitations and directions for future research

Several limitations of the study need to be acknowledged. The study was retrospective and did not examine the past psychopathology and guilt scores of veterans who had suicided, who may have had different profiles compared to suicide attempters. Ethical and practical considerations limit research that examines suicidality. The current study used a brief two-item measure of guilt, which is somewhat limited. That said, measurement variability is a limitation throughout the guilt literature, as the construct of guilt is often not distinguished from the construct of shame clearly and consistently.[31] As such, future research could examine the link between guilt (and related constructs) with psychopathology using multiple psychometric measures allowing a more multifaceted conceptualisation of guilt. In addition, future research should focus on determining the effective treatment of cognitions and feelings tied to guilt.

Conclusion

Among a cohort of Australian veterans with PTSD, there was a significant positive association between guilt and severity of PTSD symptoms, anger and alcohol use. In addition, guilt was significantly higher among contemporary veterans and those who had attempted suicide in the past. These results highlight the importance of early identification of guilt by clinicians and the application of effective treatment to repair or reduce feelings of guilt.

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References

1. McFarlane AC, Hodson SE, Van Hooff M, et al. Mental health in the Australian Defence Force: 2010 ADF Mental Health and Wellbeing Study: Full report. Canberra: Department of Defence; 2011.
2. American Psychiatric Association. Diagnostic and statistical manual of mental disorders 5th edition. Arlington (VA): American Psychiatric Publishing; 2013. 947 p.
3. Currier JM, Holland JM, Mallott, J. Moral injury, meaning making, and mental health in returning veterans. Journal of Clinical Psychology. 2015; 71(3): 229-240. doi: 10.1002/jclp.22134
4. Pugh LR, Taylor PJ, Berry K. The role of guilt in the development of post-traumatic stress disorder: A systematic review. J. Affect. Disord. 2015; 182:138-150.
5. Bryan CJ, Ray-Sannerud B, Morrow CE, et al. Guilt is more strongly associated with suicidal ideation among military personnel with direct combat exposure. J Affect Disord. 2013a; 148: 37-41. doi: 10.1016/j.jad.2012.11.044
6. Bryan CJ, Morrow CE, Etienne N, et al. Guilt, shame and suicidal ideation in a military outpatient clinical sample. Depression and Anxiety. 2013b: 55-60. doi: 10.1002/da.22002
7. Andrews C, Creamer M, Crino R, et al. The treatment of anxiety disorders: Clinician guides and patient manuals. Cambridge: Cambridge University Press; 2009. 611 p.
8. Browne KC, Trim RS, Myers US, et al. Trauma-related guilt: Conceptual development and relationship with posttraumatic stress and depressive symptoms. J Trauma Stress. 2015; 28: 131-141.
9. Kim S, Thibodeau R, Jorgensen RS. Shame, guilt, and depressive symptoms: A meta-analytic review. Psychol. Bull. 2011; 137: 68-96. doi: 10.1037/a0021466
10. Meehan W, O'Connor LE, Berry JW, et al. Guilt, shame, and depression in clients in recovery from addiction. J. Psychoact. Drugs. 1996; 28: 125-134.
11. Brown T, Evangeli, M, Greenberg N. Trauma-related guilt and posttraumatic stress among journalists. J Trauma Stress; 2012; 25: 207-210. doi: 10.1002/jts.21678
12. Henning KR, Frueh BC. Combat guilt and its relationship to PTSD symptoms. J Clin Psychol. 1997; 53: 801-808. doi: 10.1002/(SICI)1097-4679(199712)53:8<801::AID- JCLP3>3.0.CO;2-I
13. Keane TM, Kolb LC, Kaloupek DG, et al. Utility of psychophysiology measurement in the diagnosis of posttraumatic stress disorder: Results from a department of veteran's affairs cooperative study. J Consult Clin Psychol. 1998; 66: 914-923. doi: 10.1037//0022-006x.66.6.914
14. Norman, SB, Wilkins KC, Myers US, et al. Trauma informed guilt reduction therapy with combat veterans. Cogn Behav Pract. 2014; 21: 78-88.
15. Lee DA, Scragg P, Turner S. The role of shame and guilt in traumatic events: A clinical model of shame-based and guilt-based PTSD. Psychol Psychother. 2001; 74: 451-466. doi: 10.1348/000711201161109
16. Litz BT, Stein N, Delaney E, et al. Moral injury and moral repair in war veterans: A preliminary model and intervention strategy. Clin. Psychol. Rev. 2009; 29: 695-706. doi: 10.1016/j.cpr.2009.07.003
17. Marx BP, Foley KM, Feinstein BA, et al. Combat-related guilt mediates the relations between exposure to combat-related abusive violence and psychiatric diagnoses. Depress Anxiety. 2010; 27: 287-293. doi: 10.1002/da.20659
18. Kubany ES, Haynes SN, Abueg FR, et al. Development and validation of the Trauma-Related Guilt Inventory (TRGI). Psychol. Assess. 1996; 8: 428-444. doi: 10.1037/1040-3590.8.4.428
19. Phelps AJ, Steel Z, Metcalf O, et al. Key patterns and predictors of response to treatment for military veterans with post-traumatic stress disorder: a growth mixture modelling approach. Psychol. Med. 2018; 48(1): 95-103. doi:10.1017/S0033291717001404
20. Hendin H, Hass AP. Suicide and guilt as manifestations of PTSD in Vietnam combat veterans. Am. J. Psychiatry. 1991; 148: 586-591. doi: 10.1176/ajp.148.5.586
21. Department of Veterans Affairs. Contemporary Veteran. Canberra: Australian Government; 2020. Available from: https://clik.dva.gov.au/glossary/contemporary-veteran#:~:text=A%20contemporary%20veteran%20is%20defined,content%20classified%20with%20this%20term.
22. Australian War Memorial. Canberra ACT; Australian War Memorial. Conflicts; 2016 Aug 11. Available from: https://www.awm.gov.au/conflicts/

23. Weathers FW, Keane TM, Davidson, JR. Clinician-Administered PTSD Scale: A review of the first ten years of research. Depress Anxiety. 2001; 13: 132-156.
24. van Der Kolk BA, McFarlane AC, Weisaeth L, editors. Traumatic Stress: The Effects of Overwhelming Experience on Mind, Body and Society. New York: The Guildford Press; 1996. 596 p.
25. Reinert DF, Allen JP. The alcohol use disorders identification test (AUDIT): a review of recent research. Alcohol.: Clin. Exp. Res. 2002; 26: 272-279.
26. Forbes D, Hawthorne G, Elliott P, et al. A concise measure of anger in combat-related posttraumatic stress disorder. J. Trauma. Stress. 2004; 17: 249-256. doi: 10.1023/B:JOTS.0000029268.22161.bd
27. R Core Team. R: A language and environment for statistical computing. Austria: R Foundation for Statistical Computing; 2015. Available at: http://www.R-project.org
28. Swinscow TDV, Campbell MJ. Statistics at Square One: Ninth Edition. UK: BMJ Publishing Group; 1997. 140p.
29. Novaco RW, Chemtob CM. Anger and combat-related posttraumatic stress disorder. J. Trauma. Stress. 2002; 15: 123-132.
30. Orth U, Wieland E. Anger, hostility, and posttraumatic stress disorder in trauma- exposed adults: A meta-analysis. J Consult Clin Psychol. 2006; 74: 698-706.
31. Tangney JP, Patricia W, Carey F, et al. Shamed into anger? The relation of shame and guilt to anger and self-reported aggression. J Pers Soc Psychol. 1992; 62(4): 669-675. doi: 10.1037/0022-3514.62.4.669
32. Okulate GT, Jones OBE. Post-traumatic stress disorder, survivor guilt and substance use – A study of hospitalised Nigerian army veterans. SAMJ. 2006; 96: 144-146.
33. de Leon J, Baca-Garcia E, Blasco-Fontecilla H. From the serotonin model of suicide to a mental pain model of suicide. Psychotherapy and Psychosomatics. 2015; 84(6): 323-329. doi: 10.1159/000438510
34. Kerr K, Romaniuk M, McLeay S, et al. Increased risk of attempted suicide in Australian veterans in associated with total and permanent incapacitation, unemployment and posttraumatic stress disorder severity. Aust N Z J Psychiatry. 2017; 52(6): 1-9. doi: 10.1177/0004867417718945Tables

Humanitarian Aid/Disaster Relief (HA/DR) in the Australian Defence Force: Health aspects

N Westphalen

Introduction

This article follows previous papers by the author, regarding occupational and environmental medicine in the ADF.[1,2,3,4,5,6,7,8,9] These papers, as well as a recent Productivity Commission inquiry,[10] describe why high workplace illness and injury rates confirm the need to improve the management of hazards associated with ADF workplaces, with better emphasis on prevention. To this end, a submission by the Royal Australasian College of Physicians to the aforementioned inquiry, advocated this would best be achieved by premising the ADF's health services on a systems-based occupational health strategic model.[11]

Doing so would require reassessing the fundamental inputs to capability (FiC)[12] for both Joint Health Command (JHC), and Defence's Work Health and Safety Branch. Previous papers have explained that the current state of the ADF's occupational and environmental health services, and the small number of civilian specialist practitioners within the Australasian Faculty of Occupational and Environmental Medicine (AFOEM), indicate that implementing a mature holistic and sustainable model would take 10–15 years' sustained effort.

The current strategic-level guidance for ADF Humanitarian Aid/Disaster Relief (HA/DR) operations is in Australian Defence Doctrine Publication (ADDP) 3.20 *The Military Contribution to Humanitarian Operations*, which was last updated in 2013.[13] The purpose of this article is to inform future iterations of ADDP 3.20 and other related ADF and single-service references by expanding on previous papers as to how such a model can be applied regarding ADF health support for HA/DR operations.

Overview

Internationally, the United Nations (UN) defines humanitarian aid as aid provided to a stricken population that complies with the basic humanitarian principles of humanity, impartiality and neutrality, in order to save lives, limit extraordinary suffering and prevent further damage to the affected society.[14] The UN outlines three major HA categories:

1. **Direct HA.** Face-to-face distribution of goods and services to the affected population.
2. **Indirect HA.** Activities such as transporting relief personnel and supplies with no affected population contact.
3. **Infrastructure support.** General life support services, as well as construction tasks that facilitate relief but are not necessarily delivered solely for the affected population.[15]

The UN Office for the Coordination of Humanitarian Affairs also notes that:

> *'Promoting gender equality must be central to the humanitarian community's commitment to protect and provide assistance to people affected by emergencies. Conflicts and disasters impact women, girls, boys and men of various ages and backgrounds differently. Gender, age, socioeconomic and cultural backgrounds greatly affect the roles people play in their family and community, and how they are affected by a crisis'.*[16]

These considerations explain how the ADF health services that are predicated on a systems-based occupational health strategic model can and should contribute to HA/DR operations.

ADF aspects

Previous missions. Australia's first humanitarian aid mission responded to the 1918 influenza pandemic in the southwest Pacific,[17] while its largest remains that to the destruction of Darwin by Cyclone Tracy in 1974.[18,19] More recent domestic HA/DR missions include (but by no means limited to) the annual Army Aboriginal Community Assistance

Program conducted since 1996,[20] and the ADF's responses to Cyclone Larry in 2006,[21] the 2010–11 Queensland floods,[22] and the 2019–20 bushfires.[23] Overseas ADF HA/DR missions include northern Iraq after the 1991 Gulf War,[24] the 2004 Indian Ocean tsunami, the 2005 Kashmir earthquake, the 2010 Pakistan floods, and the 2015 Vanuatu and 2016 Fiji cyclones.[25] Reference should also be made to the ADF's contribution to the ongoing biennial Pacific Partnership deployments since 2006.[26]

The ADF and its antecedent organisations, therefore, have a long HA/DR history. The impact of climate change, in particular, indicates that the frequency and scope of these missions will continue to expand.[27]

Current roles. ADDP 3.20 explains how the ADF typically undertakes HA/DR missions as part of a Whole-of-Australian-Government (WoAG) response. Like other countries, decisions to undertake HA/DR missions and their nature, level and duration often not only reflect altruistic imperatives per the UN, but also their use as 'soft power' enablers in support of Australia's national interests.[28]

Hence, although it may not be specifically stated doctrinally, in general terms, ADF health support for HA/DR missions can be differentiated from non-HA/DR missions in that:

- In many cases, the ADF is *not* the lead Australian government agency. Disaster responses within Australia are typically led by the local State or Territory government, while overseas disaster responses are usually led by the Department of Foreign Affairs and Trade.[29]
- Rather than acting as a *supporting* arm to a deployed force, the ADF health assets may be the primary force *being supported by* other arms, as occurred for the 1994–95 Rwanda deployment.[30]
- As the ADF's health services typically provide an initial and short-term HA/DR response until normal services are restored, or other agencies take over:
  - the notice to move is often far shorter compared to other ADF deployments, and
  - there is a far greater level of interaction with other (non-ADF) health agencies.

While the ADF employs a joint approach to its HA/DR operations, the following sections explain how the health contributions by each service are complementary rather than interchangeable.

Air Force HA/DR considerations

Australian Air publication 1000-D *The Air Power Manual* states:

> *'Air power affords the Government options to respond to the entire spectrum of conflict from providing humanitarian assistance or disaster relief to delivering national security imperatives and protecting national interests.'*[31]

The *Air Power Manual* also notes that air mobility is often the transportation mode of choice when speed, reach, and obstacle and surface threat avoidance are required. The air power attributes that are especially relevant to HA/DR missions include the ability to rapidly deploy, sustain and redeploy personnel and materiel to, from or within an operational theatre.

However, the key limitations with respect to Air Force HA/DR support pertain to:

- Access to suitable on-site fixed-wing airfields (including—but not limited to—runways, taxiways and ramp areas, all of which need to be of suitable length/size, condition and weight-bearing capacity), air traffic control facilities and personnel (especially in congested airspace), ground support equipment and personnel (in particular for aircraft unloading), and access to fuel. These limitations can be mitigated by the airfield performance and self-loading/unloading capabilities of aircraft such as the C17 Globemaster III,[32] C-130J Hercules,[33] and C27J Spartan.[34]
- Aircraft payload, which is limited to at most tens of tons, and usually entails a trade-off against fuel load and hence range. Subject to the previous dot point, this limitation can be partly addressed with high sortie rates.
- Aircraft and aircrew personnel maintenance, the latter including adequate food, fluids and rest. This can be addressed using relief aircrew and maintainers.

Hence, it should be expected that Air Force would be responsible for providing health-related aerospace HA/DR support as follows.

- Airfield availability permitting, providing the initial response to an HA/DR event via the strategic or tactical airlift of disaster health assessment[35] and aeromedical evacuation (AME) teams.
- Providing an initial lifesaving surgical response for multiple casualties *within* 36 hours of the incident. This timeframe being premised on the victims who *most* need such surgery,

being *unlikely* to survive beyond this period. Combined with the aforementioned limitations, this consideration usually means that, after the disaster needs assessment, an early priority would be the triage, resuscitation and evacuation of such casualties to the nearest suitable health facilities, *unless*:

- The volume of on-scene lifesaving surgical work / post-operative care *within* this timeframe is *small* enough to be accommodated by air-transportable surgical team(s) *without* logistic support, or
- These team(s) can meet the surgical *and* post-operative demands with the logistic support available until either the demand reduces or can be relieved by follow-up surgical teams (see below).

This implies the need for HA/DR AME teams to include intensivists and other highly-skilled retrieval specialists, as occurred in response to the 2002 and 2005 Bali bombings,[36,37] and the 2019 White Island volcano disaster.[38]

- Along with the other services, contributing to the follow-on WoAG response *beyond* 36 hours of the incident. These operations may entail providing fixed-wing strategic and tactical:
  - Airlift support, with respect to time-critical medical (among other) stores, and the deployment, sustainment and redeployment of relief medical (among other) teams. It should also be noted that the absence, damage or destruction of suitable seaports or their enabling infrastructure, or lack of suitable beaches or landing craft, may result in the airlift option becoming the *sole* alternative.
  - AME services for the affected population and HA/DR responders, supported as required by in-theatre AME staging teams.

Ambulances line up behind a 37 Squadron C-130J Hercules to receive civilian patients evacuated from Bundaberg Hospital during the 2013 Queensland floods'.[39]

Navy HA/DR considerations

Australian Maritime Doctrine (AMD) states that:

> *'Warships repeatedly demonstrate that their inherent capabilities make them uniquely valuable in providing both short notice and long-term assistance in disaster relief, not only for coastal locations, but sometimes well inland. While embarked helicopters can be particularly useful and ships may act as logistic support bases, hospitals and command posts for long periods, the specialist skills available in ships also mean that their personnel can be invaluable sources of trained manpower for rehabilitation and repair work. Most importantly, naval forces are self-supporting and do not create additional logistic burdens in situations where infrastructure has been destroyed or severely damaged.'*[40]

AMD also notes that, although ships move at only one-thirtieth the speed of aircraft, they can carry thousands of times the payload.[41] Furthermore, their capacity to be replenished at sea means they can remain on-task for weeks or even months at a time.

Conversely, the key limitations regarding Navy HA/DR support pertain to:

- The distances inherent to HA/DR operations within Australia's area of strategic interest, which mean ship transit times are typically measured in days, compared to hours for aircraft.
- The availability of accessible seaports and their enabling infrastructure. This can be mitigated by hydrographic teams conducting port surveys and/or Navy clearance divers performing obstacle clearance before the ships arrive. Other options include using suitable beaches (subject to landing craft availability) and/or ship-board helicopters within their range, payload, weather and other operational constraints.
- Ship and ships' company maintenance, noting that (as examples), ships are *not* staffed to conduct 24-hour flight deck/well dock operations and need to replenish their freshwater supplies by running their reverse osmosis plants offshore. These limitations can be mitigated by forward planning.
- Hence, it should be expected that Navy would be responsible for health-related maritime HA/DR support as follows.
- Complying with its International Convention on Safety at Sea (SOLAS) obligations, such

as treating foreign crewmen at sea who lack access to health care, or caring for ill or injured shipwreck survivors.[42] Although these obligations are usually met with the ship's extant health assets (for example, the 2010 SIEV 221 incident),[43] augmentation may be required in remote or demanding situations, such as the 2009 SIEV 36 incident.[44]

- In some circumstances, the initial response to an HA/DR event ashore may begin by reassigning the nearest available ship, as occurred when HMAS *Parramatta* (II) was diverted for an earthquake on Bali during a heretofore routine 'up top' deployment in 1976.[45] As this occurs with minimal notice, the ship's ability to respond will reflect her extant health capabilities, which (noting most do *not* carry a medical officer) will usually restrict her to providing *indirect* support for crew members working ashore.
- Expanding the initial Air Force response, via:
  - The strategic, tactical or forward sealift of HA/DR personnel, equipment and stores, including the deployment, sustainment and redeployment of medical relief teams. It should also be noted that the absence, damage or destruction of suitable airfields and/or their enabling infrastructure within the range of the aircraft that would otherwise be available for airlift purposes, may result in the sealift option becoming the only alternative.
  - The provision of an onboard lifesaving surgical response for casualties ashore *beyond* 36 hours of the incident. It should be noted that for this to occur, the Maritime Operational Health Units that routinely deploy aboard the Landing Helicopter Docks *Adelaide* or *Canberra*,[46] or the Landing Ship Dock *Choules*,[47] would require mission-specific augmentation.
- Along with the other services, contributing to a follow-on WoAG response, such as:
  - Restricting the deployment footprint ashore by providing 'sea-based' strategic, tactical and forward sealift support for the deployment, sustainment and redeployment of shore-based health assets. This may include using helicopters for sea-based airlift and AME support.
  - Providing a sustained follow-on onboard *direct* HA/DR primary care and other aforementioned health services for the affected population, *if tasked*. This response will most likely *only* be provided for incidents within Australia (as occurred during the 2019–20 bushfires)[48] or for overseas Non-Combatant Evacuation Operations (NEO) involving Australian nationals and other approved evacuees (as occurred in 2000 in Operation PLUMBOB).[49]
  - Otherwise providing a sustained onboard *indirect* HA/DR primary care and other health services for entitled personnel who are part of an ADF, WoAG or international response. These may include ADF health assets that in turn, are providing *direct* HA/DR primary care and other health services *ashore* for an affected population.

Medical Officer LEUT (now CMDR) Ninian Melville (left), and CPOMEDU (now LEUT) Melissa Thomson head from the submarine rescue ship MV Stoker *to the yacht* Garmin *for a civilian SOLAS medical evacuation, Indian Ocean, 2017*[50]

Army HA/DR considerations

Army's Land Warfare Doctrine 1 (LWD1) states:

> *'Army's responsibilities include promoting and shaping the international security environment, and responding to crises that are not strictly defined as war—such as humanitarian assistance and disaster relief. These actions provide weight to Australia's strategic and diplomatic efforts'.*[51]

LWD1 also refers to Army's strong expeditionary culture, which is essential to conducting overseas HA/DR operations.[52]

Army's key HA/DR contribution pertains to its ability to provide a scalable response without the same space (Navy) or weight (Air Force) constraints; for example, employing heavy machinery plant

to restore damaged or destroyed infrastructure. Its ability to co-locate health teams with (or even among) the affected population also makes Army better suited than the other services for direct HA/DR health support, especially over extended periods.

Conversely, Army's key limitations pertain to:

- Its dependence on the other services with respect to deploying to, sustainment in and redeployment from the affected area(s), whether overseas or remote locations within Australia. This is partly mitigated by Navy and Air Force acceptance that enabling sea- and airlift support for all three Services as one of their elemental roles.
- The footprint size, disposition and duration of deployed Army assets, especially in locations where the infrastructure is already under strain or has been destroyed, or overseas if there are cultural, political or other sensitivities regarding foreign presences. As previously indicated, these can be mitigated via 'sea-basing', for example, as per the biennial Operation RENDER SAFE deployments.[53]

Hence, it should be expected that Army would be responsible for health-related land-based HA/DR support as follows.

Assembling follow-on mission-specific land-based HA/DR health teams and units at the relevant mounting base (typically RAAF Bases Richmond, Amberley or Townsville for Air Force, otherwise HMAS *Kuttabul* or Townsville for Navy) for loading and transport.

Once deployed, using these teams and units to contribute to the follow-on WoAG response, typically via providing:

- Sustained *indirect* HA/DR primary care and other health services for entitled personnel who are part of an ADF, WoAG or international response.
- Sustained *direct* HA/DR primary care among the other aforementioned health services for the affected population, *if tasked*.
- Forward support for the deployment, sustainment and redeployment of land-based health assets. This may include using helicopters for land-based airlift and AME support.

Private Markus Collins treats an earthquake survivor, Dhanni township Punjab province, Operation PAKISTAN ASSIST, 2005[54]

HA/DR medical logistics

A key consideration for Joint Logistics Command relates to providing medical stores support at the mounting bases for the respective Air Force and Navy initial health HA/DR responses, which would transition to likewise sustaining the deployed land-based Army HA/DR health units. This issue is complicated by the aforementioned fact that, while the medical logistic requirements for *indirect* HA/DR health support are again likely to reflect other ADF operations, that for *direct* HA/DR health support needs to accommodate the vulnerable population subgroups.

Implications

The author has previously advocated that the ADF health services should be based on a systems-based occupational health strategic model, premised on the following considerations.

The need for 'health' (not just 'treatment') services, that reflect a complex, highly medically selected, *young* working age, geographically widely dispersed, exceptionally mobile and (for now) predominantly male population, which is probably exposed to the most diverse range of higher-risk workplace hazards of any Australian workforce.[55]

Previous papers have explained why, absence of data notwithstanding, anecdotal evidence suggests that:

Perhaps 30–40 per cent of ADF clinical presentations to a typical 'garrison' medical practitioner are for generally preventable musculoskeletal injuries. About half may be workplace-related (typically related to manual handling or slips/trips/falls); the remainder tends to be sports-related.

Possibly another 30–40 per cent of these presentations are for generally preventable workplace mental health issues. Around half of these members lack psychological robustness for whom the ADF has been a poor career choice; the rest are psychologically robust but are not coping with excessively demanding or otherwise dysfunctional ADF workplaces or personnel management practices.[56]

This paper, therefore, contends that, as perhaps up to 80 per cent of ADF primary care presentations may be work-related (compared to only 2.4 per cent of civilians),[57] HA/DR support should *not* distract the ADF's health services from their primary role of supporting the ADF workforce, especially noting that the proposed model remains compatible with providing *indirect* HA/DR support on the same terms as other ADF operations.

It is accepted that this model is not best suited to provide *direct* HA/DR health care for vulnerable population subgroups. However, the ADF health reserves *can* provide 'militarily-oriented' specialist augmentation (again, as for other ADF operations) in the form of surgical teams, AME retrieval intensivists, general, public health and occupational and environmental health physicians, and allied environmental health professionals.

Otherwise, the provision of 'non-militarily-oriented' specialist augmentees, such as obstetricians/gynaecologists and paediatricians, depends on whether or not they are intended to deploy with an ADF HA/DR health team. Doing so implies they require the same opportunities to become familiar with the ADF team(s) with which they will deploy as their 'militarily-oriented' specialist peers; else, they would be better deployed with a formed *civilian* HA/DR team, as part of a broader WoAG effort.[58]

Conclusion

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

The author's previous articles, therefore, advocate that the ADF's health (not just treatment) services should reflect the ADF's complex, highly medically selected, young working age, geographically widely dispersed, exceptionally mobile and (for now) predominantly male workforce. This means they should be premised on a systems-based occupational health strategic model.

This paper explains the extent to which the health contributions by each service to HA/DR operations are complementary rather than interchangeable. It also explains why HA/DR health support should not distract the ADF's health services from their primary role of supporting the ADF workforce, noting that the proposed model remains consistent with providing indirect HA/DR support on the same terms as other ADF operations.

This means any requirement to provide direct HA/DR health care for vulnerable HADR subgroups will require augmentation, either by incorporating the relevant specialists into the ADF's health teams or deploying them as part of a broader WoAG HA/DR response within deployable civilian health teams.

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Commander Westphalen transferred to the Active Reserve in 2016. Comments regarding this and previous articles are most welcome.

Disclaimer

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

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References

1 Westphalen N. Occupational and environmental health in the ADF. JMVH. 2017 Jan;25(1):44-52. Available from: http://jmvh.org/wp-content/uploads/2017/02/reprint.pdf.

2 Westphalen N. Primary health care in the ADF. JMVH. 2017 Oct;25(4):84-9. Available from: http://jmvh.org/wp-content/uploads/2017/11/AMMA-JMVH-October-2017.pdf.

3 Westphalen N. Assessing medical suitability for employment and deployment in the ADF. JMVH. 2018 Jul;26(3):42-8. Available from: http://jmvh.org/wp-content/uploads/2018/08/AMMA-JMVH-July-2018.pdf.

4 Heslop DJ, Westphalen N. Medical CBRN Defence in the Australian Defence Force. JMVH. 2019, Jan 27(1):66-73. Available from: https://jmvh.org/wp-content/uploads/2019/01/AMMA-JMVH-Jan-2019-compressed-1.pdf.

5 Westphalen N. Compensation in the Australian Defence Force. JMVH. 2019 Jan;27(1):58-65. Available from: https://jmvh.org/wp-content/uploads/2019/01/Compensation-in-the-Australian-Defence-Force.pdf.

6 Westphalen N. Rehabilitation in the Australian Defence Force. JMVH. 2019 Oct;27(4):7-14. Available from: https://jmvh.org/wp-content/uploads/2019/10/AMMA-JMVH-October-2019.pdf.

7 Westphalen N. Casualty Evacuation in the Australian Defence Force. JMVH. 2020 Jan;28(1):29-38. Available from: https://jmvh.org/article/casualty-evacuation-in-the-australian-defence-force.

8 Westphalen N. Military Medicine Capabilities in the Australian Defence Force. JMVH. 2020 May;28(2):39-49. Available from: https://jmvh.org/article/military-medicine-capabilities-in-the-australian-defence-force.

9 Westphalen N. Health promotion in the Australian Defence Force. JMVH. 2021 January;29(1):52-60. Available from: https://jmvh.org/article/health-promotion-in-the-australian-defence-force.

10 Productivity Commission. Overview: A better way to support veterans and their families. 2019 Jul. Available from: https://www.pc.gov.au/inquiries/completed/veterans/report/veterans-overview.pdf. It is essential to note this report uses the term 'veteran' to refer to *current* as well as ex-serving ADF members.

11 Royal Australian College of Physicians. RACP submission to the draft Productivity Commission report 'A Better Way to Support Veterans'. 2019 Feb. Available from: https://www.pc.gov.au/__data/assets/pdf_file/0003/236811/subdr234-veterans.pdf.

Disclaimer: the author was requested to draft this submission, as a member of the AFOEM Policy and Advocacy Committee (PAC). It was cleared by both the Faculty and College PACs prior to submission.

12 See Department of Defence. Defence Capability Development Handbook Dec 2012. Available from: http://www.defence.gov.au/publications/DefenceCapabilityDevelopmentHandbook2012.pdf. This reference describes the following Fundamental inputs to (in this case health) Capability (FiC).

- Personnel;
- Organisation;
- Collective training;
- Facilities;
- Supplies;
- Major systems;
- Support, and
- Command and management.

13 More recent interim guidance can be found in Joint Doctrine Note (JDN) 5–20 *ADF Response to a Natural Disaster/Emergency*, which was released on 14 Dec 2020.

14 UN Office for the Coordination of Humanitarian Affairs ReliefWeb Project. Glossary of humanitarian terms 2008 Aug (draft). p. 31-2. Available from https://www.who.int/hac/about/reliefweb-aug2008.pdf?ua=1.

15 UN Office for the Coordination of Humanitarian Affairs ReliefWeb Project. Humanitarian Civil-Military Coordination: A Guide for the Military. 2014. p. 51. Available from: https://www.unocha.org/sites/dms/Documents/UN%20OCHA%20Guide%20for%20the%20Military%20v%201.0.pdf.

16 UN Office for the Coordination of Humanitarian Affairs. Gender-Equality Programming. Available from: https://www.unocha.org/themes/gender-equality-programming. Interim ADF gender equity guidance during post-armed conflict, post-disaster and post-crisis stability activities is in JDN 2-18 *Gender in Military Operations* dated 21 Dec 2018 (only available on Defence Intranet).

17 In November 1918, the light cruiser HMAS *Encounter* took 150 tons of stores and a combined Navy and Army medical team to Samoa, where influenza had killed 25% of the population in two months, including up to half of the adult males. *Encounter* then proceeded to Tonga, where 10% of the population had died. See Sea Power Centre – Australia. The RAN and the 1918–19 Influenza Pandemic 2006 (6). Available from: https://www.navy.gov.au/sites/default/files/documents/Semaphore_2006_6.pdf.

18 Operation NAVY HELP DARWIN included 3000 personnel aboard the aircraft carrier *Melbourne*, the destroyers *Hobart*, *Brisbane*, and *Vendetta*, the destroyer escort *Stuart*, the maintenance ship *Stalwart*, the oiler *Supply*, the hydrographic ship *Flinders*, and the landing craft *Balikpapan*, *Betano*, *Brunei*, *Tarakan* and *Wewak*. See Royal Australian Navy, Disaster Relief - Cyclone Tracy and Tasman Bridge Available from: http://www.navy.gov.au/history/feature-histories/disaster-relief-cyclone-tracy-and-tasman-bridge.

19 For the RAAF and other air forces involvement with Cyclone Tracy, see Sir Commodore DW Hitchins. The Hitchins Papers: miscellaneous notes on air operations in the aftermath of Cyclone Tracy at Darwin in December 1974. Available from: http://www.adastron.com/cyclone-tracy/tracy-hitchins-papers.htm.

20 Australian Army. Army Aboriginal Community Assistance Programme (AACAP). 2015 Nov. Available from: https://www.defence.gov.au/publications/docs/AACAPBackgroundfactsheet.pdf.

21 ReliefWeb. Australia: Defence support to Queensland government—post Cyclone Larry. 2006 March 21. Available from: https://reliefweb.int/report/australia/australia-defence-support-queensland-government-post-cyclone-larry.

22 New phase for Operation Queensland Flood Assist. Defence News. 2011 Jan 28. Available from : https://news.defence.gov.au/media/media-releases/new-phase-operation-queensland-flood-assist..

23 Defence boosts bushfire support. Defence News. 2020 March 13. Available from: https://news.defence.gov.au/national/defence-boosts-bushfire-support.

24 Little M, Hodge JV. Operation HABITAT: Humanitarian aid to the Kurdish refugees in northern Iraq. MJA. 1991;155:807-12. Available from: https://onlinelibrary-wiley-com.wwwproxy1.library.unsw.edu.au/doi/pdfdirect/10.5694/j.1326-5377.1991.tb94043.x..

25 See Bullard S. In their time of need: Australia's overseas emergency relief operations 1918–2006. Port Melbourne VIC: Cambridge University Press—Australian War Memorial; 2017.

26 ADF support regional health care for Pacific Partnership 18. Defence News. 2018 June 16. Available from: https://news.defence.gov.au/media/media-releases/adf-support-regional-health-care-pacific-partnership-18.

27 Press A, Bergin A, Garnsey E. Heavy Weather: Climate and the Australian Defence Force. Australian Strategic Policy Institute. 2013 March(49). Available from: https://s3-ap-southeast-2.amazonaws.com/ad-aspi/import/SR49_heavy_weather.pdf?KWFQUjgDBM_Ygio9NNo.vXaKWnUjtldE.

28 See Curtis R. Maritime Medical Diplomacy as an Instrument of Soft Power. In: Forbes A, editor. The Naval Contribution to National Security and Prosperity. Canberra ACT: Sea Power Centre—Australia; 2012. p. 243-58. Available from: https://www.navy.gov.au/sites/default/files/documents/SP12.pdf.

29 The Royal Commission into the 2019-2020 bushfires has made 80 recommendations, some of which refer to an expanded role for the Federal government. See Noble F. 'What was unprecedented is now our future:. Royal Commission bushfire report released 30 Oct 2020 Available from: https://www.9news.com.au/national/bushfire-royal-commission-findings-80-recommendations/3b7ec98b-673b-4305-8ca7-3bad7441f726.

30 For an overview of the Rwanda deployment, see Bou J, Breen B, Horner D, Pratten G, Vogel MD. *The limits of peacekeeping: Australian missions in Africa and the Americas 1992-2005*. In: Horner D, editor. The official history of Australian peacekeeping, humanitarian and post-cold war operations. 4. Cambridge UK: Cambridge University Press: Australian War Memorial; 2019. p. 199-339. It should be noted this deployment is a good example of the overlap between HA/DR and peacekeeping operations, when the disaster is man-made.

31 Air Power Development Centre. Fundamentals of Air and Space Power. Australian Air Publication 1000-D: The Air Power Manual. 6 ed. Canberra: Air Power Development Centre; 2013. p. 113. Available from: http://airpower.airforce.gov.au/APDC/media/PDF-Files/Doctrine/AAP1000-D-The-Air-Power-Manual-6th-Edition.pdf.

32 Royal Australian Air Force. C-17 Globemaster III. Available from: https://www.airforce.gov.au/technology/aircraft/air-mobility/c-17a-globemaster-iii.

33 Royal Australian Air Force. C-130J Hercules. Available from: https://www.airforce.gov.au/technology/aircraft/air-mobility/c-130j-hercules.

34 Royal Australian Air Force. C-27J Spartan. Available from: https://www.airforce.gov.au/technology/aircraft/air-mobility/c-27j-spartan.

35 For a description of the role of Medical Assessment Teams, see National Critical Care and Trauma Response Centre. AUSMAT. Available from: https://www.nationaltraumacentre.nt.gov.au/what-we-do/disaster-management/ausmat.

36 The Bali bombing incident on 12 Oct 02 killed 202 (including 88 Australians) and injured 209 people. Five RAAF C-130 transport aircraft, 12 crews and five AME teams were deployed in response. This involved the triage, stabilisation and evacuation of 66 critically ill patients from Bali to Darwin over 21 hours. Following stabilisation in the Royal Darwin Hospital, four C-130s transferred 35 patients over 16 hours to various centres in Australia, under direction from Emergency Management Australia. See Hampson G, Cook S, Frederiksen S. Operation Bali Assist. ADF Health. 2003;4(1):12-5.

37 The Bali bombing incident on 01 Oct 05 killed 20 people and wounded over 100 more. Two RAAF C-130s, with an aeromedical evacuation team, surgical team, medical staging facility and co-ordination element, evacuated 22 casualties and some of their family members to Darwin. See Australian Institute for Disaster Resilience – Knowledge Hub, Bali Indonesia, October 2005: Criminal – Bali Bombings. Available from: https://knowledge.aidr.org.au/resources/criminal-bali-bombings. Also, Deadly blasts rip through Bali. Sydney Morning Herald. 2005 Oct 3. Available from: https://www.smh.com.au/world/deadly-blasts-rip-through-bali-20051003-gdm66o.html.

38 Whinnett E, Rose T. Australian victims of NZ volcano being sent home. 2019 Dec 11. Available from: https://www.news.com.au/world/australian-victims-of-nz-volcano-being-sent-home/news-story/b6bde1059176e4130272d0409a92c783.

39 Department of Defence – Defence Images. Defence photograph 20130129raaf8540638_0276. Available from: https://images.defence.gov.au/assets/Home/Search?Query=20130129raaf8540638_0276&Type=Simple.

40 Sea Power Centre—Australia. Maritime Operations. Australian Maritime Doctrine: RAN Doctrine 1. Canberra: Sea Power Centre—Australia; 2010. p. 110. Available from https://www.navy.gov.au/sites/default/files/documents/Amd2010.pdf.

41 Sea Power Centre—Australia. Maritime Operations. Australian Maritime Doctrine: RAN Doctrine 1. Canberra: Sea Power Centre—Australia; 2010. p. 86. Available from: https://www.navy.gov.au/sites/default/files/documents/Amd2010.pdf.

42 See Australian Maritime Safety Authority. Search and rescue. Available from: https://www.amsa.gov.au/safety-navigation/search-and-rescue#collapseArea248.

43 On 15 December 2010, SIEV 221 sank after striking coastal cliffs on Christmas Island, while carrying 89 passengers and three crew. 41 survivors were rescued by HMAS *Pirie* and ACV *Triton*. See Hope, Justice AN. Inquest into 30 deaths of (individual names); Inquest into 20 suspected deaths of (individual names). Perth WA: Western Australian Coroner; 2010. Available from: https://www.coronerscourt.wa.gov.au/_files/Christmas_Island_Findings.pdf.

44 On 16 April 2009, SIEV 36 exploded and sank off Ashmore Reef, while carrying two crew and 47 passengers. Five passengers were killed and while 31 of the 44 survivors required urgent evacuation ashore with severe burns, which took place in a highly complex operations without further loss of life. See Cavanagh G. Inquest into the death of (individual names). Darwin Coroner's Court; 2010 Mar 27. Available from: https://www.defence.gov.au/siev36/pdf/findings%20-%20SIEV%2036%20inquest.pdf. Also, Leclercq M, Robertson A. (A216) Ashmore Reef Boat Explosion: A Nightmare Scenario that Became a Reality. Prehospital and Disaster Medicine. 2011;26:s60. Available from: https://doi-org.wwwproxy1.library.unsw.edu.au/10.1017/S1049023X11002068..

45 See Bullard S. Back to Bali. In their time of need: Australia's overseas emergency relief operations 1918–2006. The Official History of Australian Peacekeeping, Humanitarian and Post-Cold War Operations. 6. Port Melbourne VIC: Cambridge University Press—Australian War Memorial; 2017. p. 140-52.

46 Royal Australian Navy. Amphibious Assault Ship (LHD). Available from: https://www.navy.gov.au/fleet/ships-boats-craft/lhd.

47 Royal Australian Navy 1. Landing Ship Dock (LSD). Available from: https://www.navy.gov.au/fleet/ships-boats-craft/lsd.

48 See Paroz D LCDR, Frank H POIS, Ricketts B ABIS. 1Navy Task Group sails to support bushfire relief efforts. Navy Daily. 2020 Jan 02. Available from: https://news.navy.gov.au/en/Jan2020/Operations/5661/Navy-Task-Group-sails-to-support-bushfire-relief-efforts.htm#.X_Wh8tgzZPY.

49 Operation PLUMBOB refers to the evacuation of Australians and other nationals from the Solomon Islands following the June 2000 coup in Honiara. See Doolan K. Operations PLUMBOB and TREK: the Solomons 2000 and 2001. HMAS *Tobruk*: warship for every crisis. Queanbeyan NSW: Grinkle Press; 2007. pp. 127-31.

50 Department of Defence – Defence Images. Defence photograph 20171121ran8609973_018. Available from: https://images.defence.gov.au/assets/Home/Search?Query=20171121ran8609973_018&Type=Simple.

51 Australian Army. Land Warfare Doctrine 1: The Fundamentals of Land Power. 2017. p. 19-20. Available from: https://researchcentre.army.gov.au/sites/default/files/lwd_1_the_fundamentals_of_land_power_full_july_2017.pdf.

52 Australian Army. Land Warfare Doctrine 1: The Fundamentals of Land Power. 2017. p. 20. Available from: https://researchcentre.army.gov.au/sites/default/files/lwd_1_the_fundamentals_of_land_power_full_july_2017.pdf.

53 Department of Defence. Operation Render Safe: dealing with the explosive remnants of war. Defence Annual Report 2016-17, p. 143. Available from:https://www.defence.gov.au/AnnualReports/16-17/Downloads/DAR_2016-17_Complete.pdf.

54 Department of Defence – Defence Images. Defence photograph 20051118adf8239682_0048. Available from: https://images.defence.gov.au/assets/Home/Search?Query=20051118adf8239682_0048&Type=Simple.

55 See Westphalen N. Enabling Operational Capability: Elements of an Australian Maritime Health Doctrine… and Why Navy Needs One. Canberra: Australian Naval Institute; 2019 May. Available from: https://navalinstitute.com.au/wp-content/uploads/ANI-Maritime-Health-Doctrine.pdf. Although the demographics described pertain to Navy, those for the other services are likely to be very similar. However, this cannot be said for their respective workplace health hazards.

56 Westphalen N. Occupational and environmental health in the ADF. JMVH. 2017 Jan;25(1):44-52. Available from: from http://jmvh.org/wp-content/uploads/2017/02/reprint.pdf.

57 Sydney University Family Medicine Research Centre. Work-related problems managed. General practice activity in Australia: Sydney University Family Medicine Research Centre; 2013–14. p. 64. Available from: https://ses.library.usyd.edu.au/bitstream/handle/2123/11882/9781743324226_ONLINE.pdf?sequence=4. Searches for more recent data regarding work-related presentations to GPs in Australia have not been successful.

58 See Department of Foreign Affairs and Trade. Humanitarian policy and partnerships - Australian Medical Assistance [sic] Teams (AUSMAT) Available from: https://www.dfat.gov.au/aid/topics/investment-priorities/building-resilience/humanitarian-policy-and-partnerships/Pages/australian-medical-assistance-teams-ausmat.

Longitudinal Change Resulting from the ADF's Arts for Recovery, Resilience, Teamwork and Skills (ARRTS) Program

T J Watt, E James Kehoe

Abstract

Arts-based activities are increasingly being offered to current and former military members as an adjunct to their established therapeutic interventions. Individuals who undertake arts-based activities have shown reductions in both anxiety and depressive symptoms. However, little is known about the specific mechanisms engaged by these activities or the duration of their positive effects. The current research aims to test changes in four mechanisms—specifically, behavioural activation, belonging, therapeutic alliance and flow states—that have been prominent contributors to success in established therapeutic interventions. The mechanisms plus changes in anxiety, depression and core self evaluations were assessed during a four-week art-based program for veterans that included visual, written, musical or theatrical streams in a nonclinical setting. Participants demonstrated increased positive changes in all four mechanisms and core self evaluations, which peaked at the end of the program. Conversely, anxiety and depressive symptoms reduced in a similar pattern. Over a six-month follow-up, the scores on all measures returned to levels similar to their baselines.

Introduction

Military service exposes members to various traumatic and non-traumatic stressors that create the potential for poor mental health.[1] As adjuncts to established therapeutic interventions, there is increasing interest among therapists and veterans alike in the possible benefits of members' pursuing arts-based activities alongside their main treatment.[2] Such arts-based activities include visual, written, musical and theatrical modalities. In this context, the present paper describes a portion of the evaluation for a program of art-based activities aimed at supplementing the treatments of wounded, injured and ill military personnel. This program, badged as the Arts for Recovery, Resilience and Teamwork Skills (ARRTS) program, was initiated by the Australian Defence Force (ADF) in 2015.

Prior to the present study, the evaluation comprised 31 of the 119 participants who were contacted 18 months or more after completing the four-week ARRTS program through 2015, 2016 and mid-2017.[3] These former participants responded on a retrospective basis to 16 statements concerning their experiences, for example, 'I had a sense of achievement from the activities I undertook'. The participants were asked to tick a box as to whether the statement applied to them before, during, and/or after the program. In addition, there was a question asking the duration of the effect following the program. The respondents also completed a measure of psychological distress (K10) and a Core Self Evaluations Scale (CSES), both of which are described in greater detail in the method section. This retrospective survey revealed that the participants experienced ongoing benefit from the ARRTS program from 18 months up to 48 months later.[3]

As may be apparent, the previous survey was limited to a small number of former participants surveyed considerably after the program. The present study aimed to fill the gap in our knowledge regarding the participants' experiences during the program and in an immediate follow-up period of six months. Whereas the retrospective study focused on categorical judgements concerning remembered experiences, the present study provided a more detailed longitudinal, quantitative assessment of the participants' experiences. In addition, the study was based on a more substantial sample (final N = 92) recruited from five cohorts who completed the ARRTS program between late 2017 and late 2019.

Art and mental health

Art-based activities have demonstrably assisted veterans and civilians experiencing anxiety, depression and PTSD.[2] Beyond remediation of mental health disorders, art-based activities have been associated with improved resilience, sense of belonging, quality of life, and reductions in stress, anger, physical complaints and social isolation.[4] Specifically for veteran populations, art-based activities in the forms of visual, written expression and theatre have demonstrated mental health benefit.[5]

Despite these promising results, art-based activities have not been well standardised. Among other things, the activities have been conducted by specialised art-therapists and art educators, which was the case for the ARRTS program. So far as can be found, published literature on the use of art educators has been limited to children diagnosed with autism.[6]

The underlying mechanisms

The present study was conducted to identify specific mechanisms through which participants experience the benefits of art-based activities. In other types of psychological therapy, four mechanisms have been prominent contributors to therapeutic success. As will be detailed below, they are behavioural activation, belonging, therapeutic alliance and flow states.

Behavioural activation: Undertaking activities that provide a sense of purpose, achievement or enjoyment in a clinical context are broadly called 'behavioural activation'.[7] Active recreational pursuits (e.g., artistic activities, hobby crafts, and sport) and even passive enjoyments (e.g., watching a movie, relaxing in a bath) may achieve behavioural activation. Multiple clinical studies have demonstrated that behavioural activation may be described as 'a low-intensity guided self-help' treatment that improves depressive symptoms. Behavioural activation may also reduce anxiety symptoms, but empirical support for this proposition has been debated.[8]

Belongingness: A sense of belonging can improve mental health in a variety of settings. By the same token, a sense of belonging can lead people to become more resilient and less vulnerable to common mental health concerns.[4] Being part of a group and the resulting processes were a mechanism by which visual art-based activities have achieved positive outcomes for veterans.[2]

Common Factors: There are four recognised categories of factors common to patient-therapist relationships.[9] The largest category is the 'working' or 'therapist alliance',[10] which is a combination of the bond, trust and vision shared by the therapist and patient. The other three categories are: client-specific factors, such as the patient's engagement, motivation, openness to change and expectations about engaging in therapy; therapist-specific factors, including skill, training, and ability to interact with the patient; and finally, therapy-specific models and techniques, such as credibility, placebo effects, therapy structure and therapy focus.

Flow states. Flow states are commonly described as living in the present, including the ability to become fully immersed in an activity with energised focus and enjoyment, potentially losing the sense of space and time.[11] Activities that produce a flow state may be connected to relief from debilitating anxiety. Along similar lines, the absorption in an activity can enhance satisfaction from an optimal challenge and increase belief in competence, thus influencing the enjoyment of activities.

Core self-evaluations: A higher-order personality trait comprised of locus of control, neuroticism, self-efficacy and self-esteem—called an individual's core self-evaluations—has been proposed as influential for an individual's effectiveness in the workplace.[12] People who have high core self-evaluations will think positively of themselves and be confident in their own abilities. Conversely, people with low core self-evaluations will have a negative appraisal of themselves and will lack confidence. A person's core self-evaluations are a predictor of job performance, job satisfaction and more effective goal setting. Beyond the workplace, a person's core self-evaluations may contribute to their overall outlook and accordingly mental health.

Psychological distress: Psychological distress, a construct comprising of symptoms of anxiety and depression, is one of the regularly assessed mental health concerns within the ADF. Prevalence in any 12 months for these disorders is 9.5% for depressive disorders and 14.8% for anxiety disorders.[1]

Research questions

Based on the above considerations, the present study addressed the following questions concerning the participants' experience during the ARRTS program and within a six-month follow-up period.

Do the participants experience changes in the underlying mechanisms of behavioural activation, belonging, common factors and flow states?

Do participants experience changes in anxiety and depressive symptoms?

Do the participants experience changes, if any, in trait-based characteristics as assessed by the CSES?

Method

Respondents: The respondents (N = 92) were recruited from five ARRTS programs conducted between late 2017 and late 2019. The respondents represented 86% of participants across the five programs. The respondents were primarily current serving members of the ADF, with the inclusion of a few civilian first responders as outlined in the demographics (Table 1).

Procedure: At the start of each program, the prospective respondents were provided with an information pack including a research outline, respondent information statement and consent form via email. For the program participants who consented, a link to the Qualtrics online platform was sent at each measurement occasion. On each occasion, the respondent could complete the survey via phone, tablet or computer. For each respondent, there was a maximum of three measurement occasions during the program: (1) Days 3–5, (2) Days 12–14, (3) Day 28, plus three- and six-month follow-up occasions. Data collection for common factors, core self-evaluations and psychological distress occurred at the start, end, three- and six-month measurement occasions, with behavioural activation, belonging and flow occurring at all occasions, as shown in Figure 1. The study was approved by the Departments of Defence and Veterans Affairs Human Research Ethics Committee, Protocol 853-17.

Measures

Behavioural Activation for Depression Scale – Short Form (BADS-SF): The BADS-SF was used to measure behavioural activation. It consists of nine items, which were developed using a university population.[13] For each item, the participant was asked to read a statement and rate how often the statement was true during the past week on a seven-point scale ranging from 0 ('not at all') to 6 ('completely'). Five items concerned the frequency and quality of recent activities, e.g., 'I was an active person and accomplished the goals I set out to do'. The other four items, which were reverse-scored, concerned avoidance and rumination, e.g., 'I engaged in activities that would distract me from feeling bad'. The BADS-SF is reported to have sound psychometric properties, e.g., Cronbach's α =.819.[13]

Community Integration Measure (CIM): The CIM is a measure of belongingness, which rates perceived connections within a community with respect to general assimilation, support, occupation and independent living.[14] While originally designed for those who have had a traumatic brain injury, the measure has been validated by McColl, Davies, Carlson, Johnston and Minnes[14] using both patient samples (Cronbach's α =.830) and university samples (Cronbach's α =.780). The CIM contains ten declarative statements, rated on a five-point Likert scale (always agree, sometimes agree, neutral, sometimes disagree, always disagree), where 'always agree' was coded as 5, and 'always disagree' was coded as 1. Higher scores are interpreted as reflecting higher levels of community integration.

Common Factors Questionnaire (CFQ): The CFQ was developed for this study from a list of 15 factors[10]

Table 1. Respondent demographics

Demographics	
Gender	
Male	65%
Female	35%
Age	
<30	29%
30-39	33%
40-49	23%
50-59	14%
>60	1%
Rank	
Officer	26%
Senior Non-Commissioned Officer	12%
Other rank	55%
Civilian	8%
Service	
Navy	31%
Army	46%
Air Force	15%
Civilian	8%
Creative Stream	
Visual arts	40%
Creative writing	22%
Acting and performance	10%
Music and rhythm	28%

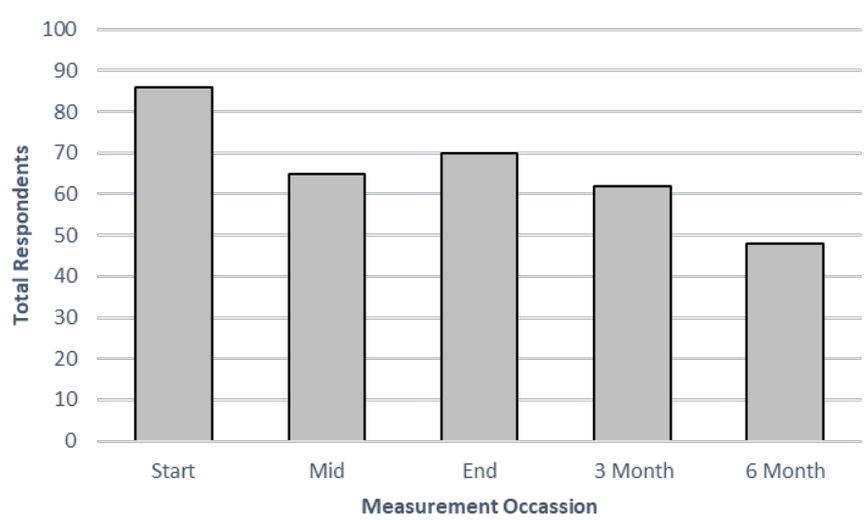
including, among others, rapport, trust, shared goals and empathy between a program participant and their instructor. The CFQ was designed to measure similar relationship factors deemed important in a variety of settings containing an artistic instructor. The questionnaire used a five-point Likert scale (strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, strongly agree). Higher scores indicate a closer relationship between the respondents and their instructor. The questionnaire demonstrates appropriate reliability when tested with a university sample (N = 395) (Cronbach's α =.822). Factor analysis revealed three factors, being instructor alliance, goal orientation and personal development.

Short Dispositional Flow Scale (SDFS): The SDFS provides a brief assessment of a nine-dimensional conceptualisation of flow state as a cognitive construct.[15] The scale was developed using samples from the general Australian population (Cronbach's a =.810). The scale contains nine statements concerning an activity nominated by each participant, for example, the artistic activity undertaken during the ARRTS program. The nominated activity rated the experienced flow state on a 5-point scale (never, rarely, sometimes, frequently, always) with higher scores indicating a greater sense of flow. For example, one statement is, 'My attention is focused entirely on what I am doing'.

Core Self-Evaluations Scale (CSES): The Core Self-Evaluations Scale (CSES) was developed out of a four-component model of Core Self Evaluations and has been validated for measuring an individual's aggregate evaluation for each factor.[16] The scale consists of 12 items and uses a five-point Likert scale (i.e., strongly disagree, disagree, neutral, agree, strongly agree) to score responses. Examples of statements include, 'I am confident I get the success I deserve in life', and 'I am filled with doubts about my competence'. The overall score has demonstrated a reliable Cronbach's a of 0.88.

Kessler 10 (K10): The K10 is widely used to measure psychological distress based on anxiety and depressive symptoms.[17] The K10 has ten items that each ask, 'about how often did you feel…', for example, 'nervous', 'hopeless', 'depressed', etc. Four items address anxiety symptoms, and six items address depressive symptoms. The response scale consists of a five-point rating ranging from 'none of the time' to 'all of the time'. Thus, lower scores indicate less psychological distress. The K10 is reported to have sound psychometric properties, e.g., Cronbach's α =.930 for the general population.[17]

Figure 1. Total respondents at each measurement occasion



BADS-SF	Yes	Yes	Yes	Yes	Yes
CIM	Yes	Yes	Yes	Yes	Yes
CFQ	Yes	-	Yes	Yes	Yes
SDFS	Yes	Yes	Yes	Yes	Yes
CSES	Yes	-	Yes	Yes	Yes
K10	Yes	-	Yes	Yes	Yes

Statistical analysis

Statistical testing was conducted using multivariate analysis of variance (MANOVA) for repeated-measure designs. For reporting MANOVA results, their textual description includes the *F* statistic and its *p* value.[18] For significant effects, the effect size is also reported, using the *d* statistic, which represents the median of the 95% confidence interval for the difference among the contrast-weighted means expressed in standard deviation (SD) units. Using Cohen's[19] recommendations, effect sizes of 0.20, 0.50 and 0.80 SD units were considered small, medium and large, respectively.

Results

Behavioural Activation for Depression (BADS)

Figure 2, Panel A plots the mean behavioural activation scores from the BADS across five measurement occasions. The mean scores rose from 39.5 at the start of the program to 44.2 at the end of the program. Thereafter, across the three- and six-month follow-up periods, the scores dropped to 35.8 and 36.6, respectively. Across all occasions, there was significant curvature as seen in a medium-sized, quadratic trend $F(1, 317) = 10.94$, $p < .01$, effect size =.393.

Community Integration Measure (CIM)

Figure 2, Panel B shows the average mean score for the CIM plus separate mean scores for the factors of belonging and independence. The three mean scores showed a pronounced rise from the start of the program to its midpoint, after which further rises were slight. After the program, the mean scores largely reverted to their starting point within the initial three-month follow-up period. The quadratic trend for the belonging factor was small and significant $F(1, 316) = 7.05$, $p < .01$, effect size =.317, while the quadratic trend for the independence factor showed a medium significant effect $F(1, 316) = 18.70$, $p < .01$, effect size =.510. Overall, the CIM as a joint measure of belonging and independent participation in a community had a small significant quadratic trend, $F(1, 316) = 13.11$, $p < .01$, effect size =.433.

Common factors

Figure 2, Panel C shows the average mean scores of common factors, including the three factors of therapeutic alliance, goals and personal development. Overall, all groups showed an increase in the experience of common factors from the start to the end of the program with a gradual decline over the three- and six-month period following the program. Overall, common factors as a total measure had a small significant quadratic trend $F(1, 250) = 7.34$, $p < .01$, effect size =.348. Among the three factors, therapeutic alliance had a pronounced quadratic trend, $F(1, 250) = 14.00$, $p < .001$, effect size =.481. Goals had no significant quadratic trend ($p > .05$), however, personal development had a small yet significant quadratic trend $F(1, 250) = 5.02$, $p < .05$, effect size =.288.

Flow state

Figure 2, Panel D shows the mean scores for the Short Dispositional Flow Scale (SDFS). Experienced flow states increased from the start of the program, through the middle stage, until the end of the program. Following the end of the program, flow states decreased at the three-month mark, prior to an upward excursion at the six-month mark. The planned statistical comparisons yielded a small yet significant quadratic trend $F(1, 291) = 4.33$, $p < .05$, effect size =.263. Regarding the apparent increase between three-month and six-month marks, a post-hoc test comparing them failed to reveal a significant difference, $F(1, 291) = 2.30$, $p > .05$, effect size =.320.

Core Self Evaluations (CSES)

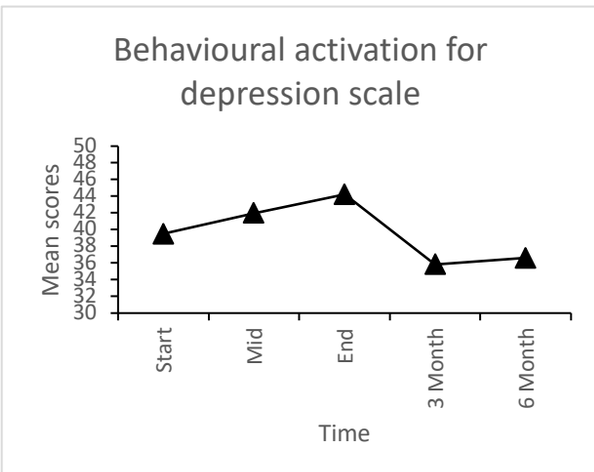
Figure 2, Panel E plots the mean CSES scores, which showed a small significant quadratic trend over measurement occasions, $F(1, 254) = 4.83$, $p < .05$, effect size =.280. Among the four subscales, only locus of control showed a significant quadratic trend, $F(1, 254) = 7.46$, $p < .01$, effect size =.348.

Psychological distress

Figure 2, Panel F shows the mean K10 scores, including the means for the anxiety and depression factors. Overall psychological distress reduced throughout the program, as did the means for anxiety and depression. Following the program, psychological distress increased in the first three months with a further gradual increase over the period between three and six months. Overall psychological distress had a significant quadratic trend, $F(1, 260) = 12.88$, $p < .01$, effect size =.452. Similarly, there were significant, small quadratic trends for the anxiety scores, $F(1, 260) = 6.98$, $p < .01$, effect size =.333, and depression scores $F(1, 260) = 13.21$, $p < .01$, effect size =.458.

Figure 2. Longitudinal graphs of responses

A



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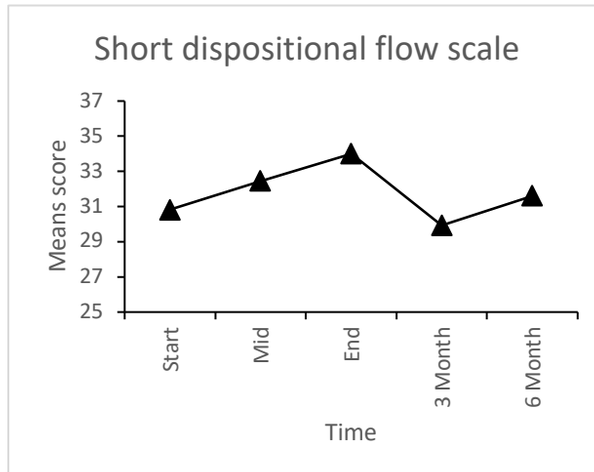

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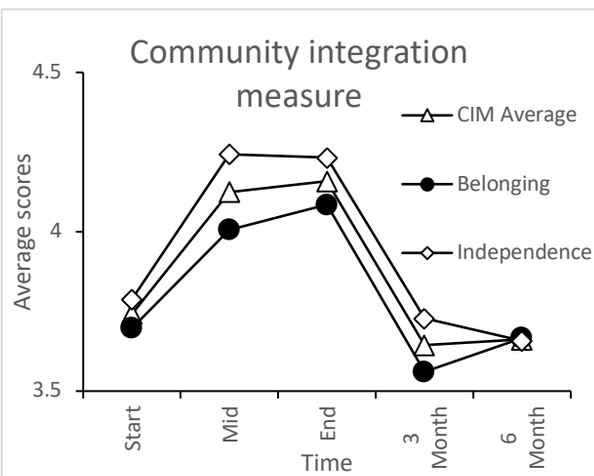

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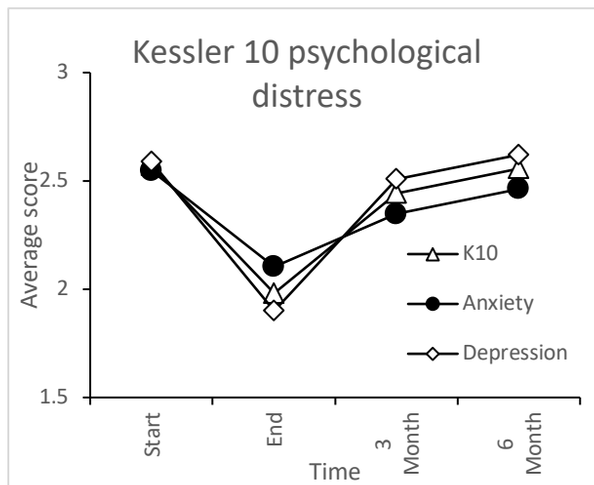

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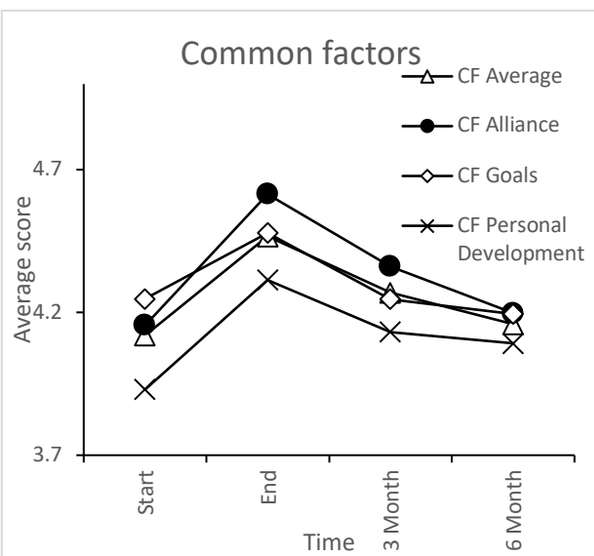

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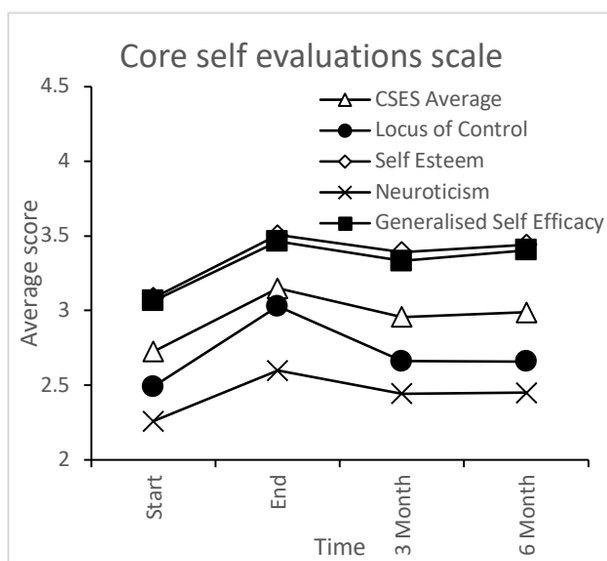

Discussion

Main Findings

Concerning the three research questions, the longitudinal pattern of the results consistently showed significant quadratic trends of small to medium size, with all effects reducing over time. The scores for the underlying mechanisms consistently grew throughout the program, but within the six-month follow-up period, returned their initial states. Conversely, the K-10 scores for anxiety and depressive symptoms showed an improvement as evidenced by a decline during the program followed by a return to their previous state during the follow-up period. Finally, the CSES showed a small rise followed by a return to baseline. Among the four subscales, only locus of control showed a significant quadratic trend.

Relationship of current findings to previous research

Longitudinal trends: The quadratic trends seen in the current results for the ARRTS program are consistent with the trends seen in the evaluation of established therapies, such as CBT, for anxiety and depressive symptoms. Meta analyses and systematic reviews of therapies for anxiety and depression have indicated, after an initial improvement during therapeutic intervention, the duration of treatment effectiveness only extends across intervals of a few weeks to a few months.[20,21] In one longitudinal study, there was a 50% relapse rate for anxiety and depressive symptoms; clients who had residual depressive symptoms at the end of therapy were twice as likely to relapse in a 12-month follow-up period.[22]

Behavioural activation: The current findings established that art-based activities conducted by professional art instructors could achieve reductions in both anxiety and depressive symptoms among respondents. These reductions are consistent with previous findings[23] that art professionals can promote behavioural activation without specific mental health training. Furthermore, the behavioural activation and reductions in anxiety and depression were short-lived, lasting no more than three months. This duration parallels the pattern revealed by a meta-analysis of the effects of behavioural activation interventions for 1–3 months post-treatment.[24]

Common factors: It has long been established that common factors are an important component of established therapies.[25] The current research has for the first time demonstrated art-based activities delivered by art professionals could also engage the common factors. In particular, the common factors of therapeutic alliance and personal development were statistically significant, while apparent goal setting did not achieve significance.

Belonging: The current results add to previous evidence that people undertaking group art-based activities experience an enhanced sense of belonging alongside other positive therapeutic outcomes.[4] This sense of belonging appears to temporarily fill the gap in belonging that the participants may experience when separated from their previous military unit. A sense of belonging to a military unit has been found to protect against anxiety and depression.[26]

Flow states: The current research adds to the existing evidence that concentrated engagement in art-based activities fosters a beneficial state of flow.[27,28] Previously, flow has been postulated to be an underlying product of art-based activities, and therefore flow has a significant place in achieving positive outcomes in art therapy.[29]

Implications

To potentially prolong the beneficial effects of the ARRTS program and ones like it, a program of follow-up arts-based activities for participants may be worthwhile. In a previous paper in this series, Watt and Kehoe[30] found that respondents were interested in ongoing participation in arts-based groups (55%) and/or a 'catch-up' with the respondents' program members. In addition, there is evidence that individual and group skills are maintained by refresher sessions at three- to six-month intervals.[31-34]

Limitations and future directions

Although the number of respondents was limited, and there was attrition over the measurement occasions, the impact of the ARRTS program was consistent across participants. Thus, the analysis had the power to detect small to medium effects. A larger sample with the current ARRTS population, including the provision for a control group, would have been desirable. However, a proposal to create an untreated control group was rejected by the relevant ethics committee. A future way of increasing the power of analysis would extend the focus of arts-based activities beyond current ADF members to discharged veterans and other first responders.

This research focused on mechanisms engaged by the ARRTS program. The picture of the candidate mechanisms could be further refined. For example, a measure of working alliance specifically for artistic

activities could be used.[35] The focus of the effects of the program on a well-validated measure of anxiety and depression (K10) could also be expanded to include more global validated measures of outcomes such as quality of life, along with the ongoing benefits from the ARRTS program experienced by previous participants up to 48 months later.[3] Given the longer duration of the experienced categorical benefits compared to the shorter-lived changes in the quantitative mechanism scores and K10, it would be worthwhile to follow up with future participants in any art-based activities using a suite of quantitative and categorical measures.

Conclusion

The positive impact of the ARRTS program for both present participants and those in the retrospective study[3] was, it should be remembered, added to the already rigorous, multidisciplinary treatments of psychological and physical injury provided through the ADF. Although the effects of the arts-based activities were small to medium, they represent a cumulative contribution to the already substantial treatment received by the ARRTS participants. Future research is required to address the limitations of the current study further while seeking to create a greater understanding of the effect of the ARRTS program. Thus, there is reason to test whether it be worthwhile for the Department of Veterans Affairs and other related organisations to introduce corresponding arts-based programs for discharged personnel, who are often a risk of mental health challenges.[27]

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References

1. Hodson SE, McFarlane AC, Davies C, Van Hooff M. Mental Health in the Australian Defence Force – 2010 ADF Mental Health Prevalence and Wellbeing Study: Executive Report. In: Defence Do, ed. Canberra2011.
2. Smith A. A literature review of the therapeutic mechanisms of art therapy for veterans with post-traumatic stress disorder. International Journal of Art Therapy. 2016;21(2):66-74.
3. Watt TJ, Kehoe EJ. Causes and duration of change resulting from art-based activities for members of the Australian Defence Force. Journal of Military and Veterans Health. 2020;28(1):7-15.
4. Macpherson H, Hart A, Heaver B. Building resilience through group visual arts activities: Findings from a scoping study with young people who experience mental health complexities and/or learning difficulties. Journal of Social Work. 2016;16(5):541-560.
5. Sayer NA. Randomized controlled trial of online expressive writing to address readjustment difficulties among U.S. Afghanistan and Iraq War veterans. Journal of Traumatic Stress. 2015;28(5):381-390.
6. Alter-Muri SB. Art education and art therapy strategies for Autism Spectrum Disorder students. Art Education. 2017;70(5):20-25.
7. Mazzucchelli T, Kanter JW, Martell CR. A clinician's quick guide of evidence-based approaches: Behavioural activation. Clinical Psychologist. 2016;20(1):54-55.
8. Dimaggio G, Shahar G. Behavioral Activation as a common mechanism of change across different orientations and disorders. Psychotherapy. 2017;54(3):221-224.
9. Duncan BL, Miller SD, Wampold BE, Hubble MA. The Heart and Soul of Change: Delivering What Works in Therapy. American Psychological Association; 2010.
10. Stamoulos C, Trepanier L, Bourkas S, et al. Psychologists' perceptions of the importance of common factors in psychotherapy for successful treatment outcomes. Journal of Psychotherapy Integration. 2016.
11. Harmat Ls, Ørsted Andersen F, Ullén F, Wright J, Sadlo G. Flow Experience: Empirical Research and Applications. Switzerland: Springer; 2016.
12. Judge T, Locke EA, Durham CC, Kluger AN. Dispositional effects on job and life satisfaction: The role of core evaluations. Journal of Applied Psychology. 1998;83(1):17-34.

13. Manos RC, Kanter JW, Luo W. The Behavioral Activation for Depression Scale- Short Form: development and validation. Behavior Therapy. 2011;42(4):726-739.
14. McColl MA, Davies D, Carlson P, Johnston J, Minnes P. The community integration measure: Development and preliminary validation. Archives of Physical Medicine and Rehabilitation. 2001;82(4):429-434.
15. Jackson SA, Martin AJ, Eklund RC. Long and short measures of flow: the construct validity of the FSS-2, DFS-2, and new brief counterparts. Journal of Sport and Exercise Psychology. 2008;30(5):561.
16. Judge T, Erez A, Bono J, Thoresen C. The Core Self-Evaluations Scale: Development of a measure. Personnel Psychology. 2003;56(2):303.
17. Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. Psychological Medicine. 2002;32(6):959-976.
18. O'Brien RG, Kaiser MK. MANOVA method for analyzing repeated measures designs: an extensive primer. Psychological Bulletin. 1985;97(2):316-333.
19. Cohen J. A power primer. Psychological Bulletin. 1992;112(1):155-159.
20. Cuijpers P, Sijbrandij M, Koole S, Huibers M, Berking M, Andersson G. Psychological treatment of generalized anxiety disorder: a meta-analysis. Clinical Psychology Review. 2014;34(2):130.
21. Steinert C, Hofmann M, Kruse J, Leichsenring F. Relapse rates after psychotherapy for depression - Stable long-term effects? A meta-analysis. Journal of Affective Disorders. 2014;168:107-118.
22. Ali S, Rhodes L, Moree O, et al. How durable is the effect of low intensity CBT for depression and anxiety? Remission and relapse in a longitudinal cohort study. Behaviour Research and Therapy. 2017;94:1-8.
23. Ekers D, Godfrey C, Gilbody S, et al. Cost utility of behavioural activation delivered by the non-specialist. The British Journal of Psychiatry. 2011;199(6):510.
24. Mazzucchelli T, Kane R, Rees C. Behavioral activation treatments for depression in adults: A meta-analysis and review. Clinical Psychology: Science and Practice. 2009;16(4):383-411.
25. Bullock B. Evidence-based practice in psychology. American psychologist. 2006;61(4):271-285.
26. Bryan CJ, Heron EA. Belonging protects against post deployment depression in military personnel. Depression and Anxiety. 2015;32(5):349-355.
27. DeLucia JM. Art therapy services to support veterans' transition to civilian life: The studio and the gallery. Art Therapy: Journal of the American Art Therapy Association. 2016;33(1):4-12.
28. Kapitan L. Art therapy's sweet spot between art, anxiety, and the flow experience. Art Therapy. 2013;30(2):54-55.
29. Wilkinson RA, Chilton G. Positive art therapy: Linking positive psychology to art therapy theory, practice, and research. Art Therapy: Journal of the American Art Therapy Association. 2013;30(1):4-11.
30. Watt TJ, Kehoe EJ. Longitudinal Change Resulting from the ADF's Arts for Recovery, Resilience, Teamwork and Skills (ARRTS) Program. In. Unpublished Work: UNSW; 2020.
31. Murphy PJ, Kehoe EJ, Butcher A. Keeping the blunt edge at bay: Preventing skill erosion. In: Murphy PJ, ed. Focus on Human Performance in Land Operations. Vol 1. Canberra: Australian Defence Force Psychology Organisation; 2009:33-39.
32. Ginzburg S, Dar-El EM. Skill retention and relearning--A proposed cyclical model. Journal of Workplace Learning: Employee Counselling Today. 2000;12(8):327-332.
33. O'Hara JM. The retention of skills acquired through simulator-based training. Ergonomics. 1990;33(9):1143-1153.
34. Sabol MA, Wisher RA. Retention and Reacquisition of Military Skills. Military Operations Research. 2001;6(1):59-80.
35. Bat Or M, Zilcha-Mano S. The Art Therapy Working Alliance Inventory: the development of a measure. International Journal of Art Therapy. 2018;24(1):1-12.

Antibacterial Warfare: The Production of Natural Penicillin and the Search for Synthetic Penicillin During the Second World War

B Short

Abstract

Begun in 1940 during World War II, the research into natural penicillin later involved British, United States and Australian military forces in carrying out the necessary extensive field testing. Penicillin-G and penicillin-V are the two natural penicillins whose chemical structures were ultimately uncovered in the US and Britain, respectively. The difficulties in determining the beta-lactam ring structure greatly hampered the second wartime project, to synthesise penicillin, a program not completed until 1957. Wartime military organisation and joint scientific collaboration integrated with large dedicated funding grants permitted the realisation by 1944 of adequate allied stockpiles of natural penicillin, a feat not thought possible in the absence of a wartime imperative. Included are brief biographies of the principal three wartime Oxford scientists.

Preamble

The international penicillin program was one of the largest wartime initiatives and among the most significant achievements in science and technology during World War II. Penicillin production went from laboratory microbiological study in 1940 to mass production by 1945. This commentary examines the participation of military medical services in the wartime development of mass-produced natural penicillin by fermentation processes and the establishment of suitable clinical testing forums. Included is a brief professional biography of the three principal Oxford experimenters following the launching of penicillin within clinical medicine.

Historically military associated improvements to the health of twentieth-century populations did not start and end with the discovery of antibiotic therapy, a theme that Roger Cooter canvassed in *Medicine and the Goodness of War.*[1] Equally important was the groundbreaking development of an effective suppressive chemoprophylaxis agent against malaria by schizonticide drugs that proved lethal to the asexual blood stages of *plasmodia,* the cause of *falciparum* and *vivax* malaria. Innovative reconstructive surgical techniques by military surgeons in both World Wars readily spilled into the domain of civilian critical trauma therapy.

The number of lives saved from the effects of bacterial infections associated with conflict by the appropriate exhibition of penicillin therapy during the latter half of World War II is incalculable. During the Great War, between 12% and 15% of the wounded treated in front-line hospitals died of infections, most notably from gas gangrene. The mortality rate from this infection during the subsequent World War was significantly reduced to 3%.[2] Battlefield case fatality rates have slowly declined throughout the twentieth and twenty-first centuries, from 19% in World War II (1939–1945) to 15.8% in the Vietnam War (1955–1975), down to 9.4% during each of the Iraq War (2003–2011) and the War Against Terror fought in Afghanistan (2001–2014).[3] Despite the combination of immediate parenteral antibiotic administration, vigorous intravascular fluid replacement and rapid helicopter evacuation to a combat-surgical facility, infectious complications remain a leading cause of both morbidity and mortality in combat-injured personnel.

Dr Alexander Fleming's penicillin

Penicillin is the 1928 name designated by physician-microbiologist Dr Alexander Fleming FRS, later Sir Alexander, to the filtrate of the mould broth that had been accidentally contaminated by the green mould fungus, *Penicillium notatum.* Eric Lax, in *The Mould in Dr Florey's Coat,* details Fleming's work in the Inoculum Department at St Mary's Hospital, London that he joined in 1906.[4] Lax questions the quaintly serendipitous explanation offered by Fleming, written 16 years after the event in 1944, of how a mould spore entered through the open laboratory window and settled on an uncovered Petri dish containing a culture of *Staphylococcus aureus.* The mould elaborated a lethal toxin in response to bacterial growth as a primitive response to a threat to a food source. When food in the microbiological microcosm is scarce, the mould expresses an intense amount of penicillin. Repeated attempts by Fleming and others to replicate the growth of penicillin under the conditions Fleming described failed.[4] Nonetheless, the mould broth filtrate inhibited the in vitro growth of staphylococci. Fleming documented in a 1929 paper the in vitro antibacterial properties of penicillin but not tests of the filtrate in vivo using experimental animal models.[5] He found that the antibacterial principle in the concentration used, was not toxic either to white cells or rabbits, nor was it a protein.[6] The paper was largely ignored until 1938 when the Australian physician Howard Florey, German biochemist Ernst Chain FRS, later Sir Ernst and English biochemist Norman Heatley commenced work at Oxford investigating the antimicrobial enzyme, lysozyme. Lysozyme is found in tears, saliva, milk, mucus and white cells and was first isolated by Alexander Fleming in 1922. In August 1940, Florey's Oxford team reported the testing of penicillin in vivo using haemolytic streptococcus-infected mice as the experimental model.[7] By early 1941, sufficient penicillin had been produced by surface culture to attempt treatment in six patients suffering severe streptococcal infections. The initial clinical applications were unfortunately flawed due to using inadequate drug dosages consequent to supply constraints.

British-American Research Cooperation

Unable to convince British pharmaceutical interests to assist in the further manufacture of penicillin, Florey and Heatley travelled in July 1941 to the United States. The mission was to seek techniques to improve penicillin production to permit formal clinical drug trials. They met with the US Department of Agriculture's Northern Regional Research Laboratory (NRRL) in Peoria, Illinois. The NRRL had pioneered the use of submerged culture fermentation techniques whereby the so-called 'deep fermentation' process allowed for a marked increase in surface area for mould growth. The culture was grown throughout the medium rather than on the surface, which the British scientists had relied on, thereby enhancing the mould output of penicillin. In addition, the NRRL workers suggested culture medium additives and the isolation of higher-yielding *Penicillium* strains.[8]

In June 1941, President Roosevelt issued an executive order establishing the Office of Scientific Research and Development (OSRD) and its agency, the Committee on Medical Research (CMR), created entirely for military purposes. In addition to penicillin, the wartime output by CMR included antimalarial drugs, insecticides, blood and blood substitutes and novel aviation medicine techniques. An outstanding achievement involved encouraging the widespread use of DDT to control malaria and dengue-carrying mosquitoes and the killing of typhus-bearing body lice. Today US authorities regard the synthetic insecticide DDT as a probable human and animal carcinogen.[9]

A pivotal meeting on 7 August took place with Florey and the new chair of the CMR appointed by President Roosevelt, Professor Alfred Newton Richards, professor of pharmacology at the University of Pennsylvania, who became a strong supporter of Florey's venture.[2] After leaving the CMR in 1946, Richards was elected President of the National Academy of Sciences for the term 1947 to 1950. Focusing primarily on the clinical testing of penicillin, Richards immediately commenced the difficult task of convincing US pharmaceutical interest in the worthwhile investment to manufacture penicillin. The long-term outlook for producing penicillin by the fermentation process was considered doubtful due to rising costs and low yields. This, more than anything else, provoked Richards to launch a new pharmacological project: the synthesis of penicillin. Initial drug firm resistance to natural penicillin production was largely overcome with the release in December 1941 of high-yield drug data from the NRRLs deep fermentation processes. The first pharmaceutical chief to commit to penicillin manufacture was George W Merck, with the heads of Squibb, Pfizer and Abbott later signing to undertake US production. The president of Merck & Co, George W Merck in August the following year was appointed by the Secretary for War, Henry L Stimson, to the innocently titled War Research Service as the inaugural director, a facility for researching biological warfare agents.[10]

The leading research organisation in England tasked to meet the medical needs of Britain's fighting services was the Medical Research Council (MRC), established by the Privy Council in 1920. It became the duty of the two agencies, the ORSD in the US and the MRC in Britain, to organise, promote and subsidise penicillin research as a matter of national defence.[8] Early US penicillin outputs were small, with quantities at the end of 1942 only sufficient to treat 100 patients. An agreement was reached in the US that the entire supply of the antibiotic should be turned over to the CMR, and from the small stock, a select group of accredited investigators were permitted access to the drug.

Early penicillin therapy in clinical practice

In November 1942, one of the most important early penicillin testing took place, treating the survivors of, until then, one of the worst civilian disasters in American history. After the World Trade Centre bombing in September 2001, the second-worst building fire ever recorded in the US took place at the popular Cocoanut Grove Nightclub in Boston on the night of 28 November 1942. Fire enveloped the brick building, housing nearly twice the legal patron capacity, with the loss of 492 lives and 173 survivors with extensive burns. Permission was granted immediately to treat 13 burns cases by prescribing an empirical dose of 5000 units of penicillin administered 4-hourly. The penicillin supply came from an emergency order by the CMR for the Merck Corporation to produce 32 litres of the drug. Sulphadiazine was co-administered with the penicillin, in a dose later determined as inadequate. Unfortunately the low-dose penicillin regimen caused an inability to accurately analyse the efficacy of the therapy.[2]

The first civilian case to receive penicillin therapy within the US was at Yale New Haven Hospital five months earlier, on 14 March 1942. A young female with beta-haemolytic streptococcal sepsis received a course of penicillin provided by Dr Heatley during his stay in the US. The patient rapidly responded and survived to the age of 90.[11] During early 1943, the first opportunity for US military testing of penicillin arose from a request by the Bushnell General Hospital in Brigham, Utah, accommodating over 200 war-related orthopaedic patients. The majority of the cases had compound fractures complicated by osteomyelitis, for which sulphonamide therapy was uniformly ineffective. No clinical trial was undertaken, and the penicillin-testing program was classed as an 'intent to treat'. The drug was administered exclusively to wounded soldiers, given parenterally and locally, in optimum dosages with diligently recorded side effects. Adverse effects were unfortunately common due to the high levels of contaminants within the penicillin solutions containing concentrations of impurities that varied from batch to batch. Phlebitis was a particularly common problem following intravenous administration together with local pain with induration in the wake of the intramuscular route. Filtration of the penicillin solutions immediately prior to injection led to a marked diminution of the unwanted reactions. The results of the Bushnell military penicillin testing were so encouraging that the US Army now regarded penicillin as vital to the war effort. A second test centre commenced in June 1943 at Halloran General Hospital, Staten Island, New York, where a further 200 wounded Army personnel were treated. Excellent drug responses were again recorded, prompting the Army to use both hospitals as penicillin therapy training schools for US Army medical officers.[2] By October 1943, the total US penicillin output had increased from two to nine billion units a week.

The first large supply of penicillin from the US to Britain was delivered in May 1943. However, Britain had conducted tests among wounded Army cases at Cairo since July 1942 during the North African campaign, using penicillin supplied by the Oxford group. The clear message from the early British testing was that administering penicillin weeks after the wounding was far too late. All subsequent British Army investigations were then moved to forward military hospitals in North Africa. From the same theatre of war, sexually transmitted disease records were also collected on the predictable beneficial effects of penicillin in sulphonamide-resistant gonococcal infections.

Synthetic penicillin studies at Oxford

Ernst Chain was joined by another biochemist, Edward Abraham FRS, later Sir Edward, to forge the Oxford scientific inquiry to synthesise penicillin, with tasks to purify natural penicillin and to determine its molecular structure. Three reasons arose for implementing a second major project to discover the synthetic pathway of penicillin side by side with solving the problems of natural penicillin mass production. The first involved the variably high levels of contamination of the penicillin cultures produced by deep fermentation. The second was the perennial problem of low yields coupled with immense production costs. Based on the cost of one gram of crude penicillin material of at least US$100, containing on the average only 5% pure penicillin, compared with the costs as late as April 1944 reported as one pound of pure penicillin costing approximately US$45 000 to manufacture.

Finally, biochemists on both sides of the Atlantic were initially quite optimistic that a synthesis was entirely feasible and achievable within a practicable time frame.[8]

By 1943, coordinated transatlantic research into the biochemistry and synthesis of penicillin was well established. Abraham and Chain, in late 1943, identified the novel beta-lactam four-numbered chemical ring attached to a side-chain as the definitive structure of penicillin. However, workers at the Merck laboratories in the US were unable to confirm this particular chemical structure. Indeed, the penicillin grown by cultures at Oxford and the US was different, suggesting the existence of two separate molecular forms of penicillin. By January 1945, X-ray crystallography at Oxford confirmed the beta-lactam ring model as the structure of penicillin-V. At the beginning of 1945, the US monthly production of natural penicillin was already 40 to 50 times greater than when the program began and represented the combined outputs of three companies, Merck & Co at Rahway, New Jersey, Pfizer at Brooklyn, New York and Squibb at Chicago, Illinois. However, by December 1945, no commercially practical synthetic process for penicillin production had been developed, prompting the US government to withdraw support.[8] The final chapter in the wartime search program for synthetic penicillin would await 1957 when an American organic chemist, Professor John C Sheehan at the Massachusetts Institute of Technology, developed the first complete synthesis of penicillin.[8]

Australian Army experience with natural penicillin

Following early penicillin fieldwork in 1943, the Australian Army Medical Corps first became involved in penicillin testing during March 1944, carried out at the Heidelberg Military Hospital, Melbourne, utilising penicillin produced at the state-owned Commonwealth Serum Laboratory (CSL) at Parkville, Melbourne. The CSL was under the wartime leadership of Army Captain Percival (Val) Bazely, a former CSL technical officer, on appointment by a colleague Colonel E V (Bill) Keogh, then Army Director of Hygiene and Pathology. Bazely and a small staff visited the US pharmaceutical companies during September 1943 and were introduced to the deep fermentation processes. Creditably, the laboratory produced a high grade, safe and reliable penicillin solution that was soon shipped to the New Guinea theatre of operations.[12]

The first Australian trials with military personnel were made using the sodium salt and the crude and refined preparations of the calcium salt administered to 141 patients. Dosage regimens included 200 000 units daily via intramuscular or intravenous routes and topical application into body cavities of up to 20 000 units. Toxic effects were virtually absent and without febrile reactions to penicillin. Initially, due to low stocks and re-supply, penicillin was limited to administration to hospital cases and then only with specific clinical indications. Later, field testing in forward areas within the South-West Pacific Area was undertaken to enable the primary suturing of wounds after cleansing, debridement and the topical application of penicillin powder. It soon became very obvious that penicillin could be employed to make operative procedures safe, or indeed possible, and mechanical fixation of fractures became virtually uncomplicated.[13] In *Medicine and Victory* (2004), Professor Mark Harrison observed that, 'with the sole exception of the official histories, there have been no books on medicine in any of the British armed services'.[14]

Australian physician Allan Walker's *Clinical Problems of War*, written in 1952, documents the medical experiences of the Australian Armed Forces during World War II and is thereby, according to Harrison, an unusual yet highly informative account of this important subject.[13]

German encounters with microbicidals during the Second World War

The antibiotic drug experience of the German armed forces during the Second World War, an important theme that Neushul omitted from his 1998 discourse, is in stark contrast to that of the allies.[2] A leading reason why the Germans were slow to develop penicillin was their long-standing commitment to sulphonamides that had been an original German chemical development. German experimental pathologist Professor Gerhard Domagk, working with the I G Farben companies, patented the sulphonamide azo-dye *Prontosil* in 1932 after demonstrating it possessed significant in vivo antibacterial activity. He published his findings in February 1935 in the pre-eminent German medical journal, the *German Medical Weekly,* entitled 'A Contribution to the Chemotherapy of Bacterial Infections'. The sulphonamide drugs, inhibiting bacterial growth, became the forerunner of the antibiotic class, drugs that killed bacteria. Domagk's work with sulphonamide synthesis won him the Nobel Prize for Physiology or Medicine in 1939, an honour that the German political regime forced him to refuse, but which he graciously accepted after the war.[15] The frequent toxic side effect profile and the rapid development of bacterial resistance exhibited

by sulphonamides proved to be serious limitations to their widespread use. However, incongruously, penicillin was administered several times to the lifelong hypochondriac Adolf Hitler by his treating physician Dr Theodor Morell, a doctor also well known for employing unconventional treatments.[16] Although work on penicillin commenced in Germany as early as 1942 at the Hoechst Dye Works, by the Normandy landings in June 1944, the company could only produce enough penicillin to use as dusting powder for superficial wounds. As late as October 1944, German supplies of injectable penicillins first became available in very limited amounts.[17]

Brief biographies of the principal wartime Oxford experimenters

To mark the one-hundredth anniversary of the birth of Lord Florey OM FRS, Professor Henry Harris delivered the Florey Centenary Lecture at Oxford on 19 September 1998.[16] Harris records that on the recommendation of Florey, a former South Australian Rhodes Scholar and newly appointed professor of pathology without any experience in the study of antibiosis, offered Ernst Chain the first position in the laboratory. An experienced biochemist, Ernst Chain was a Jewish refugee from Hitler's Germany who left in 1933 and joined Florey in 1939, by then head of the prestigious Sir William Dunn School of Pathology at Oxford. Chain completed the ongoing work on lysozyme and undertook a review of other known antibacterial substances. He proposed three candidates for further in-depth study: one was penicillin. On scant evidence, Harris reported that it was Chain who first proposed that penicillin should be further investigated.[6] The first published scientific paper on penicillin appeared in August 1940, documenting inter alia the consequences of two strokes of luck. The first involved Chain and Florey's work with mice injected with crude extracts of penicillin. The scientists' choice of mice was serendipitous since penicillin given to guinea pigs invoked unfavourable reactions. The second good fortune was that the impure penicillin contained no major toxic contaminants.[6 19]

Exerting excellent personnel management skills, the energetic Florey quickly assembled a collaborative team at Oxford. Though not considered by Harris as a profound visionary, Florey had one supreme virtue, he knew exactly what had to be done next, and he got it done. Norman Heatley, a biologist and biochemist, was the next to be invited to join the group, later introducing several important and major innovations. Heatley devised ways of measuring the activity of penicillin in fermentation liquors when present in concentrations far too low for conventional chemical evaluating methods. His cylinder plate diffusion technique provided a much easier, more reliable and sensitive assay for penicillin that was later adopted as the standard assay technique for antibiotic activity. His method for extracting the highly unstable penicillin from very dilute and heavily contaminated solutions by constructing a solvent-to-water transfer cycle, permitted impure but stable penicillin to be prepared from mould culture fluid. Due to heavy wartime restrictions, Heatley had little or no access to purpose-built apparatus, leaving him no option other than to improvise. He designed 400 rectangular ceramic vessels that were stackable and in which the medium could be changed. Finally, it was left to Heatley to monitor the first experiment in which the protective effect of penicillin was assayed in mice infected with streptococci.[19 6 20]

Howard Florey's recognition by the international scientific world was predictable and laudatory. He had been elected a Fellow of the Royal Society as early as 1941, when aged 43, not for his work with penicillin, but for work on the circulation of lymph and the secretion of mucus.[19] He was appointed knight bachelor along with Alexander Fleming in the King's Honours List in June 1944. The surrounding media-linked publicity of this event paradoxically focused almost entirely on Fleming, much to Fleming's chagrin. In 1960 Florey was elected President of the Royal Society and further acknowledged by the monarch on his appointment to the Order of Merit. In 1965 Sir Howard Florey was ennobled Baron Florey of Adelaide and Marston, and during the same year, he was invited to be the Chancellor of the Australian National University. It is said that the chancellorship was for him a deeply satisfying distinction.[20]

The first post-war Nobel Prize for Physiology or Medicine was awarded at the Nobel Institute in Oslo on a winter's afternoon, the 10 December 1945, to three joint laureates, Fleming, Florey and Chain. Nobel's will describes the prizes as awards for a discovery 'conferring the greatest benefit to mankind'. Writer Ronald Bentley commented that one measure of scientific achievement is developing a major school that creates significant and sustained conceptual and/or experimental advances and serves as a training ground for future scholars. In Bentley's opinion, only Florey had the strongest credentials of this kind.[19] The Nobel Committee's prize may be awarded to a maximum of three recipients. In all the narratives on the history of penicillin, Norman Heatley's name seems never to have been mentioned as a likely recipient of prestigious awards. Indeed Heatley's later proposal for a Fellowship of the Royal Society was also declined, adding to the appreciable injustice. The nation finally acknowledged him in

1978 on appointment as an Officer of the Order of the British Empire. More importantly, yet as late as 1990, on the occasion of the fiftieth anniversary of penicillin's development as a therapeutic drug, the 78-year-old Heatley was formally recognised. Within the 800 year history of Oxford University, Norman Heatley was awarded the university's first honorary Doctorate of Medicine. Dr Heatley continued working at the Sir William Dunn School of Pathology through to retirement, dying in 2002 at the age of 92.[20]

Ernst Chain became an expert in the developing applied science of industrial microbiology. Manifesting a flamboyant character, at times a cause of controversies within the laboratory, that ultimately prompted his departure from Oxford in 1948 to take up an academic post in Rome. The same year he married a fellow biochemist, Anne Beloff. His work with penicillin fulfilled the requirements of providing 'contributions to the improvement of natural knowledge'[21], Chain was successfully proposed for Fellowship of the Royal Society in 1949. Later in 1964 he took the Chair of Biochemistry at Imperial College, London and continued to consult with leading pharmaceutical companies. He was knighted in the 1969 honours list and died ten years later in County Mayo, Ireland, aged 73.[4]

Conclusion

Penicillin-G (benzyl-penicillin) and penicillin-V (phenoxymethyl-penicillin) are the two natural penicillins whose chemical structures were uncovered during World War II in the US and Britain, respectively. Unhappily, the difficulties in determining the beta-lactam ring structure significantly hampered the wartime synthetic penicillin production project. Today, high-resolution mass spectrometry and nuclear resonance spectroscopy can identify chemical structures within rapid time frames. Consequently, a raft of semisynthetic and synthetic penicillins appears within international drug compendiums. Wartime military organisation and scientific collaboration integrated with large dedicated funding grants permitted the realisation by 1944 of an adequate stockpile and supply of natural penicillin, sufficient for both national military and civilian needs. The rapid technological developments in the production and supply of natural penicillin between 1940 and late 1945 could not have been possible without a wartime imperative.

To encapsulate the immense contribution made by each of the 1940 Oxford tri-national experiment triumvirates, Professor Henry Harris explained, 'without Fleming, no Chain or Florey; without Chain, no Florey; without Florey, no Heatley; without Heatley, no penicillin'.[6]

The benefits to the health of humankind provided by the evidence-based prescription of an expanded penicillin class of antibiotics remains assured.

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References

1. Cooter R. Medicine and the Goodness of War. Canad Bull Med Hist. 1990;7(2):147-159.
2. Neushul P. Fighting Research: Army Participation in the Clinical Testing and Mass Production of Penicillin During the Second World War. R Cooter, M Harrison and S Sturdy eds., War, Medicine and Modernity. Stroud, Gloucestershire: Sutton; 1998.
3. Blyth DM, Yun HC, Tribble DR et al. Lessons of War: Combat-related injury infections during the Vietnam War, Operation Iraqi Freedom and Operation Enduring Freedom. J Trauma Acute Care Surg. 2015;79(4 suppl. 2):S227-235.
4. Lax E. The Mould in Dr Florey's Coat. London: Little Brown; 2004.
5. Fleming A. On the Antibacterial Action of Cultures of a Penicillium with special reference to their use in the isolation of B influenza. Br J Exper Path. 1929;10(3):226-236.
6. Harris H. Howard Florey and the Development of Penicillin. Notes and Rec Roy Soc Lond. 1999;5 (2):243-252.
7. Chain E, Florey HW, Gardner AD et al. Penicillin as a Chemotherapeutic Agent. Lancet. 1940;236(6104):226-228.
8. Swann JP. The Search for Synthetic Penicillin during World War II. Br J Hist Sci 1983;16(2):154-190.
9. Harada T, Takeda M, Kojima S et al. Toxicity and Carcinogenicity of Dichloro diphenyl trichloroethane, DDT. Toxicol Res. 2016;32(1):21-33.

10. Stimson HL. Henry L Stimson Diary [1904-1945]. New Haven: Manuscripts and Archives, Yale University Library. August 1942 Aug 27.
11. Grossman CM. The First Use of Penicillin in the United States. Ann Int Med 2008;149(2):135-136.
12. Matthews J. The Birth of the Biotechnology Era: Penicillin in Australia 1943-1980, case study 200-2. Macquarie Graduate School of Management, Macquarie University. 2001 Apr. p. 9. Available from: http://www.gsm.mq.edu.au/faculty/home/john.matthews
13. Walker A. Clinical Problems of War. Canberra: Australian War Memorial, 1952.
14. Harrison M. Medicine and Victory: British Military Medicine in the Second World War. Oxford: Oxford University Press; 2004. 1 p.
15. Domagk G. Ein Bietrag zur Chemitherapie der Bakteriellen Infektionen. Deutsche Medizinische Wochenschrift. 1935;61:250-253.
16. Wainwright M. Hitler's Penicillin. Perspect Biol Med. 2004;47 2): 89-198.
17. Doyle D. Adolph Hitler's Medical Care. J Roy Coll Phys Edin. 2005;35:75-82.
18. Fenner F. Florey, Howard (1898-1968). Aust Dict Biog 14. Melbourne: Melbourne University Press; 1996.
19. Bentley R. The Development of Penicillin: Genesis of a Famous Antibiotic. Perspect Biol Med. 2005;48(3):447.
20. Hamilton-Miller JM. Dr Norman Heatley. J Antimicr Chemo. 2004;53(5);691-692.
21. Royal Charter of Society granted by Charles II in 1662. https://royalsociety.org/~/media/Royal_Society_Contents/about-us/history/2012-Supplemental-Charter.pdf.

Self-reported Liver Disorders in Australian Vietnam War Veterans

H Wang, X Liang, K Bridle, D Crawford

Abstract

Background: Self-reported physical comorbidities are common among combat veterans. Until now, it has been unclear what underlying risk factors were associated with these self-reported health disorders.

Purpose: This study aimed to compare self-reporting and objective clinical investigations of liver disorders in a large group of Australian Vietnam War veterans and identify potential risk factors for the discordance.

Material and methods: Australian veterans who had served in the armed services in Vietnam during the Vietnam War were recruited between February 2014 and July 2015. The univariate and multivariate logistic regression models were constructed to examine the risk factors of false positive self-reported liver disorders.

Results: Of 299 enrolled participants, 80 participants (26.8%) self-reported liver disorders and 110 (36.8%) were clinically confirmed. Self-reporting gave high specificities (83.5% to 98.8%) but low sensitivities (2.70% to 66.7%) for liver disorders. Abdominal symptoms were associated with a 2.2-fold increase in the risk of false positive self-reported liver disorders (P = 0.04).

Conclusion: Abdominal symptoms are an independent risk factor for false positive self-reported liver disorders in Australian Vietnam War veterans.

Introduction

Self-reported physical comorbidities are common among combat veterans. A large portion of these comorbidities could not be diagnosed or confirmed even with intensive clinical examinations and investigations.[1, 2] Many previous studies attributed the over reporting of physical comorbidities to psychological conditions, such as post-traumatic stress disorder (PTSD).[3, 4] However, our recent study revealed that the rate of self-reported physical comorbidities among Australian Vietnam War veterans without PTSD is still as high as 46–56%.[5] Until now, it is unclear what underlying risk factors were associated with these self-reported health disorders. To address this knowledge gap, we compared self-reporting and objective clinical investigations of liver disorders in a large group of Australian Vietnam War veterans with and without PTSD and identified potential risk factors for the discordance.

Methods

Clinical data collection and laboratory tests

The study was conducted at the Gallipoli Medical Research Institute, Greenslopes Private Hospital in Brisbane, QLD. Australian veterans who had served in the armed services in Vietnam during the Vietnam War were recruited between February 2014 and July 2015. Written informed consent from all participants was obtained. A structured, comprehensive medical history was obtained, and a clinical examination was conducted by a medical officer in Greenslopes Private Hospital, Brisbane, Australia. Participants were assessed by a psychiatrist experienced in diagnosing and treating veterans with psychiatric disorders. Participants also underwent assessment by a psychologist using the Clinician Administered PTSD Scale for DSM-5 (CAPS-5), the Alcohol Use Disorders Identification Test (AUDIT) and the DASS21 scores for depression, anxiety and stress. Blood from all participants was collected for liver function test and hemochromatosis genotyping. TaqMan® SNP Genotyping Assays for haemochromatosis (C282Y and H63D mutations) were used as per manufacturer's instructions (ThermoFisher Scientific, Waltham, MA, USA). The ultrasound examinations of the hepatobiliary system were performed by sonologists with more than four years of experience. Images were analysed by investigators experienced in diagnosing and treating patients with liver disorders.

Diagnostic criteria for liver disorders

Abnormal liver function was defined when subjects with abnormal baseline alanine aminotransaminase (ALT > 40 U/L). The hepatitis B surface antigen and

hepatitis C IgG antibody were also tested to diagnose hepatitis B and C. Fatty liver disease, liver fibrosis, cancer and biliary stones were diagnosed with abdominal ultrasound and elastography (FibroScan) results.

Statistical analysis

Data on continuous variables were expressed as mean ± standard deviation (SD), the categorical variables are summarised as frequencies and percentages. T-tests were conducted for continuous variables and c^2 tests or Fisher's exact test were conducted for categorical variables. Odds ratios (OR), 95% confidence interval (CI) and ***P*** values were calculated for each variable. The univariate and multivariate logistic regression models were constructed to examine the risk factors of false positive self-report. The results were considered statistically significant when ***P*** values were ≤ 0.05. The ORs and 95% CIs were calculated for each parameter estimate. All statistical analyses were performed by SPSS version 25 (IBM Co., Armonk, NY, USA).

Ethics approval

Ethics approval was obtained from the Department of Veterans' Affairs (E016/014), the University of Queensland (2016000220) and Greenslopes Private Hospital (16/03).

Results

Of the 311 enrolled participants, 299 underwent all clinical and laboratory assessments. In total, 80 participants (26.8%) self-reported liver disorders and 110 (36.8%) were clinically confirmed. The clinically confirmed liver disorders in this study include abnormal liver function, fatty liver disease, hemochromatosis, liver fibrosis and biliary stones. All participants were hepatitis B surface antigen negative and hepatitis C IgG antibody negative. The baseline characteristics of participants with and without self-reported liver disorders are summarised in Table 1. More participants with self-reported liver disorders had abdominal symptoms, such as heartburn, dyspepsia, abdominal pain, diarrhoea and constipation, than those without (81.3% vs 58.0%, ***P*** = 0.00). Participants with self-reported liver disorders had significantly less daily tea consumption (1.50 ± 1.39 vs 2.11 ± 2.15, ***P*** = 0.00) but higher AUDIT score (9.46 ± 6.99 vs 6.57 ± 5.10, ***P*** = 0.01), suggesting they infer having liver diseases because of higher alcohol consumption. There were no differences in PTSD between the two groups, and only one participant had substance abuse. More participants with self-reported liver disorders had non-PTSD psychiatric disorders (43.8% vs 30.1%, ***P*** = 0.03).

The diagnostic performance of self-reporting is shown in Supplementary Table S1. Self-reporting gave high specificities (83.5% to 98.8%) but low sensitivities (2.70% to 66.7%) for liver disorders. The self-reporting of hemochromatosis had the highest positive likelihood ratio of 28.2 in all liver disorders. Only six of 53 subjects with confirmed fatty liver disease self-reported this condition, reflecting a general lack of awareness of this common condition in the veteran population. Participants who are unaware of clinically confirmed liver disorders had significantly less abdominal symptoms (56.6% vs 85.3%, ***P*** = 0.00) but lower AUDIT score (6.78 ± 5.68 vs 9.65 ± 7.16, ***P*** = 0.03) and less non-PTSD psychiatric disorders (25% vs 47.1%, ***P*** = 0.02, Supplementary Table S2). Univariate and multivariate analyses were performed to identify independent risk factors for self-reported liver disorders, which could not be diagnosed with clinical investigations (Table 2) and unawareness of clinically confirmed liver disorders (Table 3). We found that abdominal symptoms were associated with a 2.2-fold increase in the risk of false positive self-reporting liver disorders (***P*** = 0.04). This association suggests that a high portion of participants ascribing these non-specific symptoms to liver disorders.

Table 1: Baseline characteristics of Australian Vietnam War veterans

Variable	Veterans with self-reported liver disorders (n = 80)	Veterans without self-reported liver disorders (n = 219)	*P* value
Age	68.54 ± 3.55	68.93 ± 4.36	0.47
BMI	30.13 ± 4.45	29.68 ± 4.50	0.44
Education			0.27
University	21 (26.3%)	72 (32.9%)	
Less than Year 12	59 (73.7%)	147 (67.1%)	
Marital status			0.51
Married	72 (90%)	191 (87.2%)	
Single / divorced / widowed	8 (10%)	28 (12.8%)	
Employment status			0.17
Working	9 (11.3%)	39 (17.8%)	
Not working	71 (88.7%)	180 (82.2%)	
Abdominal symptoms			**0.00**
With	65 (81.3%)	127 (58.0%)	
Without	15 (18.7%)	92 (42.0%)	
Smoking status			0.42
Current smoker	9 (11.3%)	18 (8%)	
Current non-smoker	71 (88.7%)	201 (92%)	
Coffee (cups/day)	1.98 ± 1.68	2.15 ± 1.93	0.47
Tea (cups/day)	1.50 ± 1.39	2.11 ± 2.15	**0.00**
Drinking patterns			
Risky drinking	49 (61.3%)	116 (52.9%)	0.20
Safe drinking	31 (38.7%)	103 (47.1%)	
AUDIT score	9.46 ± 6.99	6.57 ± 5.10	**0.01**
Family history of liver diseases			0.92
With	8 (10%)	21 (9.6%)	
Without	72 (90%)	198 (90.4%)	
PTSD			0.57
With	31 (38.7%)	77 (35.2%)	
Without	49 (61.3%)	142 (64.8%)	
PTSD severity score	10.71 ± 11.14	8.75 ± 9.56	0.13
Non-PTSD psychiatric disorders*			**0.03**
With	35 (43.8%)	66 (30.1%)	
Without	45 (56.2%)	153 (66.9%)	

Risk drinking: Drink no more than 10 standard drinks per week and no more than 4 standard drinks on any one day

AUDIT: Alcohol Use Disorders Identification Test.

*: Depression, dysthymia, anxiety, mania, hypomania, panic disorder, social phobia, generalised anxiety disorder

Table 2: Features associated with self-reporting of liver disorders in Australian Vietnam War veterans for whom clinically confirmed without any liver disorders

Features	Univariate analysis		Multivariate analysis	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Age	0.99 (0.92-1.07)	0.81		
BMI	1.01 (0.94-1.08)	0.82		
Education	0.81 (0.56-1.16)	0.26		
Married	0.89 (0.35-2.29)	0.82		
Work	0.75 (0.30-1.89)	0.55		
Abdominal symptoms	2.24 (1.06-4.72)	**0.03**	2.20 (1.03-4.69)	**0.04**
Smoking	2.59 (1.06-6.34)	**0.04**	2.20 (0.86-5.67)	**0.09**
Coffee (cups/day)	0.95 (0.81-1.12)	0.54		
Tea (cups/day)	1.21 (0.99-1.48)	0.06		
Alcohol				
Hazardous drinking	0.84 (0.45-1.60)	0.60		
AUDIT score	0.94 (0.89-0.99)	**0.01**	0.95 (0.90-1.00)	0.05
Family history of liver diseases	1.89 (0.75-4.71)	0.18		
Psychiatric disorders				
PTSD	1.29 (0.68-2.46)	0.43		
PTSD severity score	0.98 (0.95-1.01)	0.17		
Non-PTSD psychiatric disorders	0.68 (0.36-1.30)	0.24		
DASS21 depression score	1.01 (0.94-1.08)	0.84		
DASS21 anxiety score	0.98 (0.90-1.05)	0.52		
DASS21 stress score	1.00 (0.94-1.06)	0.98		

Table 3: Features associated with unawareness of clinically confirmed liver disorders in Australian Vietnam War veterans

Features	Univariate analysis	
	Odds ratio (95% CI)	*P* value
Age	0.99 (0.94-1.06)	0.94
BMI	1.04 (0.98-1.10)	0.19
Education	0.65 (0.38-1.13)	0.13
Married	1.56 (0.74-3.29)	0.25
Work	0.90 (0.45-1.81)	0.77
Abdominal symptoms	1.55 (0.91-2.63)	0.11
Smoking	0.97 (0.39-2.40)	0.95
Coffee (cups/day)	0.99 (0.86-1.14)	0.84
Tea (cups/day)	0.96 (0.83-1.09)	0.51
Alcohol		
Hazardous drinking	1.00 (0.60-1.70)	0.99
AUDIT score	0.98 (0.93-1.02)	0.32
Family history of liver diseases	0.88 (0.37-2.09)	0.78
Psychiatric disorders		
PTSD	0.89 (0.52-1.52)	0.67
PTSD severity score	0.99 (0.97-1.02)	0.60
Non-PTSD psychiatric disorders	0.57 (0.32-1.03)	0.06
DASS21 depression score	0.99 (0.94-1.05)	0.77
DASS21 anxiety score	1.02 (0.96-1.08)	0.63
DASS21 stress score	1.00 (0.95-1.05)	0.93

Supplementary Table S1: Diagnostic characteristics of self-reported liver disorders in Australian Vietnam War veterans

Variable	Clinically confirmed		Sensitivity (%)	Specificity (%)	Predictive values (%)	Positive likelihood ratio
	With	Without				
Overall						
Self-report:						
With	34	46	30.9	75.7	Positive: 42.5, negative: 65.3	1.27
Without	76	143				
Abnormal liver function						
Self-report:						
With	12	43	31.6	83.5	Positive: 21.8, negative: 89.3	1.92
Without	26	218				
Fatty liver disease*						
Self-report:						
With	6	23	11.3	90.6	Positive: 20.7, negative: 82.5	1.20
Without	47	221				
Hemochromatosis						
Self-report:						
With	2	7	66.7	97.6	Positive: 22.2, negative: 99.7	28.2
Without	1	289				
Other conditions [§, *]						
Self-report:						
With	1	3	2.70	98.8	Positive: 25.0, negative: 87.7	2.34
Without	36	257				

*: Two refused ultrasound examination.

§: Liver fibrosis, cancer and biliary stones.

Supplementary Table S2: Features of Australian Vietnam War veterans who are unaware of clinically confirmed liver disorders

Variable	Veterans unaware of liver disorders (n = 76)	Veterans aware of liver disorders (n = 34)	*P* value
Age	68.79 ± 4.41	67.97 ± 3.59	0.35
BMI	30.39 ± 4.46	30.75 ± 4.23	0.69
Education			0.38
University	29 (38.2%)	10 (29.4%)	
Less than Year 12	47 (61.8%)	24 (70.6%)	
Marital status			0.22
Married	64 (84.2%)	32 (94.1%)	
Single / divorced / widowed	12 (15.8%)	2 (5.9%)	
Employment status			0.38
Working	13 (17.1%)	3 (8.8%)	
Not working	63 (82.9%)	31 (91.2%)	
Abdominal symptoms			**0.00**
With	43 (56.6%)	29 (85.3%)	
Without	33 (43.4%)	5 (14.7%)	
Smoking status			0.43
Current smoker	7 (9.2%)	1 (2.9%)	
Current non-smoker	69 (90.8%)	33 (97.1%)	
Coffee (cups/day)	2.07 ± 1.68	1.59 ± 1.23	0.14
Tea (cups/day)	1.81 ± 1.63	1.59 ± 1.42	0.48
Drinking patterns			
Hazardous drinking	42 (55.3%)	22 (64.7%)	0.35
Safe drinking	34 (44.7%)	12 (35.3%)	
AUDIT score	6.78 ± 5.68	9.65 ± 7.16	**0.03**
Family history of liver diseases			1.00
With	8 (10.5%)	4 (11.8%)	
Without	68 (89.5%)	30 (88.2%)	
PTSD			0.77
With	29 (38.2%)	12 (35.3%)	
Without	47 (61.8%)	22 (64.7%)	
PTSD severity score	8.75 ± 9.92	10.14 ± 10.51	0.50
Non-PTSD psychiatric disorders*			**0.02**
With	19 (25%)	16 (47.1%)	
Without	57 (75%)	18 (52.9%)	

Risk drinking: Drink no more than 10 standard drinks per week and no more than 4 standard drinks on any one day

AUDIT: Alcohol Use Disorders Identification Test.

*: Depression, dysthymia, anxiety, mania, hypomania, panic disorder, social phobia, generalised anxiety disorder

Discussion

This is the first study to investigate the association between psychosocial and physical components of self-reported liver disease. The study demonstrated a high rate of false positive self-reported liver disorders as well as a large number of subjects apparently unaware of their underlying liver disease. We found that self-reporting gave high specificities but low sensitivities for liver disorders. The awareness rate of fatty liver disease in the veteran population is similar to that of Alzheimer's disease, previously reported.[6] Therefore, referring to the experience in veteran communities, education about liver diseases in the general population by medical practitioners should be strengthened to improve the currently poor awareness of chronic disorders.

Among 18 included variables in our study, only abdominal symptoms are an independent risk factor for false positive self-reporting. It is independent of previously reported potential risk factors such as drinking patterns or PTSD.[5] We suggest that many veterans may misinterpret their abdominal symptoms as evidence of liver disorders. This study highlights the need for improved education about one's health status among Australian Vietnam War veterans.

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References

1. Brown MC, Sims KJ, Gifford EJ, Goldstein KM, Johnson MR, Williams CD, Provenzale D: Gender-based Differences among 1990-1991 Gulf War Era Veterans: Demographics, Lifestyle Behaviors, and Health Conditions. Women Health Iss. 2019;29:S47-S55.
2. Baumeister H, Kriston L, Bengel J, Harter M: High agreement of self-report and physician-diagnosed somatic conditions yields limited bias in examining mental-physical comorbidity. J Clin Epidemiol. 2010;63:558-65.
3. Qureshi SU, Pyne JM, Magruder KM, Schulz PE, Kunik ME: The link between post-traumatic stress disorder and physical comorbidities: a systematic review. Psychiatr Q. 2009;80:87-97.
4. Karairmak O: Establishing the psychometric qualities of the Connor-Davidson Resilience Scale (CD-RISC) using exploratory and confirmatory factor analysis in a trauma survivor sample. Psychiatry Res. 2010;179:350-6.
5. McLeay SC, Harvey WM, Romaniuk MN, Crawford DH, Colquhoun DM, Young RM, Dwyer M, Gibson JM, O'Sullivan RA, Cooksley G, Strakosch CR, Thomson RM, Voisey J, Lawford BR: Physical comorbidities of post-traumatic stress disorder in Australian Vietnam War veterans. Med J Aust. 2017;206:251-7.
6. Tan JP, Zhu LQ, Zhang J, Zhang SM, Lan XY, Cui B, Deng YC, Li YH, Ye GH, Wang LN: Awareness Status of Chronic Disabling Neurological Diseases among Elderly Veterans. Chin Med J (Engl). 2015;128:1293-300.

Cause-Specific Mortality Risks Through 2016, Among U.S. Veterans of the Southwest Asia Theater

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Introduction

Much of the research on the post-deployment mortality of veterans who deployed as part of Operations Enduring Freedom, Iraqi Freedom and New Dawn (OEF/OIF/OND) has focused on the risk of suicide among returning veterans.[1-2] To date, mortality studies of OEF/OIF/OND veterans have not included analysis of specific disease-related mortality.

While mortality studies of OEF/OIF/OND veterans have focused on suicide, morbidity studies have assessed the risk of diseases that may be related to both environmental and anthropogenic exposures that were present in the theatre of operations. These exposures included infectious diseases, sand, dust and airborne particulates, industrial pollution, diesel exhaust and emissions from open burn pits.[3] One of the most recognised exposures is that of smoke from burn pits. While there is no inventory of materials disposed of in burn pits, it is believed that solid waste such as chemicals, shipping and packing materials, medical waste and military matériel were disposed of in the burn pits.[3] Contaminants and pollutants that might be expected to become airborne due to burning waste include dioxins, furans, polycyclic aromatic hydrocarbons (PAHs), metals, volatile organic compounds (VOCs) and particulates.[3]

While no studies have examined disease-related mortality among OEF/OIF/OND veterans, some studies have assessed disease mortality among veterans of the 1990–1991 Gulf War.[4,5] These veterans may have been subject to some of the same environmental exposures as OEF/OIF/OND veterans. Therefore, their disease mortality risks may reflect that of OEF/OIF/OND veterans. Apart from a study that reported an increased risk of brain cancer deaths associated with modelled exposure to nerve agent released as a result of the Khamisiyah weapons depot demolition,[6] no increased risks of disease-related mortality have been reported among 1990–1991 Gulf War veterans. In their 2020 report reviewing research regarding potential respiratory health effects due to airborne hazards exposures in the Southwest Asia Theater of Military Operations, the National Academies of Sciences, Engineering and Medicine (NAS) concluded that there was inadequate or insufficient evidence of an association between deployment during the 1990–1991 Gulf War or post-9/11 conflicts and subsequent mortality due to respiratory disease.[7] The report did find limited or suggestive evidence of an association between exposure to airborne hazards and subsequent development of respiratory symptoms, but not respiratory cancers. Regarding mortality studies of OEF/OIF/OND veterans, the report noted that no studies looked at respiratory disease mortality separately from overall mortality.

This current study examined cause-specific mortality risks, including both disease and traumatic deaths among a cohort of OEF/OIF/OND veterans. Because of the concern over airborne hazards, this study included an analysis of mortality risks due to respiratory diseases.

Materials and methods

Data collection

This study's cohort included 1 935 168 veterans who served in either active-duty component units or reserve/National Guard units as part of either OEF/OIF/OND and ended their deployment or separated from the military through 31 May 2015. The roster utilised in this study is an updated file of those examined in an earlier follow-up.[1] Those who died while in the military, whether in theatre or elsewhere, were excluded. This study's cohort of OEF/OIF/OND veterans only included those deployed through 31 May 2015, as it was the latest deployment data available to researchers at the time this study began.

Table 1:. Selected demographic and military service characteristics for US veterans[1] of conflicts in Afghanistan, Iraq and Southwest Asia Theater of Operations (n=1 935 168)

Characteristic	Frequency	Per cent
Age at entry to follow-up		
17-21	82 998	4.3
22-25	594 232	30.7
26-35	674 347	34.8
36-45	405 455	21.0
46-+	178 136	9.2
Mean age at entry to follow-up	31.4	
Years of follow-up		
0-5	660 875	34.1
6-10	785 334	40.6
11-15	488 959	25.3
Mean years of follow-up	7.5	
Standard deviation	3.5	
Sex		
Male	1 703 367	88.0
Female	231 801	12.0
Race		
White	1 338 166	69.2
Black	267 999	13.8
Hispanic	187 773	9.7
Other	141 230	7.3
Marital status		
Married	855 259	44.2
Not married	1 079 909	55.8
Unit component[2]		
Active	1 178 815	60.9
Reserve/National Guard	756 353	39.1
Branch of service		
Army	1 005 285	52.0
Marines	256,414	13.2
Air Force	345 856	17.9
Navy	322,929	16.7
Coast Guard	4684	0.2
Rank		
Officer	198 186	10.2
Warrant Officer	18 455	1.0
Enlisted	1 718 527	88.8

1. Deployed as part of Operations Enduring Freedom (OEF), Iraqi Freedom (OIF), or New Dawn (OND) and separated deactivated through May 2015.
2. Active duty are those who served in active-duty units while in theatre. Reserve/National Guard are those who served in Reserve/National Guard Units while in theatre.

Table 2:. Selected cause-specific mortality for US veterans of conflicts in Afghanistan, Iraq and Southwest Asia Theater of Operations through 2016[1] compared to that of US population

Cause of death (ICD-10)[2]	N	SMR[3]	95% C.I.[4]
All causes	20 868	0.59	0.59-0.60
Cancers	3 278	0.56	0.54-0.58
Malignancies of digestive system and peritoneum	1 018	0.56	0.52-0.59
Malignancies of respiratory organs	523	0.37	0.34-0.41
Malignancies of trachea, bronchus, lung	487	0.37	0.34-0.40
Malignancies of breast	113	0.80	0.66-0.96
Malignancies of female genital organs	41	0.50	0.36-0.68
Malignancies of male genital organs	111	0.63	0.52-0.76
Malignancies of urinary organs, major	129	0.47	0.40-0.56
Malignancies of other and unspecified site major	862	0.73	0.68-0.78
Malignancies of lymphatic and haematopoietic system	415	0.65	0.59-0.72
Diseases of the blood and blood-forming organs	30	0.22	0.15-0.31
Circulatory diseases (major)	2 071	0.37	0.35-0.38
Circulatory diseases (other)	571	0.37	0.34-0.40
Respiratory diseases	278	0.22	0.20-0.25
Digestive diseases	578	0.31	0.29-0.34
Motor vehicle accidents, driver	1 275	1.44	1.37-1.53
Suicides	4 618	1.44	1.40-1.48

1. Deployed as part of Operations Enduring Freedom (OEF), Iraqi Freedom (OIF) or New Dawn (OND) and separated or deactivated through May 2015. Mortality is through 12/31/2016.
2. The grouping of individual International Classification of Disease (ICD-10) codes included in each of the diagnostic groups, including their ICD-10 codes, are defined in the software used to calculate SMRs and can be downloaded from the National Institute for Occupational Safety and Health website that houses the LTAS (https://www.cdc.gov/niosh/ltas/pdf/Rate-Info-Table-1.pdf).
3. Standardised Mortality Ratio (SMR) is the ratio observed to the expected based on the US population, adjusted for age, sex, race and calendar year.
4. 95% Confidence Interval.

The beginning of follow-up ranged from October 2001 through May 2015. For active-duty veterans, the beginning of follow-up was their latest date of separation from the military. For reserve/National Guard veterans, the beginning of follow-up was their latest end of deployment date. End of follow-up was the earlier of date of death or December 31, 2016. All military service and demographic characteristics were obtained from the US Department of Defense (DoD), Defense Manpower Data Center. Mortality data was obtained by matching all cohort veterans against the VA/DoD Mortality Data Repository (MDR) data. The MDR contains cause-specific mortality for all military service members who separated from military service since 1979. At the time this study was initiated, MDR had cause of death data through 2016. Cause of death and fact of death in the MDR were obtained from the National Death Index (NDI). Cause of death was coded using International Classification Disease Codes, 10th revision (ICD-10).[8]

Cause-specific mortality risks were assessed by comparing the observed number of cause-specific mortality among veterans to the expected based on that of the US population, adjusted for age at entry to follow-up, race, sex and calendar year. These comparisons are expressed as standardised mortality ratios (SMR)s and were generated by the National Institute for Occupational Safety and Health (NIOSH) statistical software known as Life Table Analysis System (LTAS).[9] Causes of mortality examined as part of SMR analyses were limited to those available in LTAS.

Results

Table 1 has selected demographic and military service characteristics for all 1 935 168 veterans. Most veterans were male (88%), white (69.2%) and served in an active-duty unit while in theatre (60.9%). The mean number of years of follow-up was 7.5 years, with 65.9% having 6 to 15 years of follow-up.

There were 20 868 deaths identified among all OEF/OIF/OND veterans. Compared to the expected based on the US population, there was a statistically significant decreased risk for overall mortality (SMR=0.59; 95%, CI, 0.59–0.60). The risks of specific disease-related mortality presented in Table 2 among OEF/OIF/OND are also less than that of the US population. There were 523 respiratory cancer deaths and 278 non-cancer respiratory disease-related deaths. The risk of all respiratory cancers among OEF/OIF/OND veterans was less than that of the US population (SMR=0.37; 95%, CI, 0.34–0.41). The risk for all respiratory-related diseases, excluding respiratory cancers, was 22% of the expected (SMR=0.22; 95%, CI, 0.20–0.25). Only for motor vehicle accident deaths (MVA) and suicides did OEF/OIF/OND veterans have statistically significant increased risks compared to the US population, (SMR=1.44; 95%, CI, 1.37–1.53) and (SMR=1.44; 95%, CI, 1.40–1.48), respectively. For over 80 other cause-specific disease mortality outcomes not presented here, but included in the LTAS SMR analysis,[9] there were no increased risks of disease mortality among OEF/OIF/OND veterans.

Discussion

This study assessed cause-specific mortality risks among OEF/OIF/OND veterans. Comparing OEF/OIF/OND veterans to the US population, there was no increased risk of any disease-related mortality, including non-cancer respiratory disease deaths or respiratory cancer deaths. OEF/OIF/OND did have a 44% excess of deaths due to MVA while a driver and a 44% excess of suicides when compared to the US population.

The excess of suicides among deployed veterans compared to the US population replicates earlier follow-ups of OEF/OIF/OND veterans.[1,2] However, as this excess of suicide is seen only when compared to the US population and not to non-deployed veterans, the association may be limited to military service in general, rather than OEF/OIF/OND deployment specifically. The excess of MVA deaths has also been observed in studies of veterans who served in the 1990–1991 Gulf War.[4,5]

Of particular interest to this study was the decreased risk of respiratory disease-related mortality among OEF/OIF/OND veterans. This veteran cohort's mortality risks due to respiratory diseases and respiratory cancers were all statistically less than that of the US general population. In fact, this veteran cohort had statistically significant decreased risks for most of more than 80 diseases assessed by the LTAS software[9] used in this study. This phenomenon may be due to the 'healthy soldier effect', which is often observed when veterans are compared to non-veterans.[4,10] Health screening required to enter the military, access to medical care while serving in the military, and performance standards related to physical fitness to remain in the military likely result in active-duty military and veteran populations healthier than the US population.

This study lacked any exposure-related data to assess cause-specific mortality risks. If a specific in-theatre exposure, such as smoke from burn pits or elevated airborne particulate matter, is related to

an increased risk of cause-specific mortality, then not differentiating veterans with high exposure from those with low or no exposure at all could diminish the ability to detect an increased mortality risk related to exposure. Should an exposure experienced during their service as part of OEF/OIF/OND be related to an increased risk of cause-specific mortality, the maximum length of follow-up possible in this study, i.e. 15 years, might not be sufficient to discern mortality outcomes related to the exposure. This study also did not have a non-deployed veteran comparison group. Because of the 'healthy soldier effect' the US population may be an inherently unhealthier population than veterans.

As recommended by the NAS 2020 report,[7] this study focused on respiratory mortality associated with OEF/OIF/OND deployment. There was no increased risk of mortality associated with any respiratory disease or respiratory cancer among this study's cohort. The absence of increased mortality due to disease among OEF/OIF/OND veterans may not be unexpected given the 'healthy soldier effect'. Despite this study's findings, the mortality and morbidity of this cohort should be followed into the future. Future studies would be enhanced by the addition of a non-deployed veteran comparison group, and airborne hazard exposure data should such measures become available.

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References

1. Kang H, Bullman T. Risk of suicide among US veterans after returning from Iraq or Afghanistan war zones. JAMA. 2008;300(6): 652-653.
2. Kang HK, Bullman TA, Smolenski DJ. et al. Suicide risk among 1.3 million Veterans who were on active duty during the Iraq and Afghanistan Wars. Ann of Epidemiol. 2015;25(2): 96-100.
3. Taylor G, Rush V, Deck A, Vietas JA: Screening Health Risk Assessment: Burn Pit Exposures Balad Air Base, Iraq and Addendum Report. Aberdeen Proving Ground, MD, Army Center for Health Promotion and Preventive Medicine, 2008. Available from: http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA493142.
4. Kang HK, Bullman TA. Mortality among U.S. Veterans of the Persian Gulf War. N Engl J Med. 1996;335:1498–1504.
5. Barth SK, Kang HK, Bullman T. All-cause mortality among US Veterans of the Persian Gulf War: 13-year follow-up. Public Health Rep. 2016;131:822-830.
6. Barth SK, Kang HK, Bullman TA, Wallin MT. Neurological mortality among U.S. Veterans of the Persian Gulf War: 13-year follow-up. Am J Ind Med. 2009;52:663-670.
7. National Academies of Sciences, Engineering, and Medicine. 2020. Respiratory health effects of airborne hazards exposures in the Southwest Asia Theater of Military Operations. Washington, DC: The National Academies Press. https://doi.org/10.17226/25837
8. World Health Organization. (WHO) International Statistical Classification of Diseases and Related Health Problems, 10th Revision. Geneva, Switzerland: WHO; 1992.
9. The National Institute for Occupational Safety and Health. Available from: https://www.cdc.gov/niosh/ltas/default.html.
10. McLaughlin, R, Nielson L, and Waller M. An evaluation of the effect of military service on mortality: Quantifying the healthy soldier effect. Ann of Epidemiol. 2008;18:928-936.

Experiences of a Prisoner of War: World War 2 In Germany[1]

Re-Print Stephenson Vol 9 No 1

E Stephenson[2]

On 16 December 1943, I was sitting at the Navigator's seat in a very noisy Lancaster bomber over Berlin when something occurred that changed the pattern of my life. We had just dropped 13,000 pounds of bombs... a 4,000 pound "cookie" plus incendiaries and we were stooging along at 163 mph (280 km/hr) taking infra-red photographs for the first time in WW2, when we were attacked from below by a German night fighter which hit the port wing and fuselage, setting the wing on fire and wrecking my instrument panel.

Several hundred gallons of petrol burning less than 20 feet from you is an occasion for rapid action in the way of evacuation of the area, which five of us did before the plane blew up or crashed. We did this through the for ward escape hatch and used parachutes.

The difference was astounding:

Out into the cold night air (it was about 2020 hours) count 5, pull the rip cord, a jagging thrust In the thighs and back and ... utter silence. The ground came closer and I could see snow around but I was probably dazed by a blow I had received in the aircraft when a cannon shell hit my instrument panel and glass and metal went everywhere. Anyway, I didn't see the church steeple that snagged my parachute and I hit a wall, causing a fracture of the right epicondyle and a Potts fracture of the right ankle.

I came to in a German doctor's surgery being stitched up with our pilot and bombardier present too. Then we were taken to part of a German maternity hospital under guard in Berlin. My leg and arm were plastered and 2 days later we were taken by train to Frankfurt am-Rhein to Dulag Luft, a holding camp, where we were put in solitary confinement.

The Germans did not heat our cells and a damp plaster on one arm and one leg in the middle of a German winter doesn't induce much sleep.

Next day we were interrogated. Before each operation we'd been reminded at briefing that, if captured, we would give only rank and name. My interrogator spoke perfect English and began (when he saw my plasters) "Oh! Bad luck! Well how are things at Spilsby"...my home base. A bit disconcerting for a start and he asked a lot of questions but I feigned loss of memory, pointing to the cuts on my head.

After interrogation, we were put back into our cells for a day and another interrogation and after that taken to the transit camp proper. After the guard closed the gate and wrapped a large chain round the post and padlocked it, he uttered in English (probably all he knew) that deathless prose we were to hear so many times "For you, the war is over!"

After Christmas, we were moved to Zagan, Upper Silesia (in the former Polish territory) by cattle-truck (8 horses, 40 men) to Belaria compound of Stalag Luft 3. This was 5 to 6 kilometers away from the main camp which also had a North, South, Centre, East and West compound plus a jail, a hospital and a German 'vorlager'. We were very fortunate at Belaria and indeed at Stalag Luft 3 generally. This was a POW camp for Allied Officers who were flying personnel. It had been planned by Goering himself as a "super" camp because he was a WWl flyer himself.

Belaria at that stage had 8 huts for accommodation, each with an ablution area with washbasins. 3 or 4 showers, usually cold , and a urinal. Half of one hut was given over to a sick-quarters or 'Lazaret'. Belaria also had a ration store with a kitchen attached and an "abort"...an 8-holer in 2 rows of seats.

The Lazaret had a long room (about 40 ft by 15 ft) with a bench down one side, cup boards underneath and a washing sink. It had an examining couch and stools for patients to sit on while being treated. It had an old micro scope and a hand driven centrifuge.

The rest of the Lazaret contained a room, which was a dormitory for 10 - 12 men in double bunks; a cooking area with a stove fired by wood or brown coal briquettes; plus an Elsan type toilet and wash basin. There was a small room to house an infrared lamp

and a UVL lamp. There were also two cupboards, one for linen and the other for food storage and medical supplies.

I was the camp doctor's first patient at the Lazaret. He was looking for patients as we entered the camp at Belaria. An Irish lad named Mcilroy was another patient. He came from Dublin and when we asked why he was in the RAF he replied with a wicked grin "Well, we can't have these Germans knocking the British about, else who would we fight after the War". He had an old compound fracture of be thigh, which took a hell of a long time to heal and was obviously very painful, but he did not complain once and always had a grin. Another patient was Tommy Hughes who had a badly cut head, with shaven hair and masses of bandages; Ginger Rutherford , a Geordie with a lot of cuts and bruises, and a young spitfire pilot, Stan Griffith, with a huge black-eye and frostbite alter loosing a boot. We all spent 7- 10 days there but Mcilroy and I were there longer.

Apart from the camp doctor, CAPT Monteuuis RAMC, who was captured at St Valery in 1940, there was an Australian medical student who had been a Hampden pilot, Geoff Comish . He had been a POW for nearly 3 years and spoke German. There were 4 WONCOs who between them did the cooking, cleaning, linen washing and attended the fires etc. They were magnificent and one, Peter Brewer, was also a masseur, which was in valuable. These all formed the staff of the Lazaret with German approval.

My arm was taken out of plaster at the end of January 1944 and I spent 1/2 hour 3 times a day "climbing up the wall" to overcome the bruising and avoid ankylosis. The leg had had a walking plaster put on and a heel made of wood with a piece of rubber tyre covering it. This plaster was removed in mid February and I will always be GRATEFUL TO PETE Brewer for his efforts with my rehabilitation.

I spent the next 2 months in the camp general with the other POWs who had arrived at Belaria at the same time. Then the camp doctor asked me to join him and help in the Lazaret as the camp was growing rapidly in numbers.

German Camp Staff and Routine

The German staff were members of the Luftwaffe. Initially in charge was Hauptman Wemer until the number of POW's grew and the Oberst (Colonel) arrived. He had been invalided from the Stalingrad front but I did not discover his name. Werner then became Adjutant and had a Leutnant as Abwehr (Defence) Officer and he was in charge of Felwebel Glemnitz and seceral "ferrets". These were either Unteroffiziers or Gefreiters (Corporal or Soldiers) who wore blue dungarees with a belt and a small Mauser pistol. They were also ·armed' with screwdrivers with a very long blade for poking and probing, looking for any contraband. In the camp, POWs were 'on parade' twice daily for roll call and the ferrets used to inspect the huts while we were parading.

Since it is the duty of POWs (especially officers) to escape when possible, much camp activity was geared to acquiring maps, making "ausweiss" (passes), civil clothing from uniforms, photographs and of course tunnelling. This activity was under the control of 'X' wing Commander Bob Tuck, who organised a system that kept tabs on all ferret movements. If it looked like one was getting too curious about activities related to escaping some body (usually a German speaker) would be detailed to engage him in conversation and so head him off.

Originally Belaria was full of POW from Commonwealth Air Forces but extra huts were built to house US Army Air Corps officers as more and more were shot down. This was when numbers in the camp shot up and Dr. Monteuuis, who was known as 'Twee', asked me to join the Lazaret staff to help out, about April 1944.

Dr. Monteuuis was a very unusual man. His father was French and his mother Spanish. He had very black hair and a black moustache which came down over his mouth and which he frequently chewed, when he was not smoking. He was pigeon-toed and constantly gave the Germans the idea he was a bit mad, walking round the compound pretending he had a dog on a lead. This was completely a pose.

He was fiercely dedicated to his patients, within the very severe limitations of camp life, and used to try and teach his helpers bits of anatomy and physiology during the evenings after work. It was extraordinary how 'busy' we were, just fixing up the POWs with their ailments, with which they reported very readily; after all, there was little else to do. His great philosophy was "patients get better in spite of our efforts and not always because of it" and "Nature had been at this game (of practicing medicine) for a long time and is very good at it."

It is appropriate here to consider differnces between the prison camp conditions for Allied POWs held by the enemy. I must emphasize that conditions in the German camps I was associated with were worlds apart from those in Japanese camps. The latter had a total of 132,134 allied prisoners of whom 35,756 died i.e. 27%. Of these, 22,376 were Australians of

whom 7,777 died. The Germans and Italians had almost twice as many, 235,473 with a death rate of 4% (242 Australians).

From comparisons I have from a doctor who was in an Italian camp and from 2 or 3 prisoners who were in both at some time, the German conditions were better.

Belaria had apparently been a cadet training area for the Wehrmacht before it was turned into a prisoner of war camp. To do this, the Germans had separated off some huts to form their admin centre or vorlager and then surrounded the remaining huts with a double row of barbed wire, about 4 metres high, with a gap of a metre between the rows. At ground level, between the rows, coils of barbed wire were laid. Within the perimeter, a wooden rail was placed about half a metre from the ground and 3 metres from the wire to mark the limits of movement for prisoners. On one side of the camp was another compound that housed Russian POWs. On another was a playing field area, also surrounded by barbed wire. The third side was eventually used to build extra huts as the camp was expanded to accommodate extra prisoners. In the time from January 1944 to January a year later, the camp increased from the original 50-60 to over 1100 men.

The German word for POWs is "kriegsgefangenen" which inevitably became shortened to "kriegie". When we arrived, we were the first kriegies apart from 20 or so who had been 'purged' from the North Compound. These were old lags who had escaped once or twice and the Germans sensed something was afoot at North Compound in the way of an escape and removed those they considered ringleaders, including WGCDR Bob Tuck and Geoff Cornish. In fact, Operation 200 (the Great Escape) occurred about 6 weeks later.

The Senior British Officer (SBO) was a Group Captain who abjured us to wash or shower daily (cold water but we could get an occasional hot water dunk in a wooden tub) and shave at least every other day. Shirts and under clothes were to be washed weekly if possible. Hot water was made available twice daily from the camp kitchen in jugs. Soap was either the German 'ersatz' variety or non existent except in some Red Cross parcels.

The value of these requirements became obvious after one had been a prisoner for a while. It is a shock to the system, to say the least, to be "transported within hours, from a comfortable Officers Mess to a situation where comfort disappeared, food was restricted and you had no freedom except to walk round and round the same piece of dirt every day". To let go and not bother (and a few did) would have been disastrous for morale.

We were fortunate at Belaria to have a few men who had been prisoners for some time to give us advice on life style change. Furthermore, services sprang up quickly which enabled those who were determined and interested in keeping their lives going. Classes in German, French and even Russian started. Other topics were used to give instruction and a library was started with books sent over the years to POWs. A theatrical group developed and a band consisting of a pianist, a trumpeter, a drummer, and two guitarists, and, of course, activities related to escaping.

Occupations

Occupations in a Prison Camp in Germany

Skilled	Unskilled [1]
Doctor	Map making
Dentist	Forging
Interpreter	Tailoring
Cook	Photography
Carpenter	Librarian
Musician	Acting
Mining Engineer	Brewing
	Ferret watching
	Electrician
	Scenery painting
	Tin bashing
	Tunneling
	Soil dispersing

1 The unskilled faction includes jobs which prisoners had in general, not performed before.

Parts of the camp in between huts were used as 'allotments' to grow a few vegetables but the soil was very poor, although potatoes and tomatoes would grow. I can't remember where the seeds came from for this venture.

All these gave some purpose to life. The Germans allowed us to go on to the playing field when it suited them (It was denied for some time after the Great Escape). Soccer was popular and so was cricket. Union was played but the ground was very stony and injuries were common. In the winter, we hacked the frozen ground and made a small circular mound, 3-4 inches high and about 25 metres across on the playing

field and flooded this with water to make an ice rink and play ice hockey, courtesy of skates sent by the Red Cross. Consequently, morale was fairly high and food was reasonable at least initially although this degenerated. Even so, a small proportion of POWs did not take part and "turned their faces to the wall". Most of these are self-explanatory and are referred to in the text. One hut was converted into a theatre, having been an assembly hall.

This was done by having the one carpenter in our midst making seats from Red Cross boxes in which the parcels were brought to the camp. Activity in this sea involved musicians, actors, painters, electricians and tailors (to make costumes) These gentlemen were also invaluable in altering uniforms to make them like civvy clothes for escape purposes. Most of the others mentioned were involved in the escape area. Tin bashers were those who used tins obtained from Red Cross parcels to make trays and dishes for cooking purposes. But the same expertise was turned to making long pipes when tunnelling was going on. Using an old kit bag, a rough pump could he made and connected to the pipes so produced to provide at air circulation underground for the tunnelers. This was a feature of the tunnel which let out 78 POWs in the North Camp in 1944.

Food

This consisted of a daily German ration (q.v.) handed out on a room by room basis. Hot water and a barley porridge was prepared in the kitchen where the Red Cross food parcels were stored and issued

Red Cross Rations

Canadian

1 tin Spam (12oz)
1 tin Corned Beef (12oz)
1 tin Salmon (8oz)
1 tin Sardines (8oz)
1 tin Klim
1 pkt Coffee or Tea (4oz)
1 pkt Cheese
1 tin Biscuits (8oz)
1 Milk Chocolate (5oz)
1 pkt Salt & Pepper (1oz)
1 tin Butter (16oz)
1 pkt Sugar (8oz)
1 tin Jam/Marmalade (8oz)
1 bar Soap (2oz)

British

1 tin Luncheon Meat or Sausages (16oz)
1 tin Steak & Kidney or Curry & Rice (1 pound)
1 tin Salmon (8oz)
1 tin Herrings/Pilchards (8oz)
1 tin Biscuits (7oz)
1 bar Chocolate (4oz)
1 tin Bacon (8oz)
1 pkt Boiled Sweets (4oz)
1 tin Cheese (2oz)
1 bar Soap (2oz)
1 tin Margarine/Butter (8oz)
Sugar (4oz)
Dried Fruit (8oz)
Tea (2oz)
1 tin Nestles Milk
1 tin Jam (8oz) or Syrup (4oz)
1 tin Rolled Oats/meal (5oz)
1 tin Vegetables (mixed/carrots)
1 tin Meat/Fish pasta (2oz)
Salt, Mustard, Pepper or Marmite cubes
Occasionally:
tin Cocoa/Extra Biscuits (1/4 pound)
1 tin Egg Powder (2oz)
1 tin Apple/Marmalade Puddings
1 tin Custard/Yorkshire Pudding Powder
1 tin Creamed Rice

New Zealand

1 tin Corned Mutton (16oz)
1 tin Beef (16oz)
1 tin Condensed Milk
1 tin Cafe-au-Lait
2 tins Tea (2oz each) & Sugar
1 tin Honey (6oz)
1 tin Butter (16oz)
1 tin Chocolate (4oz)
1 tin Jam (8oz)
1 tin Meat & Vegetables (16oz)
1 tin Cheese (8oz)
1 pkt Sultanas (8oz)

American

1 tin Spam/More (12oz)
1 tin Pork Luncheon Meat (12oz)
1 tin Corned Beef (I2oz)
1 tin Salmon/Tunny (8oz)
1 tin Sardines/Brisling (6oz)
1 tin Coffee (3oz)
1 tin Powdered Milk-Kiim
1 pkt Sugar (8oz)
1 tin Jam/Orange Juice or Peanut Butter (6oz)
2 bars Choc ·'D" ration (4oz)
1 pkt Biscuits (7oz) or Cereal (8oz)
1 tin margarine (16oz)
1 pkt Prunes (16oz)
60-100 Cigarettes
2 bars Soap (2oz each)
1 pkt Cheese (8oz)
1 pkt Pepper/Salt (1oz)
1 tin Rosemill Pate (6oz)

Australian Bulk

This came 3 or 4 times per week while I was at Belaria.

It was mostly dried fruit like sultanas, raisins, apple, pear, currants and sugar and was shared out on a weight basis for each man by the 'catering officer', a man detailed by the Senior British Officer (SBO) to do the job of controlling the issue of Red Cross Parcels. The Aussies bulk raisins used to get crusty on the outside of the fruit (long time travelling) and yeasty and this was very useful to make alcoholic brew which had quite a kick to it.

weekly under German supervision. These parcels were either British, Canadian, American, or New Zealand, plus an occasional Australian, or Argentine bulk issue. When we arrived, the ration was 1 parcel between 2 men per week and in the heyday became 1 per man per week, but this did not last for long and reduced until when we left Belaria in January 1945 ahead of the Russian advance from the East. It dropped to about 1 between 6. After we arrived at Luckenwalde, south of Berlin in Jan 1945, there were no parcels at all. As the bombing of Germany in creased, the rail communications were increasingly weakened. Since the Red Cross parcels came from Geneva, we realised supplies would drop off so we tried to store food.

German Rations	
At Balaria: Jan 44 to Jan 45 (Weekly per man approx)	**At Luckenwalde: Feb-May 1945 (Daily per man approx)**
165 gm Margarine (6 oz)	l/2 cup Mint tea twice daily
165 gm Honey or Jam	2/3 litre Soup (Pea, Cabbage, Meat or Barley)
60 gm Cheese	300 gm Dauerbrot
1800 gm bread (Dauerbrot) (1 loaf = 4 pounds)	25 gm Margarine
1500 gm Potatoes	750 gm Potatoes
160-170 gm Sugar	25 gm Sugar
Vegetables (Swedes, Khol, Rabi, Cabbage, Peas in season)	Salt
100 gm (4oz) Bratlings	c 15 gm meat (in stew)
Pulver or Semolina	30-40 gm per week sausage
50 gm Sausage (Blut wurst or bacon)	50 gm per week Cheese or honey
100-160 gm Meat (mince or beef or pork) per 2 weeks	
Barley 250gm per week usually cooked in the ration store and dished out on a daily basis.	

We could not store much because the Germans used to puncture all the tins at each end and the food would go bad if left too long. However, the tins of meat by Fray Bentos from Argentina were sealed with tin solder. This could be melted off by heating the empty tins and put over the puncture holes made by the Germans and so reseal the tins. Luckily for us, the puncturing took place just before the parcels were issued so the tins were only punctured for a few minutes before we got them and we sealed them quickly. There was of course no cold storage area (other than the camp kitchen) and the temperature at Belaria varied from a maximum in the summer of 40 degrees down to about -10 C in winter.

In addition to the above, we in the Lazaret at Belaria got patient comfort parcels occasionally for food distribution to the patients and on a smaller scale. They were of British, US and Danish origin.

Illness & Injuries

As would be expected, common things were common. Cuts, bruises and sprains were everyday problems. Skin diseases were frequent as cuts tended to become septic but there were numerous cases of impetigo (probably a Strep B.). Sycosis barbi hit several and I recall 2 cases of erysipelas. URTIs were frequent, from rhinitis to tonsillitis to bronchitis; only one or two asthma attacks. And of course "D&V"; the squitters, colleywobbles, Montezuma's revenge.

Clothing

As would be expected, our clothes consisted of the items we were wearing when we were shot down and these would obviously not last for ever. However, army pattern clothing became available, ration controlled, possibly obtained through Red Cross sources but undoubtedly some was material captured by the Germans in various places. We were able to have British army boots, shirts and wool underclothing and later some American greatcoats and gloves were available and kit. In addition, individual Red Cross parcels provided things like scarves, gloves, woollen hats and underclothing. There was no regularity about this and we had to make them last.

Medicaments & Treatment

Supplies came through the courtesy of the Germans and Red Cross via Geneva. Cotton bandages of various widths were available, and we used to wash the soiled ones to use again. Elastoplast was scarce but gauze dressings we available to be used dry or with petroleum jelly or icthyol or even acriflavine we made up from tablets dissolved in water. Plaster of Paris was in powder form and used with cotton bandages to make splints and plasters. Metal splints like lattice were some times to be had and used again and again, either padded with cotton wool or bandages.

We could not rely on regularity of supply of any of these unless the Luftwaffe agreed to help us out. Generally they were quite helpful. The German doctor was Stabs. Arzt Hildebrand who was a rare specimen having a sense of humor. He would visit every 2 or 3 weeks and in emergencies if he could. Fortunately these occasions were rare. He would arrange for X-rays by having POWs sent under escort to the main camp hospital. Geoff Cornish and I have

LIST OF MEDICAL SUPPLIES (I am relying on memory)	
Bandages	Ung. Hydrarg et Ammon
Elastoplast	Whitfield's Ointment
POP powder	Zinc Oxide Cream (1 tin!)
Syringes (inc. A minim one)	Ichthyol
Ampoules of Sterile Water & sodium chloride	Gentian Violet 1%
Bottles (medicine)	Iodine
Kaoline Powder	Acriflavine Tablets
Tinct opii (scarce)	Menthol Crystals
Aspirins	Tinct Benz Co.
APC (Codeine)	Mist Ipecac.
Prontosil Powder (M&B 693 - Sulphapyridine)	Mist. Pot. Cit
Prontosil Tablets	Calamine Lotion
Evipan sodium (Anaesthetic)	Petroleum Jelly
Ethyl Chloride Spray	Tabs. Sulphaguanidine
Liquor Hammamelis	Lin Meth. Sal.
	Some vitamin tablets
	Possibly Xylocaine

pooled our recollections and at Belaria plus North Compound, over an approximately 2-year period (up to 2000 men), the emergencies were:

- 3 cases of appendicitis requiring surgery
- 1 case of Hodgkin's Disease
- 3 psychiatric cases
- 3 POWs who were shot.

One of the psychiatric cases was under guard on the way to hospital and wandered off disorientated and was shot. It was not serious luckily, but the Luftwaffe was genuinely upset and arranged that any future cases would have a German speaking POW to accompany them. Later a case of deep melancholia was sent to a hospital east of Belaria with Cornish as part of the escort. Returning from the hospital, Geoff offered the guard some cigarettes if they would take him to a hotel for a beer... which they did!

The other shootings were:

A POW got drunk on "kriegie hooch" (made from raisins from Australian bulk issue; soaked in water; the raisins had a crust of sugar and yeast and this fermented). He ran out of his hut at night and collided with a Hundfuhrer, a guard with an Alsatian dog. In the ensuing melee the POW w back to his hut but was shot in the stomach and was taken to hospital. He survived.

In the third case, a kriegie was walking round the camp some time after 'The Great Escape' and touched the rail inside the fence of barbed wire. The trigger-happy guard fired at him and hit him in the hand causing a fracture of 3 metacarpals. This case was partly managed in the Lazaret and Hildebrand took him for X-rays to watch progress.

Two other cases at Belaria which were unusual were:

A needle stick injury to one of the hospital helpers, which became septic in spite of sulphonamides and osteitis set in requiring amputation of the terminal phalanx. The other was the case of a New Zealander, in his mid 20s, who developed phimosis which required circumcision. This was performed by Monteuuis with Cornish giving Evipan. The result was a magnificent piece of surgery involving some 20 sutures. The patient was warned about not having an erection for fear of disastrous surgical consequences. He became so anxious that he organised a "Fire Drill" team consisting of the patient in the bed next to him having a large cardboard fan while on the other side was a patient with a huge chunk of cotton wool and a basin of cold water. On the command "Fire" one man fanned furiously, the other doused with cold sponges and the patient rang a hand bell energetically which was a signal for any member of the staff hearing the alarm to grab the ethyl chloride spray, rush to the ward and extinguish the impending blaze!

Cases in Lazaret: Inpatients & Outpatients

As previously stated common things were common:

Bruises and Sprains: These received Liquor Harnmamelis, a bandage and when appropriate, heat and massage.

Cuts & Wounds: These were usually the result of carelessness or abrasions from falling. Treated with 1% acriflavine, they usually did well. The area the camp was in was a dusty farming area, and this could be a nuisance with larger wounds like burns. Sometimes we used Vaseline with a dressing.

Rhinitis: was treated with inhalations of menthol..

Sore Throats and Tonsillitis: received hot salt water gargles. 2-hrly Bronchitis, received inhalations and mist Ipecac. The more severe and those who were pyrexial would be admit ted to the Lazaret. If it was necessary to add Prontosil, their fluids were pushed with mist. Pot. Cit. If we had it, to reduce the risk of crystalluria, or kidney damage.

Urinary Infections: received mist. Pot. Cit. and rest in bed and fluids ++

Headaches and minor aches: got APC tablets.

Styes: hot spoon bathing... a spoon with cotton wool held by cotton or a piece of small bandage dipped

into hot water and held near the eye.

Diarrhoea: often with vomiting was treated with a. Fluids only for 12-24 hours; if still present;

b. Kaolin mixture sometimes with Tinct Opii.. If this worked, the question of how long to continue with medicine (being conscious of conserving resources) arose. Monteuuis would ask, "Can you fart with confidence?" If "yes" generally stop medicine.

More severe cases (frequent bowel motions not seen to be responding to medicine & diet, perhaps pyrexial) were admitted and Twee would perform the 'fork test'... a stool specimen was obtained and if faeces passed through fork prongs, bed and sulphaguanidine was the treatment. Otherwise mobilise slowly with food from the invalid comfort parcels.

Skin Lesions: Tinea cruris & pedis was quite common and usually responded to Whitfield's ointment.

Urticaria: calamine lotion

Impetigo: was quite common and usually responded to Gentian Violet Solution.

Ervsipelas: 2 or 3 cases occurred and responded to hot dry packs and Prontosil.

The Long March

In the latter part of January 1944, the whole camp at Belaria was given 6 hours to move to an unknown destination. The Russians were then at Breslau (Wroclaw) some 35km away and snow was 1/2 metre thick on the ground and still falling. The hospital staff were promised a horse and cart to carry medical supplies and our own belongings. In the event there was no horse so we pulled it ourselves. The rest of the POWs took the tables from their rooms, up-turned them, knocked off the legs, nailed them to the table top to make runners and tied a cord to the sledge so produced. Where the nails came from is a mystery but I bet the huts would not stand up in a storm when we left!

We left as a column of about 1000 men and the medical team brought up the rear. We were the doctor. plus 4 medical students (l an American B17 pilot) and 3 or 4 helpers. At the time we left there were some 80 kriegies with colds, flu or diarrhoea or who were not well enough to march under the conditions. Because he spoke German, Geoff Cornish and one med student were left in charge of them.

Our cart contained as much medical supplies as possible, plus invalid comfort parcels and our own food and personal items. It was at the end of the column so that any sick marchers could drop out of the column and be picked up as we passed. Our supply of aspirins and APC went down very rapidly.

Guards marched on each side of the column at about 20-25 metre intervals. The SBO walked up and down the column to keep an eye on things and the Oberst (Camp Commandant at Belarta) drove his car with the adjutant periodically up and down the column. We marched about 20km the first day, starting at about 4 am and passing the main Stalag Luft 3 camp (which seemed empty) on the way.

We were housed for the night in the barns of a farm run by Poles who gave the medical team a room to use for sick parade. which took about an hour. We were allowed to sleep in the room and they fed us thick soup. Next morning, we held an early sick parade (0700 hours) mainly of aching legs, blisters and frostbite. We only had one slice of bread for breakfast and had to march 15km that day but we were able to hitch our cart to a horse drawn wagon going our way. We arrived at Gross Selten at 1530 at a large farm run by Germans and they allowed the medics to use an out house which had a boiler room where we were able to sleep. We shared this out house with a Stabs Arzt (doctor) of a German SS panzer division & his staff. They gave us food which they cooked and we talked with them as best we could in bits of English, French and German but the only common language was "dog Latin"! Still, they also had some Schnapps! War is hell!

We stayed there a second day and, being very tired, enjoyed this. The Germans organised 2 sick carts for the next stage of our journey which was to Birkenstadt some 14km further and we arrived again at about 1600 with the light fading at a farm worked by a Russian family, who gave us (the medical team) their own sleeping quarters for a sick room and a bed room. Since the temperature outside was -10 deg C we appreciated this as well as the borsch they fed us that night and the hot coffee and bread we had next morning. We stayed there a second day and had a very heavy sick parade that day. Blisters and 'flu' were rife and the SBO managed to persuade the German commandant to take a few of the sicker POWs to the local army hospital at Muskau. The temperature rose and the snow melted off the road for our next move. Now the kriegies had to carry everything but we found moving our carts easier, especially as the weary guards liked to put their heavy packs on our carts and we made them help with pulling of course. All this time the 400 or so US Army Air Corps who had shared Belaria with us had been our companions but now the Germans separated us and moved them

off in a different direction. We gave them 3 cheers as they pulled out and they went off singing songs like Dixie and McNamara's Band. The Germans just could not understand it; after all they had tried for months to sow dissension subtly. The Oberst just shrugged his shoulders, got into his car and drove off.

The guards shepherded by Feldwebel Glemnitz trudged on and many of them were worse than we. We travelled about 15km that day and later in the morning, the SBO as part of his routine came back to the tail and of the column. The Oberst turned up again (with Hauptman Werner) and he was furious. Wemer, who was not noted for his humor, was chuckling. The Germans had done a head count as we left that morning and now the Oberst found he had "lost" 10 POWs but 16 guards had gone 'wek'

We had started off later that day and it was almost dark when we arrived at our destination but we were allocated a farm outhouse again, fortunately with lights. Sick parade included many with 'rheumatism' for which we only had aspirin and lin. meth sal. But it seemed to work. Blisters were common. We slept in 3 feet of hay that night and German bread and cheese was issued. Next day we walked 7km to Spremberg railway junction, by now out of pre-war Poland and in Germany. We were assembled in 2 large sheds where we found kriegies from East Camp. We were given barley soup and a bread ration. A train arrived with the inevitable cattle trucks and we were taken to Luckenwalde, south-east of Berlin. There, Twee and I took a few really sick men to what turned out to be a British Revier or medical post manned by Irishmen while the rest of the medical team went to Luckenwalde camp.

The whole trip from Belaria had taken 8 days and we had marched over 80km and the rest by rail.

Luckenwalde

We arrived here mid February and the next 3 months to the end of the European conflict were the most uncomfortable and frustrating. Our numbers had been swollen by the addition of POWs from East Camp at Spremberg. We had also been joined there by a New Zealand doctor from East Camp and 2 medical students, one English and one Rhodesian. This was a help as we hardly ever saw any German medical staff and got virtually no supplies from them. We were housed in tall buildings without any subdivision into rooms but with an ablutions and toilet area at one end. Beds were in 3 tier bunks and the medical staff manipulated these in one corner of the building so as to make a square with one half of one side missing to allow access. One side was 8 two-tier beds earmarked as hospital beds for patients. All personal effects, food store and medical supplies had to be contained in this area, though storage became less of a problem as food ran out and so did medical supplies.

The Luftwaffe from Belaria were replaced by Wehrmacht members in this camp, which was virtually international. As well as the Air Forces contingent were US GI's, plus Dutch, Belgian and Polish civilians, all separated by barbed wire on an international basis.

We received no Red Cross parcels in spite of repeated assurances from the Germans that we would. Since the German ration was very meager we were supposed to be receiving the same ration a German garrison troops; this was partly depressing, since it meant hunger, but partly encouraging as it was due to lack of transport by rail and road owing to bombing and indicated clearly that the Germans' ability to resist much longer was severely diminished. News about the progress of the war was erratic, though a radio was held in the camp that was able to receive the BBC but it had to be constantly dismantled and moved to avoid the Germans finding it. Nevertheless, by the end of March, morale was low and lack of food was a major factor.

In a sense, this was an advantage from a medical point of view. As our medical resources ran out there was less that we could do, other than reassurance to support those with upper respiratory tract infections and diarrhoea etc, but the kriegies were pre-occupied with blotting out their hunger and other ailments lost some of their impact, I suspect.

Later, in April, a German Panzer division was making a final stand in the area and moved around the camp as it retreated from the Russians. The commander sent word that any prisoners found within their lines would be shot on sight. This discouraged any escapes. He also sent a team to supervise surrender of any weapons in the hands of prisoners. These were dumped in a deep water-filled pit just outside our section of the camp and a surprising number turned up. One night, a JU 88 flew low over the camp firing at the advancing Russians and since it was 1 am this caused quite a panic.

In mid-April, the Germans suddenly told us to pack up and marched us to the rail yard. Before we got there, while we were in a deep cutting luckily, we were halted. A force of USAAC Martin Marauder bombers bombed the rail yards, out of the blue ending any prospective trip. We were marched back

to camp, but not before some very resourceful POWs had managed to get to a damaged rail engine and removed its battery and carried it back to camp with them. This was very useful as a source of power for the radio and improved reception so that we had regular news bulletins. This had a major effect in improving our morale and a thoroughly depressing one for the Germans. They dared not interfere at this stage as their radio did not give anything like the real picture of the war and the smart ones could see it was nearly over because they listened to our news readers who passed news about camp.

Then early one morning in May, we woke to find there was not a German guard anywhere. About 3 or 4 hours later, a huge Russian tank rolled into the camp. The kriegies cheered them hilariously, climbing up the wire fences to wave. The Russians simply drove the tanks along some of the fences, flattening them. For about an hour after that, the medical staff were as busy as anything dealing with cuts and abrasions from injured POWs.

Homecoming

Now our troubles really started. The Russians did not have any food. But they instituted a Town Major who gave us written authority to commandeer food supplies; we had 2 Russian speakers among our lot who were loaned small trucks with drivers to go and collect vegetables and eggs from surrounding farms. But to get to the farms they had to cross bridges over canals guarded by Russians who had been told not to let anybody over bridges on pain of death. Since they couldn't read, they refused passage to our fearless food gatherers. Eventually this was overcome and we were able to have some nourishment while the Russians compiled a huge inventory of prisoners, which they insisted on having before we were moved on. One of my friends was talking to a GI during this period and the GI said they were lousy. "Funny", said Gordon, "I've never seen a louse". Whereon the Yank searched through his shirt and found one! Finally, the Russians loaded us on trucks drove us down autobahns, slipping off road through burning for est to avoid destroyed bridges, the drivers stopping to slake their thirst by sucking petrol up from the tanks till we got to the American sector. The Yanks gave us showers, deloused us with DDT powder sprays, fed us with pork chops, potatoes, peas, angel cake, pineapple and cream sauce all on one plate and gave us a bed. Next day they flew us to Brussels where the Canadians gave us a shower, DDTd us again, gave us food and a bed (after we had 'done' Brussels) and handed us over to the Royal Air Force the next day. They put us in Lancasters and flew us to England.

Back to square one.

The Stephenson Decalogue

1. WAR IS HELL
2. IT IS IMPORTANT TO BE ON THE W1NNING SIDE.
3. IT IS EVEN MORE IMPORTANT TO BE ON THE MEDICAL TEAM.
4. DISCIPLINE NOT ONLY KEEPS UP MORALE: IT COMMANDS A MEASURE OF RESPECT AND WARDS OFF THE DANGER OF BRUTALITY BY THE ENEMY.
5. A SENSE OF HUMOUR IS VITAL.
6. HUNGER DESTROYS MORALE QUICKER THAN ANYTHING.
7. ADAPTABILITY IS SINE QUA NON.
8. THERE ARE NO FAT PEOPLE IN PRISON CAMP.
9. HOMOSEXUALITY IS NOT ESSENTIAL.
10. NOR ARE ANTIBIOTICS.

References

1. Stephenson EH. Experiences of a prisoner of war: World War 2 in Germany. *Aust Mil Med* 2000; 9(I). 425·1 .
2. AVM Stephenson AO OBE (Retd.). presently undertakes contract work for the Defence Health Service Branch.

This article has been contributed by GPCAPT Geoffrey Robinson, highlighting the amazing career of Professor Norton Duckmanton whose experiences gained in service of the RAAF, have changed the practice of dentistry for thousands of graduates of the Sydney Dental Hospital.

A Life of Service to Veterans

Originally published: 13 May 2014 by Sydney Local Health District, NSW Government

As an 18-year-old, when Norton Duckmanton watched his friend fatally crash a Mosquito dive bomber during Pacific War training he couldn't have known that the moment would define his 66-year career in dentistry.

Though he was unable to cry at the military funeral, years later Professor Duckmanton suffered an episode that he would later understand to be a symptom of Post-Traumatic Stress Disorder.

"When I began treating Vietnam Veterans I saw how different they were to our other patients so I decided I should finally learn something about the condition," he said.

"Looking back, I think the treatment of patients with PTSD was the area that I was able to make the greatest contribution, at a time no one else saw fit to do so."

"No one understood that these people were completely different and had special needs, including their dental health needs."

Having presented multiple research papers on caring for patients with special considerations such as PTSD, and treating hundreds of Diggers throughout his career, the Professor has reluctantly decided to retire from his post at Sydney Dental Hospital at the age of 88.

Arriving at Sydney Dental Hospital for the first time in 1948 as a first year student, Professor Duckmanton graduated in 1951 and began work as a registrar.

Since then the Professor has trained countless students at Sydney Dental Hospital and the North Western University Dental School in Chicago during two visits as a visiting professor in prosthodontics .

In 2007 he was awarded the medal in the in the general division of the Order of Australia for services to veterans and their families, and to dentistry as a practitioner and educator in the area of prosthodontics.

He has been fortunate enough to witness revolutionary changes in the field of dentistry throughout his career including the introduction of water fluoridation and the modernisation of dental implants.

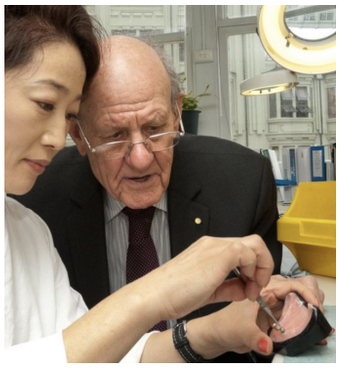
"Before fluoridation there was an enormous demand to repair the ravages of dental caries, so we've almost worked ourselves out of a job."

"Today we're training people for jobs that haven't even been invented yet involving the milling of metals by computer control and 3D printing. It's all very exciting."

Professor Duckmanton said the Sydney Dental Hospital had been a fascinating second home over the years, and that he had many friends there, including his son, Peter, a professor of endodontics.

While he said he wouldn't miss the responsibility of patient in retirement, Professor Duckmanton has vowed to stay on in an honorary teaching role for as long as he could.

"If you like what you're doing, it's not work," he said. "I see myself as being singularly fortunate and privileged having been in the right place at the right time all my life."



(Top) Professor Norton Duckmanton with technician Won Kim, and (below) Norton in his army years (second from the right).

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