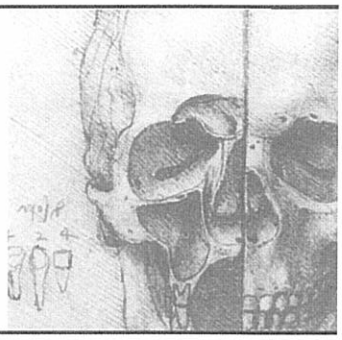
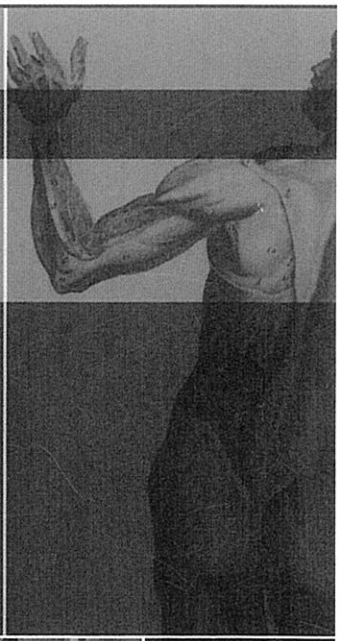
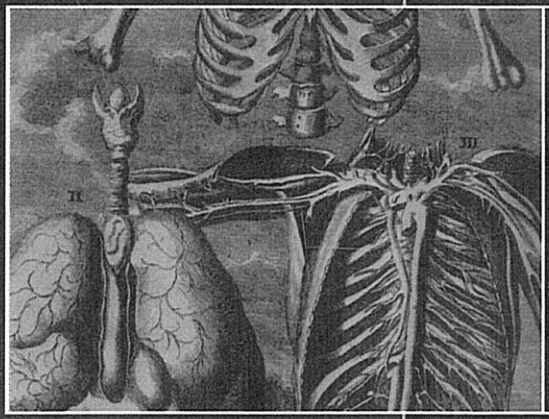
AUSTRALIAN MILITARY MEDICINE



MARCH 2003 – Volume 12 – Number 1





AUSTRALIAN MILITARY MEDICINE ASSOCIATION

STATEMENT OF OBJECTIVES

The Australian 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.

EDITORIAL

And Anthrax...

ANOTHER INTERESTING FORTNIGHT has come to an end, as our ADF ships and personnel pre-deploy to the Gulf. One of the key issues over this period has been the Australian Defence Forces Anthrax Vaccination Program. While generally not controversial, the Anthrax Vaccination Program has reached that status with help from the media and the ADF decision to repatriate those ADF members who refuse to have the vaccine.

One recurring issue has been the safety of the vaccine, which although licensed in the United States and the United Kingdom, is not licensed in Australia. Despite comments to the contrary, this vaccine has been the subject of detailed scrutiny by both Defence and independent reviewers. In particular, the United States Institute of Medicine (IOM), in their publication "The Anthrax Vaccine: Is it Safe? Does it work?"1, has carried out an extensive review of both the efficacy and safety research. They conclude that it is an effective vaccine against anthrax, including inhalational anthrax, and that there are no life-threatening or permanently disabling immediate onset adverse events. They also conclude that there is no evidence of elevated risks of later-onset health effects, including to the reproductive system.1

Dr Nass, in a letter to Emergency Medicine News2 in July 2002, raises the spectre of Gulf War Syndrome, claiming that anthrax vaccination has been linked to Gulf War Syndrome in 5 studies. Her claims were based on a number of prevalence and cross-sectional surveys, which showed some association of multiple vaccines, including plague and anthrax, with reporting of long term symptoms only3-5. In fact, the evidence, while still weak, was far stronger for the number of vaccines given rather than the specific vaccine.3-5 There was no direct claim of an anthrax vaccine link to Gulf War Syndrome by any of the studies and at least one did not even look at anthrax as a risk factor.6 In contrast, the IOM reviewed a large number of epidemiological studies and found no support for these assertions1. A good reminder to go back to the original articles, particularly when sensational claims are made.

You will have noticed that there was not a third issue in 2002. Delays with processing and printing meant that the second issue was very late getting out and the decision was made to move to the first issue of 2003 to bring things back on track. To that end, the first issue of 2003 will be an interesting one. Serendipitously, our Ten Years On article is a review on anthrax, an issue that, like the spore, will not die. We also have excellent articles on aeromedical evacuation, thermobaric munitions, Defence health care, health policy development and Reserve humanitarian support. We also have the second and final part in the historical review of Tudor Naval Medicine. Our peer review process continues apace and I thank all those reviewers who have volunteered. Finally, I have a willing volunteer as Assistant Editor, Lieutenant Nial Wheate, who you will hear more from in coming issues.

Andy Robertson

REFERENCES

1. Institute of Medicine. *The Anthrax Vaccine*. Washington: National Academy Press; 2002.
2. Nass M. Anthrax vaccine not safe and effective. *Emergency Med News 2002*; 24: 44.
3. Unwin C, et al. *Health of UK servicemen who served in the Persian Gulf War*. Lancet 1999; 353:169-178.
4. Shumm WR, et al. *Self-reported changes in subjective health and anthrax vaccination as reported by over 900 Gulf War veterans.* Psychol Reports 2002; 90: 639-653.
5. Steele L. Prevalence and patterns of Gulf War illness in Kansas veterans: Association of symptoms with characteristics of person, place and time of military service. *Am J Epidemiol 2000*; 152: 991-1001.
6. Cherry N, et al. Health and exposures of Gulf War veterans. Part II: The relation of health to exposure. *Occup Environ Med 2001*; 58:299-306.

PRESIDENT'S MESSAGE

ONE OF THE SADDEST THINGS IN OUR WORLD is the human being's propensity to be unable to resolve its differences without resorting to violence. We see it at an individual level, at a group level and at a societal level. At a societal level it's called war.

Over the centuries there has only really been one consistently positive outcome from armed conflict, and that has been the advancement of medicine. War forces military health professionals to innovate and work quickly to resolve problems. Australian Military Medicine and our Conferences have often highlighted this historical context, and I recall papers and articles that have explored the influence of war on surgery, infection control and medical evacuation. These, and other health challenges, have been materially advanced by the medical heroes (usually unsung) of war.

Well, it seems my predictions in the last Journal have proved (almost) to be right. And so once again it seems that we will be going to war. It will be a war that brings with it the potential for biological or chemical warfare. One for which we have had to revamp our ability to combat these forms of warfare.

What happens next will be watched with interest. I suspect that by the time you read this the decision will already have been taken. If we go to war, there will no doubt be lessons for us all. We can only hope that these lessons will be properly learned to protect us in the future, and perhaps significant leaps forward will be able to be made in some of these areas.

Perhaps one of the potentially difficult consequences of this conflict, if it occurs, may b the impact of the, at present, clear division in public opinion in relation to whether or not Australian troops should be involved.

This, sadly, raises the prospect of a repeat of the experience of Vietnam veterans, with the clear and demonstrable impact that has been suffered by many by not being able to trust that the Australian public, undeniably, has supported what they have being doing. If Australian troops end up in a conflict that is not widely supported, it will be a clear challenge for the Defence community to ensure that, firstly, the reception when they return is not like that our Vietnam veterans received and, if it is, that the necessary support mechanisms are put in place to prevent the kinds of health problems that we have seen previously.

HUMAN ERROR IN MEDICINE

I recently had the privilege of attending a workshop on Human Error in Medicine.

What a revolution it would be if we could see a culture of safety that mirrors that in aviation. A culture that accepts that humans do make errors, and recognise that, almost invariably, those errors are unintentional and created by factors that are usually outside the influence of the individual. A culture that looks at errors as an opportunity to learn and to put in place measures to prevent similar errors that happen in the future.

In my service in the Navy, I have seen the stark contrast in cultures that existed (and I suspect still does) between the aviation and seaman worlds.

Military aviation has a strong safety culture. Any and every incident that involves a potential or actual safety issue is fully reported and fully investigated. Humans error is dealt with on the basis that there are factors that underlie them – fatigue, lack of training or experience, and so on.

Several years ago, the Navy introduced a safety incident reporting system. From my contact with that system (and I stress that it may have changed), the one thing that never got reported was any incident of unsafe navigation. Why? – well, every ship captain took the view that admitting to such an incident would result in a black mark in his performance report.

My perception is that the health care system is still sitting with the ship driver's. One of the challenges of all health professionals, and one that in my view can be led by the Defence Health Service, is changing that culture.

DRUGS IN SPORT

It was fascinating to see that it took only 48 hours for a certain cricketer to leap up as the most mentioned name in the news media in a one-week period.

It is equally interesting to observe that, while the sportsman was being banned for using a substance that could mask a performance-enhancing drug, the Defence scientific community is exploring the use of performance enhancing drugs in combat.

CONFERENCE 2003

It's a long time between drinks, but this year's conference is coming around the corner.

To be held in Adelaide on 17 to 19 October, I'm sure it will be every bit as good as previous conferences.

The last time we were in Adelaide, the Defence Health Services were involved in major operational deployments, and this affected attendance. Despite this, the conference was a great success, no doubt due to the involvement of our members and the great atmosphere that can be enjoyed in Adelaide. We hope that our attendance will not be affected by current operations, and I have no doubt that Adelaide will treat us as well as it did last time.

So I challenge you all to sit down and write that paper now. Details of the conference can be found elsewhere in this journal.

Until October.

Russ Schedlich

Invitation to Submit Abstracts

The 2003 Australian Military Medicine Conference Committee invites you to submit abstracts for oral and poster presentations on Military Health related topics at the 12th Annual Conference.

17–19 October 2003

Oral Presentations

Twenty minutes presentation time, including five minutes for question & answers to be held at the conclusion of each presentation or session (time permitting).

Poster Presentations

Poster sessions may be suitable for people who have not completed research, or are seeking information from other interested parties. Participants will be required to prepare a display which will be mounted on a display panel in the Trade/Refreshments area

Topics may include, but not be limited to:-

• Aeromedical Evacuation	• Aviation Medicine	• Tropical Medicine
• Military Medical History	• Military Nursing	• Operational Health Support
• Medical Logistics	• Medico-Legal Aspects	• Medical Fitness
• Battlefield Surgery	• Underwater Medicine	• Clinical Practice
• Occupational Health & Safety	• Human Factors	• Disaster Health
• Military Dentistry	• Field Hygiene	• Medical Equipment

Deadline 1700 EST – 30th June 2003

For more information visit: www.amma.asn.au

ORIGINAL ARTICLES

Secondary Medical Services for Israel Defence Forces Career Personnel in an Age of National Compulsory Health Insurance[1]

A. Goldberg, J. S. Pliskin, Y. Peterburg[2]

ABSTRACT

Background: IN JANUARY 1995, the Compulsory Health Insurance Law came into effect in Israel. The legislation was an egalitarian move that set forth that every resident of the State of Israel was entitled to health services according to a uniform "basket of service". Individuals were also given the right to choose the identity of their service-provider. The law, however, does not apply to the Israel Defence Forces (IDF) soldiers. Soldiers receive health services from the IDF Medical Corps or civilian agents acting on its behalf. Career personnel pay a "health tax" to the state but they do not have the privilege of choosing their service provider as do other members of their family in accordance with the law.

Objectives: The objectives of the paper were:

- to investigate the subjective attitudes of career personnel towards the medical service they received from the medical corps or from outpatient clinics of contracted civilian hospitals; and
- to determine if career personnel are "discriminated" against with the medical services they receive.

Methods: The study population included 273 women and men serving as career personnel. The participants were chosen from among career personnel referred to three clinics who constitute 60% of all referrals for secondary medical services. All participants filled a questionnaire, which was analysed using SPSS.

Results: Results indicate that career personnel view themselves as less healthy than their conscript counterparts. There are bigger gaps between the expectations and actual treatment, especially with respect to sick leave and medical restrictions. There is also a lack of continuity of care and follow-up.

Conclusions: The law discriminates against career personnel compared to other residents of the state, and the consequences are registered in lack of satisfaction among career personnel with the medical services they receive – even through these services are provided by highly professional physicians and cover a very broad basket of services.

Keywords: Israel Defence Forces (IDF), Secondary care, Satisfaction, Career personnel

1. Goldberg A, Pliskin JS, Peterburg Y. Secondary Medical Services for Israel Defence Forces career personnel in an age of National Compulsory Health Insurance. *Aust Mil Med 2003;* 12(1): 4-8.
2. Avishay Goldberg Ph.D, is a Lecturer and researcher in the Department of Health System Management and in the Department of Emergency Medicine, Ben-Gurion University of the Negev. Israel, and a Colonel (retired), IDF Medical Corps. Joseph S. Pliskin, Ph.D, is Professor, Department of Health System Management, and Professor, Department of Industrial Engineering and Management, Ben-Gurion University of the Negev, Israel and Professor, Department of Health Policy and Management, Harvard School of Public Health. Yitzhak Peterburg M.D, Ph.D is Director General of Clalit Health Services, Ben-Gurion University of the Negev, a Lecturer and researcher in the Department of Health system Management, and a Lieutenant Colonel (retired) IDF Medical Corps.

INTRODUCTION

Since January 1995, a compulsory health insurance law has been in force in the State of Israel that stipulates that every resident of the state is entitled to health services by law, according to a fixed and defined 'basket of services'. Individuals have the right to choose the particular system (i.e. sick fund) that will provide them with medical services from among the service providers working with the sick fund of their choice.

The Compulsory Health Insurance Law does not encompass Israel Defence Forces (IDF) service personnel, including career personnel. Clause 55 of the law stipulates that medical services for IDF solders will be given by the Medical Corps or by an agent acting on behalf of the Medical Corps[1]. The IDF Medical Corps operates a broad spectrum of medical services for all IDF personnel, draftees and career personnel, including secondary medical care. The secondary medical system operates in two configurations. The first is a comprehensive system, comprised of army personnel in all medical specialties, which is located in a military camp and operates under the full responsibility of the army. The second is based on the hospital-based civilian secondary medical system, which operates under a contractual relationship between the Ministries of Defence and Health, and the public medical system designed to provide secondary medical services and hospitalisation within the framework of government-owned hospitals[2-4]. IDF personnel are referred to specialists by the primary medical system that serves as a gatekeeper to secondary medicine[5,6]. It is a system designed to serve its clients. The client is part of the system and the client's character, subjective perceptions and satisfaction carry significant weight in the process of formulation and actualisation of health policy.

Career personnel are a special population. They are mobilised into the army like any soldier; they receive a medical profile and serve until their contract with the army is not renewed or they reach retirement at age 45 (whichever comes first). Unlike draftees who may change posts a few times in the course of two to four years of conscript service, in the course of twenty years service and more, career personnel serve in a host of posts. Each unit has its own family medicine setup, often tied to a different secondary medicine service-provider than the individual's previous post; moreover, at secondary medicine clinics, reserve-duty physicians usually change frequently[7]. In the course of their service, career personnel develop medical problems – some tied to the nature of their occupation, some the product of age common to civilians and persons in the military. Career personnel who remain in the army to the age of retirement leave the service at an age when they face the 'ramifications' of the natural aging process and have time to devote themselves more to personal needs, including a growing awareness of medical problems. The health professionals to whom army retirees turn are neither familiar with the client and the patient's past history, nor are they well acquainted with the military milieu where such patients have spent the better part of their lives[8]. Families of career personnel receive their medical care from the civilian system and upon demobilisation, career personnel generally join the medical framework where their family has been receiving their medical services all along[7,9].

With the passage of the Compulsory Health Insurance Law in 1994 – a law that provides universal access to basic medical care in exchange for payment of a 'health tax' by all employed persons - IDF career personnel have been transformed into an 'underprivileged population' compared to their families and the public-at-large[10,11]. They are discriminated against in terms of freedom to choose their own service-provider, the right to ongoing care and care at the hands of a family doctor familiar with the medical history of the entire family over time (the same physician whom the demobilised career person will ultimately turn to in most cases upon leaving the army)[8]. Ironically, career personnel are required to pay part of the 'health tax' out-of-pocket although they do not enjoy all the benefits granted to civilians[12].

This study examines the subjective perspectives of IDF career personnel vis-à-vis the secondary medical services they receive from the IDF Medical Corps and civilian agents acting on its behalf.

METHODS

The sample population was chosen from among IDF career personnel receiving secondary medical services from both medical service configurations: one, a military specialist clinic; the other, out-patient clinics of hospitals working under contract with the military system. The military clinics chosen for this study focus on sec-

ondary medical care at the large centre for specialist medicine located in the centre of the country and outpatient clinics at three hospitals working under contract with the military. The participants were chosen from among career personnel, who constitute 60% of all referrals for secondary medical services, referred to three clinics that have a clear impact on the performance of career personnel in the field, in training units and rear units: orthopedics, dermatology and ophthalmology. The clinics were chosen in consultation with key decision-makers in the Medical Corps: the Chief Medical Officer, the commander of the Central Command clinic and the commander of the specialists' clinic complex. The commanders of the three specialist clinics chosen to represent the entire medical system - orthopedics, dermatology and ophthalmology – were also consulted.

The sample population was comprised of 273 men and women career personnel, 82.4% males and 17.6% females. Statistics show that overall, 87.4% of career personnel turned to IDF-operated specialists' clinics and 12.6% turned to hospital outpatient clinics. The ratio among draftees turning to the two clinics was different – 60% to IDF-operated specialists' clinics and 40% to civilian hospital outpatient clinics. The preference for IDF-operated clinics among career personnel was clearly evident.

A questionnaire was drawn up. Career personnel were requested to fill out the questionnaire distributed after exiting the doctor's office. On-site staff at the clinics, familiar with the questionnaires, were responsible for distribution to respondents, answering any questions and collection of the completed questionnaires.

During the three weeks during which the sample population was chosen, 20 career personnel were interviewed following completion of the questionnaires. The subjects expressed great satisfaction with the survey, said they understood the questions and had taken their responses in all seriousness. The researchers maintained daily contact with those administering the questionnaires at the clinics and the commanders of the military clinics. At the end of the sampling process, all the questionnaires were collected – 273 among career personnel visiting military clinics and 30 among personnel visiting hospital outpatient clinics. Responses were processed using the SPSS program for creating cross tabs between various components and between the two medical service settings – military and civilian. Gaps in expectations between the reason for the visit, the treatment expected and the treatment received were measured. Three questions concerning expectations were asked: What was the reason for the visit? What was the care the client expected to receive? What treatment did the respondent actually receive?

RESULTS

19.5% of the sample population belonged to field units, 5.7% to rear units and 73% to training units. Among draftees, most belonged to rear units but it should be noted that in the IDF most of the training units are rear units. Career personnel suffer more from chronic illnesses than draftees; 17% of the career personnel reported that they suffer from chronic ailments. 78.6% of the career personnel described their health status as "excellent" or "good", while 3.1% describe their health status as "not good" or "bad". Career personnel describe their health status as poorer than did draftees in a prior study.

Table 1: Care that career personnel expect to receive compared to care they actually received

Gap between reason for visit and desired care	Care Actually Received	Desired Care	Reason for Visit	Type of Medical Service
- Respondent wanted less	25.2%	29.6%	42.8%	Doctor's Examination
= Care Equal to Respondent's Expectations	35.2%	32.7%	34.6%	Continued Treatment /Check-up
+ Respondent Wanted more	0.6%	2.5%	0.6%	Medical Restrictions
+ Respondent Wanted more	7.5%	2.5%	0.6%	Sick Leave
+ Respondent Wanted more	1.3%	5%	3.1%	Referral To Medical Evaluation Committee

Examination of the gaps among career personnel between the reason for coming to the clinic and the results of the visit indicated that the majority cited that the reason for coming to the secondary medicine clinics was the need for a doctor's examination or continued care, but that the respondents received more than they expected. Only two-thirds of those who came for a doctor's examination cited that the reason for their visit was a doctor's examination (see Table 1). On the other hand, with regard to medical restrictions, sick leave and medical review boards, the respondents expected more than what they stated as the reason for their visit to the clinic on the questionnaire (Table 1). Similar behaviour was found among draftees in a prior study. For example, 0.6% of the career personnel cited that they had come to the clinic in order to receive a medical restriction. An identical percentage received medical restrictions, but a larger percentage (2.5%) said they expected to receive medical restrictions although they had not cited this as the reason for their visit.

Career personnel that visited medical installations (civilian and military) were also queried about the accessibility of the clinics, availability of service, organisation of the facility and its environment, and attitudes of service staff. There was no difference found between civilian and military clinics. Only 28.9% rated the accessibility and availability of service as "very good". 49% rated the organisation of the facility and its environment as "very good'. 36.4% ranked the attitude of service staff as polite, and that the doctors devoted sufficient time to the client and provided adequate explanations. Here as well, measurements of degree of satisfaction among career personnel with overall service and secondary medical care were lower than among draftees. The majority of draftees described the environment in the various medical facilities in positive terms. Half the draftees had cited that the facilities were accessible and available and more than two-thirds cited the politeness of various service staff.

Career personnel viewed themselves as less healthy than draftees and, against the backdrop of greater options afforded their families and the absence of ongoing care or follow-up encountered for themselves, respondents demonstrated gaps between their expectations from medical care and the actual care received[10].

DISCUSSION

The Compulsory Health Insurance Law does not ignore career personnel and stipulates that the law will not apply to those serving in the army; all army personnel shall receive health services from the Medical Corps or from agents acting on its behalf. Overnight, with passage of the law, the status of career personnel changed significantly in regard to receipt of health services. Career personnel, unlike draftees, pay the universal health tax paid by all workers through National Insurance but they cannot enjoy freedom of choice in choosing their health service provider as other members of their family can. Career personnel receive medical services from a single vendor whose character is different from parallel health service providers in the civilian health system. For example, a person in the army can find him or herself receiving medical care for an eye problem each time from a different ophthalmologist due to the high turnover among reservists staffing the military clinics. Although, from an objective standpoint, members of the military enjoy medical care that is among the best and the most advanced in Israel, career personnel are not satisfied with the secondary medical services they receive from the IDF, whether provided within the framework of military clinics or at hospital out-patient clinics, against the backdrop of the Compulsory Health Insurance Law. In both cases, there are significant gaps between the care career personnel wanted to receive and the care they receive in practice. They would prefer to receive all their care from the civilian service where they feel they could exercise more control over the services they receive.

REFERENCES

1. *State of Israel. Compulsory State Health Insurance Law, 1994*, Rishumot 1469, June 26, 1994.
2. Gross R, Yuval D, Yafe Y, Burma V., *Role of the Primary Physician in Israel: Preliminary Findings from a National Survey*. Brookdale Institute:1994.

3. Report of the State Commission for Inquiry into the Functionality and Efficiency of the Health System in Israel, headed by Judge Shoshana Natanyahu, *Vol. 1, Majority Opinion, 1990.*
4. Report of the State Commission for Inquiry into the Functionality and Efficiency of the Health System in Israel, headed by Judge Shoshana Natanyahu, *Vol. 2, Minority Opinion, 1990.*
5. Glazer Y. *Optimal incentives in the health system.* Health Policy Unit, Gertner Institute; 1993 Dec.
6. Gross R, Benbassat J, Nirel N, Cohen M. *Quality of care in scattered primary clinics.* Brookdale Institute; 1992; 82-93.
7. Danon Prof.Y, IDF Chief Medical Officer (1987-1991). Personal interview.
8. Shiloach E, Gril A. *A New Method for Medical Service for Career Personnel is Needed.* Tzevet 1998: 24-26.
9. Weiner M, IDF Chief Medical Officer (1994 – 1997). Personal Interview.
10. Kristol R. *Medical Service for Career Personnel.* Tzevet 1997: 12.
11. Michaeli Prof. D, IDF Chief Medical Officer (1975-1979). Personal Interview.
12. Chief Medical Officer Command. *Medical Services for Career Personnel.* IDF: 1995.

ORIGINAL ARTICLES

Thermobaric Munitions and their Medical Effects[1]

David Andrew[2]

ABSTRACT

THERMOBARIC MUNITIONS ARE those munitions that, by design, produce more heat and overpressure than conventional explosives by exploding a vapour in the blast zone. Their main use initially was in airborne fuel-air explosive bombs. Whilst the United States has concentrated on airborne weapons, Russia has produced thermobaric weapons and warheads, from airborne bombs to rifle grenades.

Their medical effect is principally primary blast and they affect organs where there is a tissue interface of varying densities, such as the lungs, bowel and inner ear. Damage manifests itself in the severity and onset of occurrence, depending on distance from the blast and orientation of the victim, and can be diagnosed by simple investigative techniques.

This paper was originally written as a presentation for the Australian Military Medical Association Annual Conference in October 2001 and was displayed as a poster at the Defence Health Symposium in 2002.

INTRODUCTION

Thermobaric munitions are those weapons that are designed to produce enhanced temperature and pressure compared to conventional explosives and are often referred to as fuel-air explosives (FAEs). They produce a much greater incidence of primary blast injury than conventional explosives and this is their main mechanism of injury.

This first part of this paper will discuss the history, design, and weapons employed to deliver thermobaric munitions. The second will discuss the medical effects and treatment, concentrating on the sequelae of primary blast injury.

HISTORY

Thermobaric munitions can be traced back to the German Army of World War II who used a six barrelled 15cm Nebelwerfer rocket launcher on the Eastern Front. One of the launcher's loadings incorporated propane gas. The first five rounds carried the gas and the sixth was the detonating round. This gas was released when the round landed, mixed with the air to produce an explosive vapour, and was then detonated by the final round[1]. At a later stage, larger calibre rockets contained conventional explosive inside a thin wall to give an increased blast effect. Following these early attempts, little was developed until the 1960's.

The United States started using FAEs during the Vietnam War[2] and had various loadings of aircraft bombs. The Soviet Union started using thermobaric weapons during their war in Afghanistan and the Russia has used them more recently in Chechnya. Russia has loadings in aircraft bombs and rockets, and ground launched rockets down to a man portable size[3].

DESIGN

Thermobaric munitions work by initially dispersing an aerosol cloud of gas, liquid or finely powdered explosive. Known fuels such as ethylene oxide, propylene oxide[1], ammonium nitrate[2], and powdered PETN[4] have been reported. This cloud flows around objects and into cavities and structures. It may penetrate small openings, such as openings in buildings, bunkers and engine bays of armoured vehicles[1], before being ignited.

The result is a plasma cloud that reaches temperatures of between 2,500-3000° Celsius[4]. The time that the cloud burns is slow compared to conventional high explosive and aluminium powder is added to some explosives to enhance this[5]. It is this longer duration or dwell time of the blast wave or overpressure, which can be up to 73 kg/cm² (1000 lb/sq in),

1. Andrew D. Thermobaric munitions and their medical effects. *Aust Mil Med 2003*; 12(1):9-12.
2. Sergeant David Andrew BN MRNCA RN RAAOC, 5 Camellia Court Toowoomba QLD 4350, (davidandtheresa@bigpond.com) is posted to 7CSSB at Enoggera and works for Queensland Health as a Registered Nurse.

that is the main reason for its lethal and destructive effects[4]. The injuries are more severe in confined spaces as the blast wave reflects back and forth, submitting the target to multiple insults.

One should not forget the burning effects of the explosion either, as it consumes all oxygen in the area and the resultant vacuum pulls loose objects into this void[4]. If the explosive does not detonate, the affected area can be highly toxic, as one of the common fuels used is ethylene oxide. Ethylene oxide is a gas used as a sterilising agent in the health industry and is extremely toxic if inhaled[6]. This may lead to accusations of the use of chemical warfare if this situation were to occur.

WEAPONS

The employment of thermobaric munitions starts at the soldiers' level with Russia using RPO-A Shmel disposable rocket launchers and thermobaric rockets for the RPG-7 family of weapons. The effectiveness of the Shmel round has been compared to the 122mm artillery round, especially against buildings[7]. There is also a 42mm hand held magazine grenade launcher[8].

Next in line are the anti tank rocket launchers that are either wire or radio guided and include the Shturm, Ataka, Fagot and Kornet systems. The Shturm and Ataka can also be helicopter launched[3].

The USSR has been fond of multiple ground-launched rocket systems since Stalin and this tradition has continued since. There are Uragan and Buratino 220mm launcher systems and the 300mm Smerch rocket systems[3].

Airborne weapons include the 80mm S-8D and the 122mm S-13D unguided rockets, 500 kg ODAB-500PM bomb, the KAB-500kr-OD television guided bomb and the ODS-OD BLU dispenser with BKF ODS-OD-cluster bomblets[3].

The United States has the CBU-55 cluster bomb[2], the BLU 96 guided glide bomb[1] and, the granddaddy of them all, the BLU 82[9]. The BLU 82 is a high blast bomb launched on a pallet from the back of an USAF MC-130H Combat Talon (Hercules) Aircraft and it was first used in the Vietnam War[2]. It contains 5715 kg of a jellied slurry explosive called GSX, a mixture of ammonium nitrate, aluminium powder and polystyrene soap, and produces an overpressure of 1000 lb/sq in. It is reported to be able to clear a 3 mile path through a minefield[9]. It is often launched in pairs giving these weapons the title of the 'Blues Brothers'[10].

In the war against terror in Afghanistan, the United States used a new generation of thermobaric bombs, the BLU-118/B11. It is the BLU-109 2000lb penetrating warhead with a thermobaric filling of 560lb, and can be fitted with a laser guidance or glide bomb kit[12]. A warhead for the Hellfire missile has also been developed[13].

PRIMARY BLAST INJURY MEDICAL EFFECTS

Primary blast injuries are those caused by a blast pressure wave or blast wave[14,15,16], which emanates from the epicentre of the explosion at a pressure of thousands of pounds per square inch[14]. Normal atmospheric pressure in comparison is 14.7 pounds per square inch[17]. Gailbraith[18], describes this phenomenon as a combination of shock wave[15], and dynamic overpressure, and damage is dependent on the pressure and length of its duration[16]. This causes disruption of air spaces in the body and shear forces where there is an air /tissue interface or where tissues of different densities connect[16,19]. It predominantly affects the pulmonary, cardiovascular, auditory, gastrointestinal, and central nervous systems.

General treatment is based on airway, breathing and circulation assessment, in conjunction with oxygen therapy. Prophylactic antibiotics[16] and tetanus vaccine[14] should be considered. Follow up should be done at a medical facility.

PULMONARY SYSTEM

Mellor et al.[16] describe the mechanism of injury, when the blast wave hits, as dependant on the bodies alignment to wave and when it passes through tissue interfaces. This sets up a stress wave that causes damage, particularly at the lobes, along the ribs on the side of the blast, mediastinum and alveoli, and, if low velocity, may rupture the more rigid bronchioles. The alveoli, if ruptured, leak fluid into the lungs, which could lead to complete filling or 'shock lung' or 'blast lung'[18]. Other complications of alveolar rupture are arterial gas embolisms[14,19], pneumothorax and/or haemothorax[14]. Mellor et al[16] note that respiratory distress related to a non-fatal injury may not present for several hours, with Armstrong[14] suggesting 48 hours.

Treatment first requires assessment by continuous auscultation, to detect abnormalities, as well as continual assessment of rate and depth of respiration and pulse oximetery to assess pulmonary function[14].

Mellor et al.[16] add serial blood gases and erect chest radiographs, and oxygen therapy and chest drain if a pneumothorax or haemothorax is present.

CARDIOVASCULAR SYSTEM

The cardiovascular system may be affected by an air embolus in the heart or coronary arteries[16,18,] or by diffuse damage to the myocardium[16]. Sharpnack et al. describe a post mortem sheep's heart with extensive epi and sub-epicardiac haemorrhage after exposure of a live sheep to blast overpressure.

Symptomatic treatment is required and detection is the key. Auscultation for bruits, indicating vascular leakage, and for faint heart tones, indicating cardiac tamponade, and monitoring ECG changes, that might indicate heart damage, is required[14].

AUDITORY SYSTEM

Gailbraith[18] describes auditory damage in stages. In mild damage, the tympanic membrane is ruptured[15, 19,] with mild hearing loss. In more severe cases, the membrane could disintegrate and the ossicles dislocate, requiring surgical intervention. In the worst cases, the inner ear is damaged producing 'sensorineural' deafness and disabling pain, nausea and balance problems. Mellor et al.[16] concur and add that dislocation of the ossicles may occur without tympanic rupture, the organ of corti is most at risk and labyrinthine rupture will lead to dizziness and vertigo. Investigating a patient's ears will detect damage[14,18]. In mild cases, the ears should heal naturally but, in more severe cases, surgery is required[18].

GASTROINTESTINAL SYSTEM.

Mellor et al.[16], feel gastro-intestinal damage is probably more common than is diagnosed and occurs when stress waves cross pockets of gas trapped in the bowel. Bruising occurs in mild cases[15] but, in severe cases, perforation may occur, particularly at the ileocaecal junction[16]. Monitoring for peritonitis, due to leaking bowel contents[18], and haemorrhaging is required[14]. This can occur up to 14 days after the injury[18]. Treatment for the perforations and haemorrhage is surgery[18], and close monitoring is required to detect these injuries and their complications[14].

CENTRAL NERVOUS SYSTEM

The main injury to the central nervous system from primary blast is a cerebral arterial gas embolism and this may cause an unexplained deterioration in function or death[18]. Sharpnack et al[20] describe a post mortem sheep's brain exposed to blast overpressure showing air emboli within the basilar artery and posterior portion of the arterial circle of the brain.

Hyperbaric oxygen therapy is the main treatment and 100 percent oxygen if this is not available[21]. Detection is by closely monitoring the patient's level of consciousness and peripheral nerve function[14]. In these cases, air may be seen in the retinal vessels[16].

CONCLUSION

Thermobaric weapons have been around for over sixty years and their main damaging effect is through primary blast injury. The mechanism and treatments for primary blast injury have been described, and it can be seen that a patient may have more than one system involved[18].

REFERENCES

1 Bellamy RF, Zajtchuk R. *The weapons of conventional warfare.* In: Bellamy RF, Zajtchuk R, editors. *Conventional warfare: ballistic, blast and burn injuries.* Washington D.C: Office of the Surgeon General; 1991. p. 1-52.

2. Stockholm International Peace Research Institute. *Anti-personnel weapons.* London: The Institute; 1978.

3. Human Rights Watch. Backgrounder on Russian fuel air explosives ("vacuum bombs"). http://www.hrw.org/press/2000/02/chech0215b.htm Accessed 2002.

4. Grau LW, Smith TA. *Crushing victory: fuel-air explosives and Grosny 2000.* Fort Leavenworth: Foreign Military Studies Office; 2000.

5. Akhavan J. *The chemistry of explosives.* Cambridge: Royal Society of Chemistry; 1998.

6. Sax NR, Lewis RJ. *Dangerous properties of industrial materials.* 7th ed. New York: Van Nostrand Reinhold; 1987.

7. Gander T. RPO-*A Schmel rocket infantry flame thrower.* Janes Infantry Weapons; 2000.

8. Dudka V, Volkov B. Russia: Formation of a concept of weapons for combat on urbanized terrain. *Military Parade 2001;* 3:68-72.

9. BLU 82. *Jane's Air Launched Weapons;* 2000 (36).

10. Andrew MK. Personal correspondence. 2001.

11. Global Security.org 2002. BLU-118/B *Thermobaric weapon.* http://www.globalsecurity.org/military/systems/munitions/blu-1118.htm. Accessed 2002
12. Gai D. *New weapons prove successful in Nevada test.* http://defence-data.com/current/page13964.html. Accessed 2002.
13. Isby DC. Thermobaric warhead for hellfire successfully tested. *Jane's Missiles and Rockets; 2002.*
14. Armstrong JF. *Bombs and other blasts.* RN 1998; 61(11):26.
15. Crane J. Violence associated with civil disturbance In: Mason JK, Purdue BN, editors. *The pathology of trauma.* 3rd ed. London: Arnold; 2000; pp. 75-88.
16. Mellor SG, Dodd KT, Harmon JW, Cooper GJ. Ballistic and other implications of blast. In Ryan JM, Rich NM, Dale R.F, Morgans BT ,Cooper GJ, editors. *Ballistic trauma: clinical relevance in peace and war.* London: Arnold; 1997, pp. 47-59.
17. Anderson K. editor. *Mosby's medical, nursing, & allied health dictionary.* 5th ed. St. Louis: Mosby-Year Book Inc; 1995.
18. Gailbraith KA. *Blast and projectile injuries.* Lecture notes for No.5 Wound Ballistics Course 22-26 January 1996, Cranfield University: Shrivenham (England); 1996.
19. Hiss J, Kahana T. Modern war wounds. Mason JK, Purdue BN, editors. T*he pathology of trauma.* 3rd ed. London: Arnold; 2000.
20. Sharpnack DD, Johnson A J, Phillips YY. The pathology of primary blast injury. In Bellamy RF, Zajtchuk R, editors. *Conventional warfare: ballistic, blast and burn injuries.* Washington DC: Office of the Surgeon General; 1991, pp. 271-295.
21. Moon RE. Treatment of decompression sickness and arterial gas embolism. In Bove AA, Davis JC. editors. *Bove and Davis' Diving Medicine.* 3rd ed. Philadelphia: W. B. Saunders Company; 1997, pp. 184-204.

A View From The Front

The Expanded Role of the Dental Officer[1]

Wing Commander Greg Mahoney[2]

ABSTRACT

THE EFFICIENT USE OF DEPLOYED PERSONNEL in the Area of Operations (AO) is essential. This often requires personnel to perform tasks beyond the scope of their normal duties. Medical personnel are not immune to this. This paper explores the expanded role for the operational Dental Officer. It does this by:

1. determining the criteria under which the expanded role should work, primarily the Dental Officers ability and availability to perform certain tasks;
2. exploring the lessons of history;
3. examining the training and maintenance of skills necessary to perform the expanded role and, finally,
4. discussing the problems associated with an expanded role.

INTRODUCTION

Before any examination of the expanded role of the Dental Officer in the Australian Defence Force (ADF), it first had to be established whether there was a primary role for the Dental Officer in the Area of Operations.[1] This primary role of field dentistry was established by addressing the following questions:

1. What are the dental casualty rates in the Area of Operations under various conditions?
2. Do these rates affect combat effectiveness/ do toothaches affect work performance?
3. Are these rates high enough and their treatment time consuming enough to warrant an operational role for the dentist?

It was only then that the possibility of an expanded role was examined.

The findings of the Mahoney study[1] were that:

1. Dental emergencies occur at such a rate so as to cause a reduction in the effectiveness of the deployed force.
2. Deployed dental assets can return those casualties back to duty, thus maintaining operational capability and minimising the requirement for evacuation.

Therefore, there is a definite operational role for the dental team. This operational role is important to preserve combat power and as a force multiplier

THE EXPANDED ROLE CRITERIA

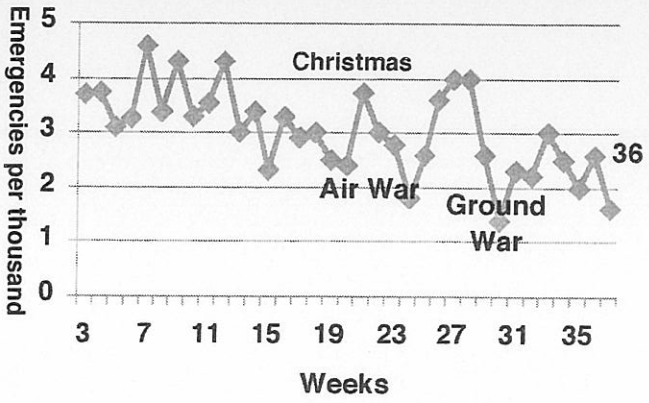
The tasks determined for an expanded role for the Dental Officer would have to meet certain criteria in order to be viable to the ADF. Firstly, the Dental Officer must have the time to perform these tasks. If the primary role meant that there was no time to perform additional task, then any thought of an expanded role would be nonsensical. Secondly, the Dental Officer should in the proximity to take advantage of the opportunities of the operational situation (i.e. deployed with assets these tasks relate to). Thirdly, and most importantly, the operational Dental Officer must have the ability to perform these tasks, gained either through their undergraduate or postgraduate training. These skills must be easily maintained and, in the case of postgraduate qualification, easily gained.

THE AVAILABILITY

If the dentist is unavailable to perform their allotted task due to the pressures of their primary role, then an expanded role is not feasible. Deutsch and Simecek[2], found in Operation Desert Shield/Storm that, just prior to the action starting, there was a dramatic increase in the rate of dental emergencies and that this figure dramatically decreased at the start of the air and then the ground war. Whilst commanders may believe that troops are ready for battle if they have had there

1. Mahoney RG. The expanded role of the Dental Officer *Aust Mil Med 2003*; 12(1): 13-18.
2. Wing Commander Greg Mahoney, B.D.Sc., Grad.Dip.Clin.Dent., M.Sc.(Dent), is a specialist dental officer in the RAAFSR

routine check up, the troops' major concern is that chronic toothache or broken filling that has annoyed them. This is not unexpected as the troops and their commanders would want to make sure that before action was to start they would be as fit and as prepared as possible. The graph below dramatically illustrates this.



Graph 1. The Weekly Rate of Dental Emergencies during Operation Desert Shield/Storm for US Marines[2]

The Dental Officers' primary role of field dentistry reduces just prior to, and at the start of, an offensive. This creates an opportunity to utilise the skills of the Dental Officer in other areas.

THE OPPORTUNITY

Due to their primary role, Dental Officers are regularly deployed with medical assets, from level 2 health care facilities upward.

THE ABILITY

If refresher courses and updates were constantly required, then there would be an adverse impact on the overall dental efficiency within the ADF. The training should not place an onerous burden on the training establishments and resources of the ADF. In considering this, the fact that the vast majority of Dental Officers entering the ADF come from the undergraduate program and there is a high turnover of dental officers once their return of service is completed (usually 3-4 years) should be remembered. The initially military training of Dental Officers takes over[3] months and, if there were a similar requirement to then become operational, there would be little time in those early years after graduation for the dental officer to become proficient as a dentist.

The end result of having an onerous and overambitious training program would be that either so few Dental Officers would be operationally ready that the Dental Corps could not met the ADF requirements or that the only dentists gaining operational status would become the senior dental officers.

LESSONS OF HISTORY

Perhaps the best measure of ADF Dental Officers' ability to preform these expanded tasks is to review what has happened in the past.

Falklands' War

During the Falklands' War in 1982, the principle hospital support for the British forces was HMS Canberra. The dentists on board HMS Canberra, from the outset, were recognised as a resource, which could be used for triage. As a consequence, they were incorporated into the medical team and practiced their drills on the voyage to the Falklands, where it was reported that patients required constant reassessment and updating by experienced well-trained teams. The system worked well and that the success in employing resuscitation trained dental officers in the triage role was particularly worth noting.

Additionally, the surgical centres at Ajax Bay and Fitzroy Settlement had experienced Dental Officers trained in triage and resuscitation techniques. These roles were filled 'with great success' by dental officers drawn from the Royal Navy and the Royal Army Dental Corps.[3-5]

Beirut

On 23 October 1983, at the US Marine encampment around Beirut International Airport, a terrorist bomb packed into a yellow Mercedes truck exploded in the middle of the ground floor of the barracks where 350 marines were quartered. The explosion killed the on shore medical officer and either killed or badly wounded the remaining 12 corpsmen of the medical team.

The initial on-site efforts at the disaster site were co-ordinated by the two dental officers and a preventive medical officer of the US Navy. A flight surgeon and six corpsmen from USS Iwa Jima and a medical officer from USS Virginia quickly supplemented them. It was these personnel who organised the field first aid station and battalion aid station. It was also this group who performed the first level of triage.[6-7]

Darwin

In the ADF, there have been incidences where the dental officer has supplied vital life saving support when the medical support could not. The best documented of these incidences was on a Royal Australian Navy (RAN) ship off the coast of Darwin. At 1800 hrs on 22 Oct 1985, HMAS STALWART was in company with HMAS PERTH 210 miles (336 km) north east of Darwin bound for Surabaya (Indonesia). At the time, the Fleet Medical Officer (FMO) and the ship's Sea King helicopter were in Darwin having medevaced a sailor with suspected appendicitis.

During a cleaning and transfer operation involving the ship's bilge, a number of seamen became seriously affected by hydrogen sulphide gas. The senior medical assistant performed the immediate treatment and resuscitation. Shortly after, the medical officer from HMAS PERTH arrived. The dental officer had been unaware of the incident and 'fortuitously' came into the sickbay at 1935 hrs. At the Board of Inquiry, the dental officer's actions were described 'on arrival in the sickbay (he) instilled a sense of order and set about recording casualty details'. His presence was indeed fortuitous as the number of casualties steadily increased after the first medivac. At about 2240 hrs, the FMO returned with the Sea King helicopter. It was at this time that the assessment was made that the most affected seamen (4) required aeromedical evacuation to Darwin. On the flight to Darwin were the two medical officers and a number of the sickbay staff. In the end 59 sailors required medivac to Darwin and 3 sailors (all in the first flight) died. The Dental Officer's action during the incident received a commendation.[8]

Other Military Emergencies

In another attack on a U.S. base, Ramstein Air Base in Germany was bombed. The dental clinic was nearby but the base medical clinic and the Army Hospital were not. The air base dental staff had been trained in wartime medical skills and the clinic had medical supplies for such an emergency. The dental staff provided the immediate casualty care and triage, maintained airways, controlled haemorrhages, started IV fluids and prepared patients for transport. Lives were saved and suffering eased by the dental personnel.

During an air show at Kaiserslatern, Germany, two jets from the Italian Air Force demonstration team collided in midair near the centre of the show spreading fuel and debris over spectators. The medical and dental staff on site provided the immediate treatment of the casualties. "Had the trained dental personnel not been available, the total response force would have been inadequate and additional lives may have been lost."

Haney[9] states that U.S. Navy dental personnel have successfully responded in times of need as demonstrated by action on the U.S.S. Nimitz and U.S.S. Stark. Dental personnel were also involved the emergency treatment of Pentagon staff on 11 September 2001 following the terrorist air crash.

The lessons of history, therefore, are that:

1. Medical personnel are not immune to death and injury.
2. Medical personnel in busy times are not always available to deal with unexpected circumstances.
3. The dentist and the dental team can assist with medical care with little additional training but this training has to be part of overall disaster-preparedness training.

ADF HEALTH DIRECTIVE 416

The ADF has a Health Directive (HD) on the role of the Dental Officer and reference is made in this to their expanded role. Within these roles, there are a number of well established tasks dental officers and the medical community are familiar with. These include:

Maxillofacial Surgery. The ability of the Dental Officer to perform some basic maxillofacial surgery is essential. The Dental Officer must be able to surgically remove teeth and perform some basic fixation of fractured maxilla and mandibles so that the patient can be transported to more definitive care, as 25% of dental casualties are maxillofacial or oral surgery in origin.[10] On the whole, these skills are gained during their undergraduate years.

Forensic Dentistry. The forensic identification of the deceased has long been recognised as an important part of the Dental Officer's role. Often it is the dental examination alone that can identify victims in war and mass disasters. Dental forensics provide a cost effective method for identifying the dead.[11,12]

Health Administration. Senior Dental Officers have long history of providing administrative support in the ADF Health Service.

Decontamination of Nuclear, Biological and Chemical (NBC) Casualties. Dental Officers and Medical Officers both have undergone the same basic training in order to be effective decontamination officers.

Other health services taskings as dictated by the operational situations. Perhaps the more contentious expanded roles for the dental officers are those that require some postgraduate training and experience. "Depending on the operational circumstances and the qualifications, experience, and training of individual dental officers, those dental officers not required in the previously described duties will be given emergency tasking in such roles as": (HPD 416.)

1. Assisting surgeons in general surgery. All Dental Officers are trained in their undergraduate course in basic surgical and operating theatre skills, such as anatomy, surgery, suturing, and debridement. Therefore, the Dental Officer would be more than capable in providing this support, particularly where trained medical staff are not always available (sickness, injury, away on other duties, etc). Recently, during deployments to Op Belisi, dental officers were used in this capacity as they were the best person to assist as it was difficult to staff the positions with appropriately trained personnel.
2. Assisting anaesthetists, enabling them to manage multiple operations concurrently. The Graduate Diploma in Clinical Dentistry in Pain Control and Sedation has been undertaken by a number of members of the ADF and it has equipped those Dental Officers with the necessary skills to assist anaesthetists. Hence, the continuing involvement of the ADF in this type of course is essential, as not only is its course content very closely aligned to the ADF's needs but it also provides the successful participant with postgraduate recognition. Those skills gained include cannulation, intubation, Advanced Cardiac Life Support, drug administration, and recovery management.
3. Early Management of Severe Trauma (EMST). Interestingly, EMST is included in the operational role of the Dental Officer in the ADF. If the level of EMST training and qualifications are to the Royal Australian College of Surgeons standard, then it is perhaps unworkable for all operational Dental Officers to be trained and maintained to this standard (it is certainly not beyond the Dental Officer's capabilities). The commitment required for this type of training is time consuming and there is an additional problem of the maintenance of skills. This is not to say that Dental Officer should not be trained in EMST. There would be some post graduate trained Dental Officers whose training and work would lend itself to gaining and maintaining an EMST standard fairly easily. More appropriately, I believe, is that all Dental Officers could be trained to provide advanced life support. Dental Officers, during the initial training in the ADF, have demonstrated that they can be trained in advanced life support and upper airway management. This is also supported by the experience with the dentists involved in the Graduate Diploma in Clinical Dentistry. It is believed that because the dentist's familiarity with the upper airway in their everyday professional life that they are undaunted with its management (Private Communication - Dr D Stewart 2002).

The concept of the expanded role for the Operational Dental Officer is not new; the HD416 has been around since 1996. What is perhaps new is the realisation that the operational Dental Officer can fulfil those roles and that we now have the appropriate training in place. This needs to recognised for a number of reasons; firstly, with the market testing of health services in the ADF and the privatisation of services, efficient use of the available resources is paramount. Secondly, we need to maintain our capability to deal with emergency and operational crises.

TRAINING

Much has been made of this expanded role but, as laid down by the criteria, these skills must be easily gained and maintained. To this end, a number of strategies may be employed to improve the situation.

A New Undergraduate Syllabus. Preference should be given to graduates from universities whose undergraduate training best suit the needs of the ADF. While all universities in Australia have roughly the same course outlines, variations do occur and it would be prudent to inform these universities of our requirements as an employer of graduates and undergraduates.

Adopt the existing Grad Dip Clin Dent (Pain Control and Sedation). At present, most of the fully trained operational Dental Officers have completed this

course and most have done it at their own expense or with the goodwill of the course coordinator. As the graduates of this course are actively using their gained skills on graduation, this course has a distinct advantage in that skills are maintained. Alternatively, the existing Grad Dip could be modified to the exact requirements of the ADF. While the present syllabus is closely aligned to the ADF requirements, some modifications could be made (for example, simulation of battle conditions and injuries). The main advantage of the present Grad Dip is that it is a recognised civilian qualification and skills could be maintained by the Dental officer's everyday practice. These skills are subject to reassessment and reaccreditation.

Look at ADF requirements and include training in initial officer training. To a degree this is already being done; however, there are problems with the course content being and the need to return the graduate back to their posting.

PROBLEMS

As with any role in the medical fraternity within the ADF, there are problems in retention, maintenance of skills and marketing.

Retention. Skills gained through the ADF are often time consuming and expensive. In order to be competent in the roles of the Operational Dental Officer, some time would have to be spent in the ADF and an even longer time would be required to gain value from the Dental Officer's training. Retention of skilled members in the ADF is not confined to Dental Officers. This is a force wide problem and its solution is beyond the scope of this paper.

Maintenance of Skills. This is one of the essential criteria for the expanded roles. Those with the Grad Dip Clin Dent find that their skills can be maintained through their everyday practice, while others would need to have sessions in operating theatres where the maintenance of their skills could be formalised and recorded.

Spreading the word. Perhaps the greatest obstacle to the expanded role of the dental officer is the ignorance of the general health sector to the Dental Officer's abilities. Additionally, it must be said that the Dental Officers have their part to play by believing in their own abilities and communicating this to the wider health community, and recognising that they are part of the health team.

CONCLUSION

The Dental Officer that is capable of fulfiling their expanded role would be a valuable addition to the Operational Health Team. The Falklands' and U.S. experience has shown that it is vital that they train and integrate with the medical team and our own experience has shown that they have the ability to preform their expanded role. As it is imperative that the ADF and its health services maximise the available resources at hand, an expanded role for the operational Dental Officer is essential.

ACKNOWLEDGEMENTS

I wish to acknowledge the valuable contributions made by Dr Douglas Stewart, Head of Dept, Oral Medical and Surgical Sciences, Westmead Hospital and Course Coordinator of the Graduate Diploma of Clinical Dentistry in pain control and sedation. Additionally, Captain Timothy Maddern (RAN) and Lt.Col. Steven Curry from ADF Health Services Branch have been most helpful with suggestions and contributions.

REFERENCES

1. Mahoney GD. *Role of the Operational Dental Officer in the Australian Defence Force.* Master of Science Thesis (Dentistry). University of Sydney. (2001).
2. Deutsch WM, Simecek JW. Dental emergencies among Marines in Operation Desert Storm/Shield. *Mil Med 1996*;161(10): 621.
3. Ryan JM. *The Falklands War – Triage.* Ann R Coll Surg Engl 1984; 66 (3):195-6.
4. Williams JG. 'Canberra' (Role Conversion) *Triage and Resuscitation.* Trans Med Soc Lond 1982-1984; 99-100: 81-5.
5. Batty GC. Changes in the care of battle casualties: Lessons learned from the Falklands Campaign. *Mil Med 1999*;164(5):336-40.
6. Frykberg ER, Hutton PM, Balzer RH. Disaster in Beirut: An application of mass casualty principles. *Mil Med 1987*: 152(11): 563-566.
7. Scott BA, Fletcher JR, Pulliam MW, Harris RD. *The Beirut terrorist bombing.* Neurosurg 1986:18(1): 107-110.

8. Royal Australian Naval Board of Inquiry. HMAS STALWART: *Toxic Gas Accident 22 Oct 1985*. Summary of the Board of Inquiry Report.
9. Morlang WM. *Dentistry's vital role in Disaster Preparedness*. Calif Dent Assoc J 1996 May: 63-66.
10. Mahoney GD, Coombs M. A literature review of Dental Casualty Rates. *Mil Med 2000*: 166 (10).
11. Gillespie TH, et al. Dental identification of remains from the 23 October 1983 bombing of the U.S. Marine Headquarters, Beirut, Lebanon. *Mil Med 1985*; 150(12): 635-39.
12. Kessler HP, Pemble CW: Forensic dental identification of casualties during Operation Desert Storm. *Mil Med 1993*: 158 (6): 359-62.

A View From The Front

Proper use of expertise in the Australian Defence Force Reserves (Medical Branch) – Goodwill Hunting[1]

Roy G. Beran[2]

BACKGROUND

The Australian Defence Force (ADF) Reserves (Medical Branch) has recently received publicity in unexpected quarters such as the North Shore Times Newspaper[1]. The article recognised the recruitment of specialists to the Royal Australian Navy Reserves Medical Branch and gave a brief background to their direct entry officers course with special recognition of CMDR Mike Garvan for his initiative in recruiting these doctors. Similar recognition was provided in Navy News [2] and the emphasis was on the acquisition of new blood and wider resources for the ADF Medical Branch.

The Reserve Forces Medical Branch include consultants in a variety of disciplines, not all of which are routinely required at the site of conflict in a combat scenario. It follows that those specialists deemed less important to the frontline troops may also be deemed as less valuable members of the Medical Branch. It may be perceived that their skills are less important and, indeed, this may well be true at a time of conflagration and war.

Over recent times Australia, as a progressive and prosperous nation within the Pacific Rim, has attracted very negative publicity in its handling of asylum seekers. It must be said that its attitudes and management of such asylum seekers has not varied greatly from other nations and was recently emulated and adopted by the United Kingdom, recognising that imitation represents the greatest form of flattery and acceptance. It would follow that while people offer lip service to denigrate the Government's position; the reality is that it does not stand alone in its approach, although this approach provides for antipathy and despair.

With the commissioning of HMAS MANOORA and HMAS KANIMBLA, there is the capacity to reverse this image, provide real and tangible medical care and offer goodwill missions far exceeding the costs. The paper which follows gives an alternate perspective to the use of ADF Reserve Medical Officers who could provide exemplary medical care and facility to a region of the world devoid of tertiary medical care in a wide variety of disciplines. Although this paper will adopt the perspective of the discipline of its author, it does so strictly to give an example of what is possible.

PROPOSITION

The Medical Branch of the ADF Defence Health Service is strictly identified as non-combatant, with an ethical and moral obligation to provide health care for those in need. Throughout the history of the ADF, the Medical Branch has provided such high quality care, not only to its own members but also to prisoners-of-war and wounded from both sides of a conflict. The provision of high quality medical care transcends borders and boundaries, cultures and bigotry. It allows the expression of humanity and offers dignity to those who might otherwise be deprived of a quality of existence.

The uniform of the ADF need not be restricted to a definition of might and force, although the Australian soldier is recognised as amongst the best in the world, as has been exemplified by President Bush's recent commentary regarding his desire for the SASR to be part of any assault team in his forward planning concerning Iraq. The ADF uniform can also be a symbol of humanity, of dignity, of caring and the Medical Branch has the capacity to provide such care in the name of the ADF, in uniform and as ambassadors for Australia.

Within the disciplines of the neurosciences, the Reserves include neurologists, neurosurgeons, psychiatrists and radiologists, who could function as a team. Contact amongst colleagues has already indicated a willingness of serving officers in each of these disciplines to consider deployment on a humanitarian basis, providing care within their area of expertise. The hospital ships, or for that matter, deployable med-

1. Beran RG. Proper use of expertise in the Australian Defence Force Reserves (Medical Branch) – Goodwill Hunting. *Aust Mil Med 2003;* 12(1): 19-21.
2. LCDR Roy G. Beran RANR is a specialist neurologist in the RAN Reserve.

ical centres, could have installed portable CT scanning equipment, pathology laboratories with rudimentary facilities and a team such as that outlined above in the neurosciences, could act as a mobile deployable unit. This unit could be used at pre-determined times to areas within our region of the Pacific where such services are totally lacking. Consultants could easily be absent from their private practices for periods of two weeks at a time. Areas to which they were to be deployed could be advised months in advance so that all conditions within their area of expertise could be accumulated and the care concentrated over the two week deployment. This would mean that neurologists would work as neurophysicians rather than generalists, thereby using a far higher degree of expertise and knowledge within their specific area of training. Similarly neurosurgeons would work in their area of expertise rather than as general surgeons and again be far more productive and offer far greater facility to the area. Psychiatrists and radiologists could likewise provide much greater facility and, were it possible to have an EEG service, then conditions such as epilepsy and the like could likewise be far better treated and the differentiation between psychological disturbance and epileptic condition could be easier to differentiate.

Such deployment would provide real incentive for sub-speciality experts in such areas as the neurosciences but also in cardio-respiratory illnesses, gastroenterological and hepatological complaints and other sub-speciality areas so that those with these specialised skills would feel a valued and integral part of the ADF Reserve Medical Branch.

DISCUSSION

This approach has been adopted by a variety of teaching hospitals, particularly in such areas as Fiji and New Guinea, but has been provided as a private service. Such private facilities fail to achieve the recognition that a similar service provided by the ADF would attract by way of goodwill for Australia. Australia is indeed the "lucky country" within our sector of the Pacific with standards of healthcare comparable to anywhere in the world. It is the utilisation of these services by uniformed officers that would place the ADF in a position of enhanced respect for performing a humanitarian role in times of peace. The idea that specialists could give of their time, in uniform, and could return to our nation and our neighbours the benefits of their years of training, is something that would be most rewarding for the doctors concerned and would attract great goodwill recognition for the country.

There are often said to be more reasons for not doing something than for doing it, and this appears to be the perennial argument against using the Medical Branch in the operations as suggested above. The argument given is that HMAS MANOORA and HMAS KANIMBLA, while designed to provide the facility of a hospital ship, are far more valuable a resource for troop carrying and deployment purpose than as a medical facility.

The cost involved in the deployment of a team of experts such as that outlined above is deemed to be prohibitive. Such argument ignores the fact that each of the specialists involved in the deployment, at least within the neurosciences, would be paid far less within their ADF rank pay structure than they would ever earn within their private practices. In discussions with colleagues, I found not one consultant who was not prepared to make that sacrifice to deliver service that he or she felt was utilising their expertise to its maximum potential. For such specialists, not only within the neurosciences but in the other areas already identified, the salaries provided within the ADF do not come close to covering the costs of running a practice, the ongoing overheads and the burden that is placed on colleagues to cover what needs to be covered during a deployment. Nevertheless, the concept of providing a service for those denied any facility within the area of speciality is reward enough to justify the personal cost for each member of the team.

The ADF is already recognised as one of the best fighting teams in the world. The pictures from East Timor, however, demonstrated that the soldiers, sailors and air-men and women were seen as friends of the locals, providing care and shelter and a willing hand to rebuild a shattered nation, not yet in its infancy. It is argued that the goodwill generated from medical teams providing care in the name of the ADF, in specialist areas such as the neurosciences which are not yet available to these nations, would provide a far greater humanitarian picture with the potential of saving life and enhancing its quality.

Having overcome the hurdle that might be presented by the personal costs faced by each member of an expert specialist team, particularly those who have to leave private practice with ongoing overheads and

commitments, the only requirement left to make this vision a reality is for there to be sufficient courage on the part of administration and commitment by politicians to reach out and be prepared to underwrite services designed specifically to realise benefits, both tangible and intangible, the magnitude of which are incalculable in terms of humanity.

CONCLUSION

There could be no better use of the specialised expertise within the ADF Reserves (Medical Branch) than to open the window of opportunity to our near neighbours to realise the benefits of specialised healthcare provided by men and women in the proud uniform of our wonderful country. The very definition of Defence is to save life and what better way to save life than to offer those less fortunate than us the opportunity for expert medical care, which of itself is a perfect opportunity for "goodwill hunting".

REFERENCES

1. Doctors delight in Navy training. *North Shore Times 2002* Jun 28: 10.
2. Davis G. Doctors not reserved – Pilot program results in recruits. *Navy News 2002* Jun 10: 10.

REVIEW ARTICLES

Aeromedical Evacuation Issues in East Timor – The Implications for Deployment[1]

S.P. Cook and S.R. Frederickson[2]

ABSTRACT

THE AUSTRALIAN DEFENCE FORCE (ADF) has had an Aeromedical Evacuation (AME) capability in Dili, East Timor supporting INTERFET and UNTAET since September 1999. This unit, the Aeromedical Staging Facility (ASF), has provided excellent experience for military medical staff and has also provided excellent support to both the peace enforcing mission and the East Timorese people.

Analysis of cases from May 2000 to January 2002 demonstrates that ADF medical officers may not be adequately trained in various aspects of medicine to provide appropriate care to both ADF and civilian personnel and may not meet civilian standards. ADF Personnel are required to do several courses prior to deployment but often are deployed without these prerequisites. Permanent Medical Officers are also often not as clinically competent as their civilian counterparts.

The issue of competency and training needs to be addressed for current and future operations where the increased incidence of small scale Operations Other Than War has reduced the ADF health support capability. The paucity of combat casualties since Vietnam has decreased the requirement for a first class highly specialised aeromedical retrieval and resuscitation team.

INTRODUCTION

Aeromedical retrieval is an important component of ADF operations and doctrine[1]. It allows rapid evacuation of casualties from the site of injury to a definitive resuscitation centre and, after stabilisation, transfer to a higher level of care if required. Aeromedical retrieval was first used effectively in Korea and extensively utilised in Vietnam where casualties could be transferred from site of wounding to definitive surgical and resuscitation centre in 20 minutes[2].

The ADF has had an AME capability in Dili, East Timor since the start of INTERFET, which has continued on in support of the United Nations Peace Enforcing Mission UNTAET. Currently the ASF consists of dedicated 6 people AME unit with two medical officers, two nursing officers and two medical assistants. The unit is located at the Heliport in Dili and provides fixed wing (FWAME) and rotary wing (RWAME) AME for United Nations members and East Timorese locals. The ADF has a second AME capability in East Timor with the Australian Regular Army AME team in Moleana facilitated by 5 Aviation Regiment. This unit will not be discussed in this article.

This article will analyse the statistics of AME missions performed by the ASF team over a 21 month period and will aim to identify the capabilities required to perform these roles.

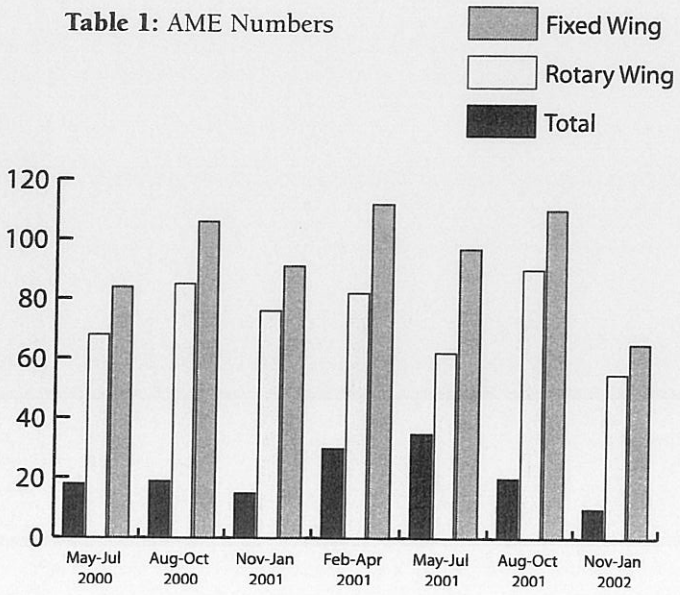
ANALYSIS OF MISSION DATA

AME Numbers

The ASF performed a total of 666 AME in the period between May 2000 and January 2002 (Table 1). Of these evacuations, 139 were fixed wing and 527 were rotary wing. On average, the ASF was undertaking 32 AME's a month with 7 fixed wing and 25 rotary wing. It is interesting that the current fixed wing AME course is four weeks long, not including the Operational Health Support (OHS) phase of the course, and the rotary wing course is one week long. The bulk of ADF AME's are now rotary wing and not fixed wing.

1. Cook SP, Fredericksen SR. Aeromedical Evacuation Issues in East Timor – The Implications for Deployment. *Aust Mil Med 2003*; 12(1): 22-26.
2. SQNLDR S.P. Cook is the Base Medical Services Officer at 3 Combat Support Hospital RAAF Richmond. SQNLDR S.R. Fredericksen is the Senior Medical Officer at RAAF Edinburgh. Correspondence to SQNLDR S.P. Cook at 3 Combat Support Hospital, RAAF Richmond, NSW. Email: steven.cook@defence.gov.au

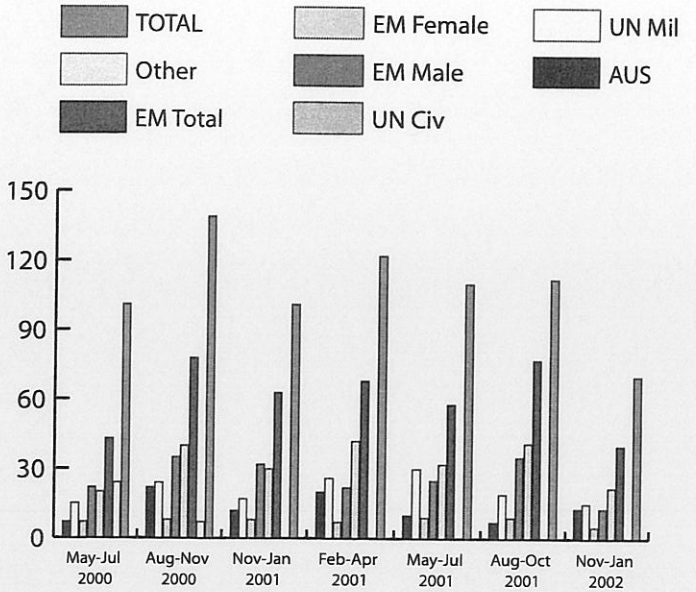
Table 1: AME Numbers



AME Patient Numbers

The patients retrieved by the ASF staff included ADF Personnel, other UN military personnel, UN civilians and East Timorese. Of the 757 patients retrieved by the ASF, 88 were ADF personnel compared with 431 East Timorese. 31 patients were not reported (Table 2). The East Timorese civilians were the most unwell patients with the prerequisite for transfer being only priority one or two cases. The East Timorese transferred were also of varied age including 17% of cases being aged 16 years or under.

Table 2: AME Patient Breakdown

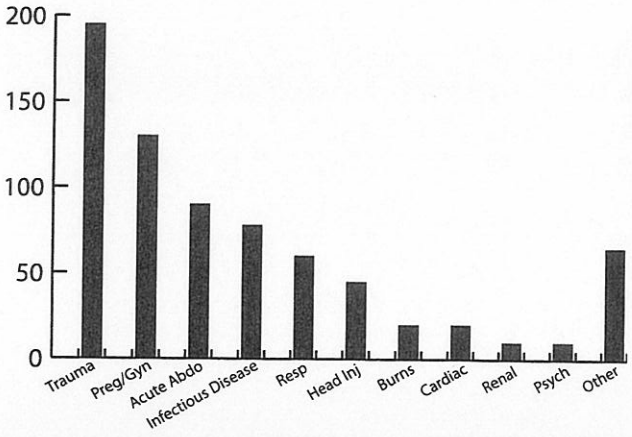


Illness Categories

Trauma with head injury was the bulk of the clinical cases with a total of 240 cases (45 head injuries) out of the 720 cases recorded (Table 3). These cases included a variety of presentations such as crocodile attack, machete injury, falls, motor vehicle accidents and gunshot wounds. Obstetric and gynaecological problems were also prevalent with 132 cases. This figure includes the 3 deliveries occurring in-flight. Other obstetric cases included antepartum haemorrhage, obstructed labour, twin pregnancies, arm or leg presentations and postpartum haemorrhage.

The remainder of cases include a variety of presentations such as a variety of infectious diseases, respiratory conditions and burns. The most unwell East Timorese patients were transported for care at the United Nations Military Hospital (UNMHET) with the others sent to the International Committee for the Red Cross Hospital (currently the Dili General). Severely ill infants were unable to be admitted for ventilation at the UNMHET due to the presence of only adult ventilators.

Table 3: Illness Categories



Aircraft Utilisation

Aircraft utilised were sourced from a variety of different countries (Table 4). The bulk of the rotary wing AME were performed on CHC Australia Bell 212 and Super Puma aircraft. Other rotary wing aircraft include the Russian Mi-8, the Chilean Army Puma and the New Zealand Iroquois. Fixed wing assets used were the SAFAIR C130 and the PEL AIR West Wind. Strategic AME's were also performed by the ASF to Thailand and Portugal.

Table 4: Aircraft Used

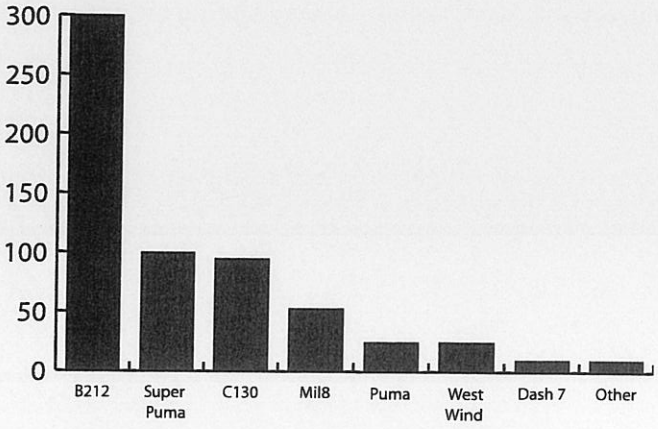


Figure 1 – The patients positioned in the Chilean Army Puma. The female patient with the fractured mandible is positioned on the middle litter. The configuration within the Chilean Army Puma allows for rapid evacuation of up to six casualties with seating for up to four medical personnel.

The AME team received a call at 1405hrs on 04 February 2001, informing of two patients injured in a Motor Vehicle Accident (MVA), one with neck pain and the other with facial injuries. On arrival the AME team was escorted to the Regimental Aid Post (RAP) to assess the patients.

Patient A, a 20yr old female had suffered severe facial lacerations and disruption of the mandible as a result of the MVA. She was maintaining her own airway positioned on her side, and was otherwise stable. The cervical spine had not been cleared but the patient was encouraged not to move her neck and transfers were conducted using in line C-spine care. Patient A had also suffered a suspected fractured left humerus but there was no other sign of injury. An 18 gauge intravenous cannula was sited, 12.5mg Stemetil and 10mg Morphine administered and Hartman's solution infused.

Patient B had been struck across the chest by the roll bar of the vehicle. She had lower cervical spine pain but, on report from the NGO doctor at the scene, had no focal areas of tenderness. A hard cervical spine collar had been placed prior to the arrival of the AME team. Airway, breathing and circulation were intact. The patient's abdomen was firm and generally tender. An IVC was inserted, Hartman's solution commenced and 12.5mg Stemetil administered IMI. Intravenous Morphine 5mg was administered prior to transfer.

Patient C, a 7yr old male was placed on a stretcher for comfort. He had soft tissue loss from the right leg and was unable to weight bear. There was no other sign of injury.

The patients were loaded onto the Puma with Patient A in the middle tier. Patient A was positioned on her side with her head supported by pillows. In this position she was able to maintain her own airway and a small amount of blood drained away in flight. All patients remained stable throughout the twenty-five minute flight. On reaching Dili, all patients were transferred to the International Committee of the Red Cross (ICRC) Hospital.

AME CASE – DISCUSSION

This case highlights several important points for discussion. In particular, it highlights the need for pre-deployment clinical training. Optimum care for Patient B should probably have been inline cervical spine care with rapid sequence induction, intubation and ventilation. The patient could then have had a hard cervical collar placed and been transported with spinal precautions. On reaching Dili, the patient would have then been transferred to the United Nations Military Hospital (UNMHET) for definitive care.

This was not done for several reasons. The airway experience of the AME medical officer was not sufficient that he was confident to secure a definitive airway without complication. As such, the patient was transported on her side relying on her own ability to maintain an airway. If the patient had been intubated electively she then would have had to be transferred to the UNMHET, as the ICRC Hospital had no means for ventilating patients for a long period. The UNMHET was not geared to treat and care for East

Timorese patients for longer than two to three days.

The question to be asked is what if this patient was an Australian digger? Would the experience and clinical skill of the AME team be sufficient enough to provide care similar to that provided within Australia?

This case also highlights the need for training and exposure to aircraft other than those used within the ADF. Our increased exposure to United Nations operations, peace keeping and peace enforcing operations means that our personnel will be involved in AME on the airframes of other military or civilian organisations.

DISCUSSION

The Australian public expects a high standard of care of the deployed ADF soldier and it would seem ideal that the ADF AME team is trained to a similar civilian standard. This civilian standard is usually a dedicated retrieval service with a highly trained staff. The medical staff are usually specially trained senior emergency and anaesthetics registrars with specialised paramedics.

NRMA CareFlight employs this model and performs on average 1000 missions per year providing a retrieval service based out of Westmead and Orange. It also has a capacity for international retrieval[3]. Royal Flying Doctors Service (RFDS) operates 40 aircraft and the daily patient load is greater than 500[4].

The ADF AME teams are junior medical officers with two years experience post graduation and EMST and a one week RWAME training course on aircraft safety and basic flight medicine. Helicopter Underwater Escape Training (HUET) training is not a requirement for the ADF teams though it is a legal requirement for civilian teams. There is no requirement for training or currency in resuscitation medicine. To put this in a military perspective, before deploying to East Timor all members are required to pass a weapons handling test and shoot within three months of deployment. This is again tested in the days before deployment. It is possible to deploy to East Timor with no proficiency in resuscitation and indeed definitive airway management.

The peacetime role of a military medical officer is that of a general practitioner with a very fit, predominantly male 18-55 year old population. It involves a lot of administrative work and is not appropriate preparation for deployment. Current Anaesthetic and Emergency College guidelines outline minimum standards for transport of critically ill. The basic principle is that the transport improves patient care and management is equal or better than point of referral. The Royal Australasian College of Anaesthetists requires a trainee to have at least three months of accredited training to be left alone with a patient in the operating theatre or to transfer from operating theatre to another part of hospital[5]. Is ADF AME medicine legal when an AME team is tasked to retrieve an intubated patient from the field?

In considering the above, it is important to distinguish the differences between combat and peace enforcing AME. East Timor has seen a relatively low incidence of penetrating trauma with the majority of serious cases being Intensive Care Unit (ICU) type injuries. This closely matches the civilian experience in Australia. Experience in retrieval medicine would split AME missions into time critical and non-time critical. Time critical AME are injuries such as penetrating trauma where an operating theatre is required for definitive management and an EMST current general duties medical officer and nursing officer are qualified for the mission. Interventions such as intubation, ICC and ventilation are required skills for this mission.

A study conducted out of NRMA CareFlight suggested that an appropriate critical care doctor on helicopter retrieval of trauma patients with blunt trauma improved mortality significantly (50% reduction of predicted deaths) compared to paramedics. This was thought to be to the enhanced procedural capabilities of physicians especially in airway and ventilatory control. Prehospital times, however, were prolonged[6].

Non-time critical AME patients are patients whose injuries require intensive care rather than an operating theatre for definitive management. These injuries include severe burns and sepsis, cerebral malaria and pneumonia, dengue haemorrhagic fever and reptile envenomation. Here the patient would benefit from provision of intensive care from the moment the retrieval team reaches the patient. The team need to be skilled in advanced resuscitation skills plus both central and arterial line insertion and the use of infusions for sedation and inotropes. This is more closely aligned to CareFlight type service and possibly a more appropriate service for peace enforcing operations.

SOLUTIONS

Possible solutions to provide this level of care include co-location of the helipad with a level 3 hospital and further training of AME medical officers.

Co-location of the helipad with the level 3 hospital in Dili would allow specialists to be used on appropriate missions. For example, an Intensivist could be utilised for a head injured patient or a trauma surgeon if a thoracotomy or amputation is possibly indicated. The current situation in Dili doesn't allow specialists to be sourced and still meet launch times. There is also a considerable time delay in the transfer times. Future ADF hospitals should be co-located with the helipad.

AME medical officers should be trained to a higher level. The typical ADF medical officer only has two years post graduation experience with many having no anaesthesia or critical care exposure. A compulsory year as a senior critical care RMO would prepare the ADF medical officer for both peacetime and deployed role. This would need to be consolidated and maintained by three month annual attachments to a retrieval service or trauma unit in a hospital. This will be difficult to achieve due to critical manning and poor retention of medical officers. Perhaps use of Simulation Centres such as the Royal North Shore in Sydney could provide combat and non-combat aeromedical retrieval scenario based training to teams before deployment. Evidence suggests this is an invaluable tool in the preparation of ADF resuscitation teams for operational deployment[7].

Currently the ADF is exploring a doctrinal change of having a smaller medical footprint in the area of operations. A small highly qualified AME team would allow rapid evacuation and stabilisation of casualties. Is this the new role of the Emergency Consultant in the ADF? Could the Peace Enforcing mission in East Timor be supported by a level 2 facility in Dili with a more highly skilled AME team evacuating casualties to Darwin? We believe this should be a consideration given the fatigue starting to be demonstrated in the specialist reserve and the low workload often placed upon specialist reservists. The USAF has adopted this doctrine using CCAT (Critical Care Air Transport) teams with a focus of rapid evacuation and resuscitation with definitive treatment in the air[8].

CONCLUSION

The ASF AME team provides a valuable service in support of the UN operation in East Timor and to the local people. It provides valuable experience and training to the ADF but attainment and maintenance of the skills required for the mission needs to be addressed. This is the perspective and experience of junior doctors and not ADF guidelines or doctrine. There is currently an AME Working Party chaired by the Director of Health Capability Development addressing these issues and planning the future capability of ADF AME.

REFERENCE:

1. Department of Defence. Australian Defence Force Publication 53: Health Support. Canberra; DPUBS.
2. Austin T. Aeromedical Evacuation the first 100 years. *ADF Health 2002*;3: 43-46.
3. NRMA CAREFLIGHT website. <http://www.careflight.org> Accessed 30 April 2002.
4. RFDS website. <http://www.rfds.org.au> Accessed 30 April 2002.
5. Minimum standards of Transport for Critically Ill. Australian and New Zealand College of Anaesthetists/ Australasian College of *Emergency Medicine;1992*. Policy Document P23.
6. Bartollacci RA, Munford BJ, et al. Air medical scene response to blunt trauma: Effect on early survival. *Med J Aust1998*; 169:612-616.
7. Hendrickse AD, Ellis AM, Morris RW. Use of Simulation Technology in Australian Defence Force Resuscitation Training. *J Royal Army Med Corps 2001*; 147: 173 –178.
8. Air Force Medical Service. Concept of Operations for Critical Care Air Transport Team. HQ AETC/SGX. 1998.

REVIEW ARTICLES

Going Round The Buoy: The Defence Health Services And The Australian Policy Cycle[1]

Neil Westphalen[2]

INTRODUCTION

The Australian Policy Handbook, by Peter Bridgman and Glyn Davis, was "designed for those who become embroiled in the sometimes turbulent world of public policy...".[1] Given the substantial changes to the Australian Defence Force's (ADF's) health services in recent years, it seems worthwhile comparing the Australian Policy Cycle, as described by Bridgman and Davis, with the processes used by the Defence Health Services (DHS).

This article is based on an essay written in mid-2002 for a Master of Public Health. It includes an overview of the Australian Policy Cycle, using examples of health policies developed by the Defence Health Service Branch (DHSB). Its perspective stems from providing Senior Health Officer (SHO) feedback on draft DHSB policies and implementing them later on. Notwithstanding a lack of personal experience in working at Campbell Park, it is a valid exercise to compare DHS processes, as seen by an Area Health Service (AHS) SHO, with those described in *The Australian Policy Handbook*.

For the purpose of this article, 'DHS' refers to the ADF's three Defence Health Services as a whole, while 'DHSB' refers to that part of the Defence Personnel Executive located in Canberra, that is responsible for strategic ADF health policy.

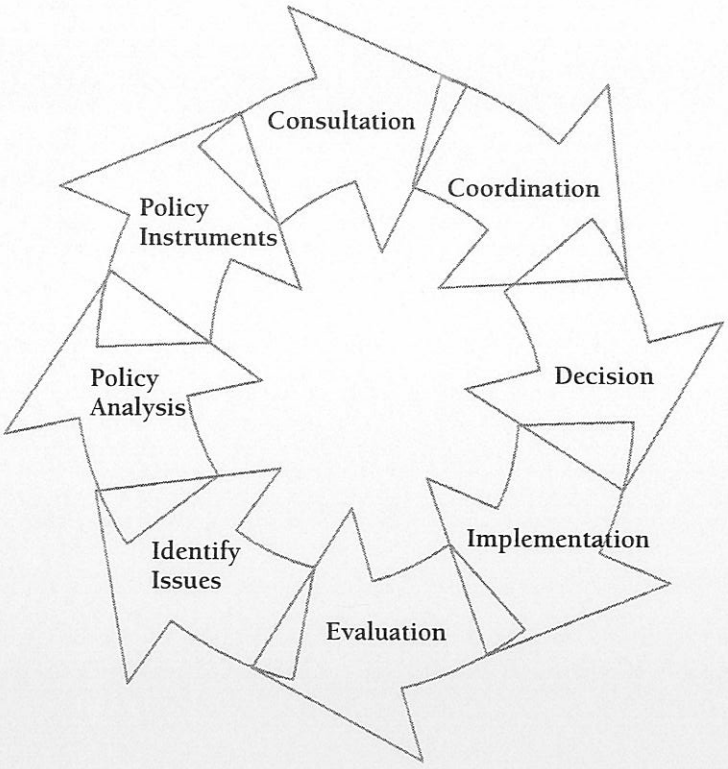


Figure 1. The Australian Policy Cycle[1]

THE AUSTRALIAN POLICY CYCLE AND DHSB

Bridgman and Davis's Australian Policy Cycle is summarised in Figure 1. Although it has eight steps, many of these can be (and often are) undertaken concurrently.

Issue Identification.[1] The Australian Policy Cycle typically starts with identifying an issue requiring either a new policy or changes to an existing policy. Issues identified as suitable are then placed on the policy agenda for action. Bridgman and Davis suggest this process entails making political judgements based on discussions with 'interested parties', which can be divided into external and internal agencies. In the DHS's case, examples of external agencies which may participate in the issue identification process include:

- CHANGES IN INTERNATIONAL RELATIONS. The initiation of the war against terrorism led HQAST to convene a Theatre Health Planning Group (THPG) to develop a health support plan for deployed ADF forces. Having been represented at the THPG, the Joint Health Support Agency (JHSA) should then have developed its own plan for ADF members who are deploying to or

1. Westphalen N. Going round the buoy: The Defence Health Services and the Australian Policy Cycle. *Aust Mil Med 2003*; 12(1): 27-33.
2. CMDR Neil Westphalen is the SMO at HMAS STIRLING and the SHO AHS-WA

returning from this operation. It is understood that, in practice, JHSA had to develop its own health support plan to support HQAST, before the latter could develop its own plan.

- LEGAL ISSUES. Changes to the Privacy Act in late 2001 led to debate within AHS-WA (and presumably elsewhere), regarding possible changes to DHS's clinical information management processes. These changes were reflected in JHSA's Directive 2/2002, which describes how this legislation is to be applied by NSA health staff.
- OTHER GOVERNMENT AGENCIES. The 1996 Australian National Audit Office (ANAO) report on ADF health services recommended that DHSB establish the level of health services required for ADF operations, while rationalising non-operational health support.[2]

Examples of agencies within DHS include:

- SENIOR HEALTH STAFF. A high priority for the previous SGADF was a policy on medical research ethics, which is now promulgated as DI(G) ADMIN 24-3.
- RESERVE ADF MEDICAL SPECIALISTS. Discussion between DHSB and the Burns and Plastic Surgery Health Consultative Group led to a draft health directive on skin photography, which went through several iterations before release.[3]
- FINANCIAL CONSIDERATIONS. An overspend on the antismoking drug Zyban led to Health Bulletin 1/2000 to control its use for ADF personnel. This led to a reduction in Zyban expenditure of about 80%.[4]
- AHS SHOs. SHO feedback from JHSA Conferences since February 2001 has led to changes being made to several Health Directives.

Bridgman and Davis stated that an issue needs four criteria to make it onto a policy agenda. This is illustrated by a DHSB decision in 1998 to vaccinate ADF personnel against Japanese Encephalitis (JE):[5]

- AGREEMENT THAT A PROBLEM EXISTS. Although JE is a risk for some deployed ADF personnel, it took some effort for DHSB to accept that naval personnel were at much less risk and therefore did not require vaccination.
- THE PROBLEM NEEDS TO BE FIXABLE. In this case, a vaccine against JE was available.
- THE PROBLEM FITS THE POLITICAL CONTEXT. For JE vaccine, key issues were that:
  - Its use was consistent with DHSB's focus on operational deployability per the 1996 ANAO report.[2]
  - Whether naval personnel should receive it in the interest of consistency across all three services, as opposed to actual clinical need.
  - Whether the problem is important enough to require action. In this case, the risk of death or disability from JE to some ADF personnel was considered high enough to proceed. However, the 10% incidence of systemic adverse reactions6 militated against its use in a low risk seagoing population.

In the end, a satisfactory outcome was reached for naval personnel regarding the use of JEV, following the necessary interactions with the senior maritime health providers.

Policy Analysis.[1] Bridgman and Davis show that policy analysts typically work their way through the following sequence:

- FORMULATING THE PROBLEM. This stems from issue identification.
- DEFINING OBJECTIVES AND GOALS. For DHSB, this is typically achieved by applying its strategic outcomes (health-related force preparation, casualty prevention and treatment, and health capability management and development) to the issue for incorporation into its business plan.
- IDENTIFY DECISION PARAMETERS. DHSB parameters typically include deployability, legal and funding concerns. In some cases the parameters come from outside DHSB. An example was the development of DI(G) PERS [16-15], regarding a new Medical Employment Classification (MEC) system, for use not only by health staff but by workforce planners and career managers.
- SEARCH FOR ALTERNATIVES. This entails research, using sources such as other jurisdictions and journal articles. Key issues for DHSB include the relevance of Australian civilian practice to the military context. This was seen in a draft Health Directive on STDs dated August 2001, whose application in its then form seemed not only likely to be problematic in the operational context but also did not address the administrative follow up required for a highly mobile military population. Furthermore, a process for tracking STD cases in the deployed military context seemed not to have been consid-

ered at that time.

- SOLUTIONS. As only one draft solution is usually circulated for further consultation, a problem for DHS is a lack of visibility outside DHSB as to whether all alternative solutions have actually been identified.

The policy analysis tools available to DHS encompass those discussed by Bridgman and Davis as follows:

- ECONOMIC ANALYSIS. This includes cost-benefit, cost-effective and opportunity cost analyses. Cost-benefit analyses uses dollars to measure which policy option will deliver the most benefit. Cost-effective analyses recognise that cost benefit analyses may not result in valid comparisons, so that some options remain viable on other than economic terms. Opportunity costs analyses indicate the extent to which selecting one policy option means forgoing another. Although DHSB performs some economic analysis, it appears to have little or no visibility regarding opportunity costs and appears to focus on cost-benefit rather than cost-effective analyses. It is suggested this has been demonstrated by the effort expended on some outsourcing reviews.
- SOCIAL FRAMEWORK. This includes the consequences of particular policy options for minority groups and/or the institutions required to provide services. The DHSB social framework is focussed on individual fitness for operational deployment, while ensuring that non-operational ADF health services are comparable to the civilian Medicare system. It is unclear, however, whether this focus on deployability is entirely compatible with the perception by some ADF personnel (reinforced by recruiting brochures) that they have an entitlement to 'free medical and dental' services, which implies that ADF health care is or should be benchmarked against the private health system. It is, therefore, not surprising that the expectations of some ADF personnel are sometimes not met.
- ENVIRONMENTAL FRAMEWORK. This considers the environmental impact of a particular policy, usually via an Environmental Impact Statement. This is not normally a significant DHS issue but may have to be considered when developing health policy for application in the seagoing environment as well as ashore. The environmental framework may also be the primary focus for NBC, aviation and underwater medicine policy and is of direct importance in occupational medicine policy.
- LEGAL FRAMEWORK. A particular concern for JHSA relates to indemnity issues that limit the use of civilian contractors for non-operational health services, such as medical coverage for airfield emergencies.

Bridgman and Davis[1] also discussed two policy analysis models developed by Charles Lindblom. His 'rational' policy making model attempts to clarify the objective(s) that a policy needs to achieve, through analysis of discrete means versus ends. The analysis per this model is comprehensive and takes every relevant factor into account, but often relies heavily on theory. According to this model, the test of a good policy lies in how well it meets the stated objective(s). This model is generally used when contemplating significant change.

On the other hand, Lindblom's 'incrementalist' policy making model recognises that the objective(s) that a policy needs to achieve is often not clear-cut and that means and ends are often indistinct. As the selection of the goals and the action required are interlinked, the analysis relies on a succession of comparisons with similar policies, thereby reducing the reliance on theory. According to this model, the test of a good policy depend on how various analysts agree on a policy, without necessarily agreeing that it is the best way to meet an agreed outcome. This model is generally used when contemplating gradual change.

In recent years the ADF has tended to apply Lindblom's 'rational' model to a variety of management processes, rather than his 'incrementalist' approach. The limitations of the former are illustrated by the 1996 ANAO report as, for example, it is possible that, because the analysis was not perhaps as comprehensive as it needed to be, the theoretical savings in DHS personnel and other costs may not be achievable. The difficulty with the latter model is that it may not be appropriate if radical changes are required. Having used Lindblom's 'rational' model in recent years to instigate radical change throughout the DHS, it is suggested that his 'incrementalist' model is more appropriate in consolidating those changes.

Policy Instruments.[1] Bridgman and Davis define policy instruments as the means used by governments to achieve their ends. Good policy advice relies on

using the right instruments for the right policy. Bridgman and Davis cited Hood (1983) in describing four types of policy instruments as follows:

- ADVOCACY. Policy instruments such as publicity campaigns argue a case rather than force a result. These are rarely used by DHSB, although one possible exception was the introduction of the 1-800-IM-SICK number.
- FUNDING. These instruments control policy funding rather than the policy itself. DHSB examples include the use of funding controls to manage Zyban and to use contractors to overcome constraints on its own staff and/or time.
- GOVERNMENT ACTION. This refers to providing public sector services, as demonstrated by the decision that DHSB should focus on the provision of health services for operational units as per the 1996 ANAO report.[2]
- LAWS. These establish a framework for government action, although much of the detail is contained in regulations. As a military organisation, DHS relies heavily on this type of policy instrument. These range from standard operating procedures at the unit and AHS level, to plans and instructions from JHSA and HQAST, to Defence Health Directives and Defence Health Bulletins from DHSB. These are in turn subordinate to Defence Instructions and other instruments approved by CDF, in accordance with the Defence Act (1903) and extant government policy.

Bridgman and Davis describe the criteria used to select the best policy instrument for a particular policy, such as:

- EFFICIENCY (or whether this instrument will be cost effective). For example, draft DHSB policies on skin photography and refractive surgery during 2002 led to resource concerns that resulted in further review. On the other hand, the Zyban health bulletin has proved a cost-effective solution.
- EQUITY (OR FAIRNESS). For example, the restrictions on the wearing of contact lenses are generally applied to all personnel, even though the care of contact lenses at sea is less problematic than for austere ground deployments. This suggests that DHSB has been concerned with equality of treatment of ADF members (apart from special groups such as aircrew, submariners, divers, parachutists, and SF personnel), at the expense of equity with respect to RAN members.
- WORKABILITY (OR WHETHER THE INSTRUMENT CAN ACTUALLY BE IMPLEMENTED). As the JHSA health support plans for Ops SLIPPER and RELEX were derived from those used for land-based operations such as TANAGER and BEL ISI, their application to seagoing personnel was found to duplicate extant processes and did not reflect actual requirements to prepare RAN members for these two deployments.

Consultation.[1] Bridgman and Davis explained the need to test a preferred choice with the wider community. Although consultation improves the quality of the policy, it is expensive in time and resources. A good example of the time and effort in ensuring consultation was the report on a new career and remuneration structure for ADF MOs, which took 21 months to complete instead of the expected three.[7] Although improvements to the DHS consultation process via JHSA have allowed Area Health Service SHOs to provide feedback on draft health policies, this has also occurred at the expense of additional time and effort.

Bridgman and Davis cited Shane and Arnberg (1996:21), who suggested that there is a continuum of consultation instruments, including:

- INFORMATION. This typically refers to marketing, usually via surveys and focus group research. DHS typically limits this consultation instrument to using contractors for data collection.
- CONSULTATION. This instrument solicits views from relevant people and groups. DHSB has typically used this consultation instrument in the final stages before a policy is approved, although advice has recently been solicited from SHOs in the early stages of an initiative to rationalise ADF policy on convalescent leave.
- PARTNERSHIP. This draws the community into the decision making process, typically by representation on advisory committees. DHSB has a very wide range of working groups, steering committees and consultative groups to provide health policy advice. Although the concept appears sound, it is unclear how often or how effectively this advice is utilised.
- DELEGATION. This shifts policy responsibility elsewhere, for example by holding a public inquiry which becomes responsible for dealing with a par-

ticular problem. DHSB has had occasion to delegate policy responsibilities (typically involving implementation issues) to JHSA and/or HQAST, sometimes with insufficient reference to resource issues.

- CONTROL. This occurs when a community makes a policy choice, for example by referendum. DHS does not use this type of instrument, although the introduction of the DHS logo in 2001 is an occasion where it may have been appropriate.

Bridgman and Davis described how, in order to remain focussed, consultative processes should have clear terms of reference, timelines and outcomes. These processes were considered by Davis (1996: 22-24) (cited in Bridgman and Davis1) as follows:

- PURPOSE. Consultation may be necessary either to improve the quality of the policy process or to achieve consensus. Since January 2001, JHSA in particular has expended considerable effort on consultation to improve transparency and accountability.
- METHOD. Consultative processes typically use a range of instruments to spread the range of opinion. DHSB however mostly relies on group processes.
- IDENTIFYING STAKEHOLDERS. DHS attempts to identify particular individuals with a known level of interest and/or expertise for its consultations. This can be 'hit and miss' initially, but typically improves over time. An example was a meeting in March 2002 regarding aeromedical evacuation, which discussed (among other things) which participants were needed for future meetings on this issue.
- BEGINNING CONSULTATION. This has been referred to previously regarding issue identification. Sometimes the first intimation to SHOs that a particular policy was being considered has been when a draft policy was released by DHSB for comment.
- CONSULTING WITH INDIVIDUALS AND GROUPS. Consultation overload and time constraints are a concern when several draft policies are concurrently released by DHSB for comment. This is a particular concern in the lead up to the DHS Steering Committee meetings where policies are tabled for approval.
- COMPLETING THE CONSULTATIVE PROCESS. A particular problem for DHSB is a lack of feedback to participants regarding the outcome of their input, generally because of resource constraints. A partial solution has been the use of follow up correspondence after the policy is released, as part of the next policy cycle.
- CONSULTATION 'TRAPS'. This term refers to special interest groups, which may not be representative of the community as a whole. It is suggested that DHSB has few problems managing special interest groups within Defence, as the role of staff in representing their particular organisation is usually clear and unambiguous.

Coordination.[1] Bridgman and Davis stated that governments strive to institutionalise coordination through appropriately designed policy structures. As many DHS policies are for internal use, the need for coordination with other agencies may appear to be minimal. There are occasions however, when DHSB provides advice to other authorities within Defence. DI(G) PERS 16-15, on the new MEC system, is a good example, as it not only affected DHS but the three single service career managers, workforce planners and other authorities. Conversely, JHSA has requested the Defence Legal Service to review indemnity issues for civilian contract health staff and to advise on the application of privacy legislation to NSA health staff.

Decision.[1] Bridgman and Davis described the decision point as the time when the work of the policy analyst is judged through a regulated process. Draft policies are presented for approval at the DHS Steering Committee, which replaced a rather ad hoc approval process in January 2000. This meets approximately every two months, with Committee members receiving the proposals four (until recently only two) weeks beforehand. Following discussion, proposed policies may be approved, recast, sent back for further review or abandoned by DGDHS. This process therefore incorporates senior level health consultation and may include discussion on the policy analysis, use of appropriate policy instruments, coordination and implementation issues.

The three main problems with the current process are:

- READING TIME. The reading time was recently expanded from two to four weeks; however, it remains to be seen whether even this is sufficient for multiple and/or complicated proposals.

- MATERIAL VOLUME. The volume of material at the meeting, as the Committee not only discusses up to a dozen policies but also deals with health budgeting and other issues.
- POLICY PRIORITISATION. Some policies receive higher priority from the Committee than others because of their relative ease, level of individual or political interest, or because they resolve a high profile but trivial problem, at the expense of day to day issues involving all ADF health facilities. This reflects the issue identification stage of the cycle discussed previously.

Implementation.[1] Bridgman and Davis (1998) describe how policy is meaningless without implementation and that this needs early consideration by policy analysts. They cited Lewis Gunn (1978), who described ten conditions for perfect implementation per Figure 2:

TEN CONDITIONS FOR PERFECT POLICY IMPLEMENTATION (GUNN, 1978)

1. No crippling external constraints.
2. Adequate time and resources.
3. A suitable combination of resources at each stage.
4. A valid theory of cause and effect.
5. Direct links between cause and effect.
6. A single implementation policy, or at least a dominant one.
7. Understanding and agreement on the objectives to be achieved.
8. A detailed specification of the tasks to be completed.
9. Perfect communication and coordination.
10. Perfect obedience.

Figure 2

It can be seen that, for various reasons, these conditions may not apply to the DHS (or indeed anywhere else in Defence).

Bridgman and Davis1 also noted Howlett and Ramesh (1995: 154-55) and Lindblom (1980:65ff) and discussed two forms of implementation instruments:

- Non-coercive forms of action. Examples used by DHSB include contracts and expenditure controls.
- Coercive forms of action. Examples used by DHSB include administrative directions through Health Directives and Bulletins.

Howlett and Ramesh (1995: 154-55) were also cited by Bridgman and Davis[1] as stating that policy implementation is affected by:

- The nature of the problem.
- The diversity of the problem.
- The size of the target group.
- The extent of behavioural change required.

These considerations were demonstrated by the new MEC system. During the initial implementation period, multiple ADF authorities continued to use their own interpretation of the new system, based on the nature of how particular clinical problems affect them, at a time when a large degree of behavioural change was required by all participants. These problems resolved as they became more familiar with the new process.

DHSB also has to contend with many of Lindblom's 'Implementation Traps' per Figure 3. This particularly refers to incomplete specifications, conflicting objectives (such as 'world's best practice', which may or may not apply to a military clinical environment) and inadequate administrative resources for the tasks at hand.

LINDBLOM'S IMPLEMENTATION TRAPS

1. Incomplete specification.
2. Inappropriate agency.
3. Conflicting objectives.
4. Incentive failures.
5. Conflicting directives.
6. Limited competence.
7. Inadequate administrative resources.
8. Communications failures.

Figure 3

Finally, it should be noted that although DHSB has accepted responsibility for policy development, its implementation has been delegated to JHSA and HQAST. As this split in the policy cycle isolates DHSB from the organisations that use the policy it generates, it is suggested this does not facilitate accountability for the end product (i.e. whether the policy actually works or has unforeseen outcomes) from either DHSB or its subordinate organisations.

Evaluation.[1] Bridgman and Davis describe evaluation as the point at which a new cycle of analysis begins to confirm, adjust or abandon current policies. Evaluations tend to follow a standard format, beginning with terms of reference and followed by an evaluation strategy, data collection, consultation and analysis. As this reproduces the overall policy process, the latter becomes iterative. This process is used by DHSB to identify issues for further action.

Although there has been considerable criticism of many new policies that have been developed by DHSB in recent years, it should be noted that many have involved major surgery to extant processes while at the same time trying to meet the needs of customer base that had undergone major structural changes. In the final analysis, at some point it becomes necessary to release a new policy despite known imperfections, in order to address immediate problems. Improvement to these policies is only possible by trying them out, identifying the problems and having a process to address them. It should be noted that many of the policies discussed in this article have not yet gone through their second iteration. Policies that have done so, such as the Health Directives on infertility management and voluntary sterilisation, demonstrate DHSB's ability to address problems with extant policy.

CONCLUSION

Comparison of DHSB's policy processes with The Australian Policy Handbook indicates a high degree of consistency with the Australian Policy Cycle. Issues are identified for consideration and are analysed by DHSB staff for potential solutions. These are matched to a limited range of policy instruments, draft versions of which are released for consultation. Co-ordination issues are addressed at a senior level before approval by DGDHS. Many steps in this cycle occur concurrently. If nothing else, it is suggested that Bridgman and Davis go a long way to explain the complexities, potential for conflict and frustrations felt by many if not most participants who are involved with the development and implementation of useful and relevant ADF health policy.

It should also be noted that that in recent years DHSB has developed many new policies that so far have only been round the cycle once. It is suggested that the quality of ADF health policy can only be properly assessed once it has been developed, implemented, assessed, revised and implemented again. This would entail going twice 'round the buoy'. The need for subsequent iterations would then depend on the general rate of policy change within Defence and how these changes impact on the DHS.

However, DHSB's main deviation from the Policy Cycle occurs at the implementation stage, as this has been the responsibility of subordinate organisations. This makes evaluating the success or otherwise of policies difficult and does not facilitate either accountability or getting issues onto the DHSB policy agenda for the next cycle. It is suggested this can only be resolved either by making DHSB responsible for policy implementation as well as development, and/or ensuring that the parties who are responsible for implementation (i.e. JHSA and HQAST) have the resources to do so.

REFERENCES

1. Bridgman P, Davis G. *Australian Policy Handbook*. 2nd ed. Sydney: Allen and Unwin; 2000.
2. Australian National Audit Office. *Performance Audit Report No 34:* Australian Defence Force Health Services. Canberra: Australian Government Publishing Service; 1996.
3. Sparrow J. ADFDOCS E-mail message. 2002 March 20.
4. Emonson D. Personnel communication to N. Westphalen. 2000 May.
5. Schedlich R. E-mail to N. Westphalen. 2002 August 12.
6. National Health and Medical Research Council. *The Australian Immunisation Handbook*. 7th ed. Canberra: Commonwealth of Australia; 2000.
7. Westphalen N. ADF Career and Remuneration Study (MOCRS) Report. Canberra: Defence Health Service; 2002.

TEN YEARS ON

Anthrax – Clinical characteristics and use as a biological warfare agent[1]

Sue Sharpe[2]

AETIOLOGY

ANTHRAX IS CAUSED BY the microorganism Bacillus anthracis, a large Gram positive rod-shaped bacterium which is commonly found singly or in pairs. The organism is capsulated in clinical specimens, but endospores are produced in vitro, in soil, and in decaying animal tissue.

These endospores are relatively resistant to heat and chemical disinfectants (they can be destroyed by boiling for 30 minutes or more, or exposing to 140°C dry heat for three hours), but may remain viable for months in animals hides or for years or decades in dry earth.[1]

EPIDEMIOLOGY

B. anthracis is found world-wide, particularly in Asian and African countries. It is widespread in south-eastern Australia due to distribution by dust storms and wild pigs and dogs.

Anthrax is naturally an infectious disease in farm animals occasionally transmitted to man, usually by inhalation or ingestion of spores or via sub-cutaneous abrasions. Almost all animals are susceptible, especially herbivores. There is no true reservoir, but spores may remain viable in soil.

Man-to-man transmission is extremely unlikely.

PATHOLOGY

Three principal antigens are associated with the pathogen.

Capsular antigen

D-glutamic acid polypeptide formed by virulent strains of B. anthracis in infected tissue. The capsule is anti-phagocytic, and protects the bacterium from lytic antibodies. It is important in pathogenicity and in the establishment of infection. The gene coding for this antigen resides on a plasmid known as pXO2[2].

Somatic (Cellular) Antigen. Polyscaccharide of equal proportions in D-galactose and N-acetylglucosamine in the cell wall.

Anthrax Toxin.

Complex toxin produced in vivo mediated by a temperature-sensitive plasmid (pXO1)[3,4]; consists of a protective antigen (PA) (Mwt 85,000), lethal factor (LF) (Mwt 83,000), and oedema factor (OF) (Mwt 89,000)[5] – a combination of these factors produces toxicity. The toxin is responsible for the symptoms of the disease.

PA is the most important toxin in protection and contains the major immunogenic epitopes. It binds to the cell surface, where it undergoes proteolytic cleavage, exposing a site to which OF and LF bind. The complex is then internalised, probably by endocytosis.[6] It is believed that the oedema factor causes an increase in the amount of cyclic AMP in the cytoplasm of the host cell[7].

Virulence is dependent of the production of toxin and the presence of a capsule. Accumulation of toxin in tissues affects the central nervous system, which may result in respiratory failure and anoxia.

Antibiotic therapy may sterilise tissue, but toxin may persist until is metabolised, prolonging the clinical disease.[8]

CLINICAL MANIFESTATIONS

Three different presentations of anthrax occur, depending on the route of infection. All can progress to fatal bacteraemia by dissemination via the bloodstream. Meningitis sometimes occurs as a complication of severe cases.[8]

Cutaneous Anthrax.

This is the most common form of the disease in humans. Spores penetrate the skin via minor cuts or abrasions, which may become itchy. When the spores

1. Sharpe S. Anthrax – Clinical characteristics and use as a biological warfare agent. *Aust Mil Med 1993*; 2(1): 4-10.
2. This is the second in our series that looks back at articles published in Australian Military Medicine ten years ago. SBLT Sharpe was a microbiologist who entered the RAN to become an Instructor Officer. SBLT (now LEUT) Sue Sharpe, RAN has subsequently completed the Graduate Medical Scheme and returned to the RAN in 2003 as a medical officer.

germinate – two to five days after exposure – an inflamed papule appears at the site of inoculation. Pus is usually not present unless a secondary infection is involved.

Within a few days, a vesicle (called a malignant pustule) forms, filled with a bluish-black fluid. This vesicle will eventually break down, being replaced with a black eschar with a gelatinous surrounding oedema (this lesion is not usually painful). The eschar will dry out after one to three weeks, separating from the surrounding skin and leaving a scar. [8,9]

If untreated, or in extremely severe cases, cells, may spread to regional lymph nodes, which may become enlarged and tender, and invasion of the blood stream by the pathogen may follow.[5]

Mortality in untreated cases is between five and twenty percent, and under five percent if antibiotic therapy is prompt.[9]

Inhalation Anthrax.

One to five days after inhalation of spores, common respiratory symptoms develop (fever, non-productive cough, myalgia, malaise). Spores are phagocytosed by macrophages, and carried to regional tracheobronchial lymph nodes, where they germinate and rapidly multiply.[10]

Although an apparent improvement may occur, symptoms abruptly worsen after a few days; high fever, dyspnoea, cyanosis, chest and neck oedema, respiratory stridor, chest pain and pleural effusion are common. Haemorrhagic oedematous mediastinitis often occurs, and may develop into haemorrhagic meningitis.[5,8] Anthrax toxin may directly affect the pulmonary capillary endothelium which may result in thrombosis and respiratory failure.[11]

A few bacteria are usually able to evade the host's cellular defenses and escape into the blood stream via the efferent lymphatic. They are cleared by the reticuloendothelial system (especially the spleen), but are able to establish a fatal bacteraemia.[5]

The patient's condition rapidly deteriorates, leading to respiratory distress, cyanosis, and death usually within 24 hours.[5,8] Unless the disease is identified and antibiotic therapy started within 12 hours after inoculation, inhalation anthrax is usually always fatal.[11]

Chest x-ray shows distinct mediastinal widening.[12] Pneumonia caused directly from anthrax does not occur, but secondary infection causing pneumonia may result [5,11].

Gastrointestinal Anthrax.

This is an extremely rare disease, following ingestion of spores in contaminated, undercooked meat. Deposition and germination of spores in the submucosa of the ileum and caecum and subsequent toxin production may cause oedema, haemorrhage and necrosis, and result in nausea, vomiting and diarrhoea. The incubation period is usually between two and five days.[8]

In severe cases, cholera-like gastroenteritis may follow, with abdominal pain, fever, bloody vomitus and diarrhoea, intestinal obstruction, prostration and shock. Haemorrhagic inflammation of the small intestine and bowel perforation may also occur. These symptoms are associated with a very high mortality rate (25% to 75%).[5]

Regional lymph nodes may become infected, leading to a systemic infection.

Very rarely, tonsillar or pharyngeal ulceration may also be evident. Formation of a pseudomembrane, followed by difficulty in swallowing and respiratory compromise may result.[5]

DIAGNOSIS

Laboratory Diagnosis.

Gram stains and immunofluorescent antibody assays on pustule exudates or blood are useful. Sputum is generally not suitable as spores do not usually germinate until they reach the lymph nodes.

Blood samples should be cultured, although specimens from cutaneous tissue, lymph nodes, sputum or CSF may also be suitable. B. anthracis grows on routine media, especially blood agar, and has characteristic grey-white, irregular, hair-like colony forms when grown optimally in aerobic conditions at 37°C.[5,13]

Serology on paired sera is only worthwhile as confirmation.

Differential diagnosis.

CUTANEOUS ANTHRAX: orf, plague, tularaemia, staphylococcal carbuncle.

INHALATION ANTHRAX: initially influenza or any of a wide range of bacterial, viral or fungal URT infections. Very hard to recognise promptly, although a BW attack would probably result in an explosive outbreak.[9]

Look for mediastinal widening in chest x-ray, chest wall oedema, haemorrhagic pleural effusions and haemorrhagic meningitis.

May be confused with an aerosol attack of

Staphylococcal B enterotoxin (SEB), although the onset of symptoms of SEB would be more rapid, and no mediastinal widening would be present.[11]

Plague pneumonia also has similar symptoms to inhalation anthrax, but these patients would have pulmonary infiltrates, which are usually absent in anthrax.[11]

GASTROINTESTINAL ANTHRAX: acute abdomen, appendicitis, gastroenteritis.

TREATMENT

The antibiotic of choice is penicillin-G administered parenterally, although tetracycline is also effective. Most strains are also sensitive to erythromycin and chloramphenicol.[5,8,11]

Cutaneous lesions should not be excised and drained, as this may lead to dissemination of the pathogen into the bloodstream and septicaemia. The patient should be isolated, and the lesion kept sterile and dry. Skin grafts may be necessary after the infection has resolved. Corticosteroids are sometimes used to treat severe malignant pustules.[8]

Pulmonary anthrax is usually diagnosed too late for antibiotic therapy, although administering both antibiotics and antitoxin may be of some benefit. Therapy should be continued for a prolonged period of time.[8]

RECOMMENDED THERAPY

2 x 106 units of penicillin-G every 2 to 6 hours until oedema subsides, followed by oral penicillin for at least 7 to 10 days. Erythromycin, tetracycline, or chloramphenicol may be used in penicillin–sensitive patients.

In the event of a BW attack where multiple drug-resistant strains of B. anthracis have been used, treatment should be given as follows:

1,000 mg ciprofloxacin orally at first sign of the disease, followed by 750mg orally twice daily OR

200 mg intravenous doxycycline initially, then 100 mg twice daily.

Unvaccinated personnel should also be given a single 0.5 ml dose of vaccine subcutaneously. Two additional doses of 0.5 ml should be given two weeks apart.[11]

Personnel vaccinated with fewer than three doses should receive a single 0.5 ml booster.[11]

Antibiotic therapy should be continued for at least four weeks. If vaccine is not available, antibiotics should be continued for a prolonged period of time.

If possible, the surrounding environment should be decontaminated: formaldehyde is effective for sterilising soil and equipment. (Gamma radiation has proven to be effective in factory decontamination, but ethylene dioxide and autoclaving do not appear to be as efficient)[8].

SUSCEPTIBILITY OF POPULATION

Susceptibility is very high in unvaccinated individuals. There appears to be no documented evidence for differences in susceptibility between males and females.

PREVENTION

Several different vaccines are suitable for human use; either live attenuated or killed vaccines. All efficient vaccines either contain or produce PA; neither LF nor OF are protective by themselves.

Non-Living PA Vaccines.

Effective vaccines of protective antigen adsorbed onto an aluminium hydroxide adjuvant (from the US)[14] or alum precipitated (from the UK)[15] are available and appear to give protection against inhalation anthrax (although protection against large challenges or highly virulent strains of B. anthracis may not be afforded).

Doses at 0, 2 and 4 weeks, 6, 12 and 18 months and then every year are recommended. Protection seems to be acquired after the third dose (limited data available). These vaccines are the best option at present. Antibodies are produced in virtually all patients after the 12 month booster.

Reaction to the vaccine is usually only mild to moderate, with tenderness, erythema, oedema and pruritus. More severe complications are rare (less than 1 % of cases), but may limit the patient's use of the extremities for 1 to 2 days, and induce myalgia, malaise, or low grade fever. Severe systemic reactions (anaphylaxis) are very rare.

The vaccine should be stored at 4°C – NOT frozen.

NB: No definitive field trials have been performed to evaluate vaccine efficiency, and no information is available correlating specific immune response to vaccination and protection afforded, particularly with respect to aerosol challenge, or against virulent strains of B. anthracis. [Editors Note: There have been subsequent research papers in Vaccine and a review by the Institute of Medicine in this area]

Live Attenuated Spore Vaccines.

A live spore vaccine (STI – derived from the Sterne spore vaccine) from the former USSR of a non-encapsulated attenuated strain which lacks the pX02 plas-

mid is also available. This vaccine is administered by scarification or even by aerosol.[16] Boosters are needed every year. Although protection is likely to be higher than that of the killed vaccine, no conclusive comparative experiments have been conducted.[17] Severe reactions are common – necrosis at the site of inoculation sometimes occurs.

If the patient survives the disease, recovery from anthrax provides solid immunity.

Recently, recombinant vaccines, and more efficient delivery systems of the PA antigen are being developed (see Future Directions).

POTENTIAL AS BW

Advantages as a BW.

An aerosol attack of B. anthracis would cause inhalation anthrax, which has a short incubation period, is difficult to recognise promptly and, unless diagnosed early, would produce fatalities.

B. anthracis is easy to cultivate in large numbers in the laboratory, which would enable third world countries to acquire a large stock.

The protective qualities of the endospore allow stability of the pathogen in sunlight (for several days), in soil (for decades), and in aerosol form.

The hardiness of the bacteria is its ability to survive in harsh environments, and the ease with which it can be distributed via the wind would be attractive if widespread dissemination of the pathogen is desired and long-term contamination of the environment is not deemed important (e.g. in terrorist activities)[8].

A small scale attack may be able to target key personnel, but without extensive contamination of the environment, and disinfection of the area would be possible.[8]

Antibiotic-resistant strains are easily engineered in the laboratory.

Current vaccines may not provide enough protection against a large challenge of spores, and the prolonged therapy necessary following an attack could seriously deplete antibiotic stocks and medical resources.

Disadvantages as BW

Spores persist for prolonged periods of time, and their dissemination is difficult to control, which would be detrimental if the target area was of importance.

Protection of own personnel would be necessary.[8]

FUTURE DIRECTIONS

Vaccines

Several different approaches are being researched. Ideally, vaccines should:

- be safe to humans;
- broadly protective after only one dose;
- effective, with negligible side effects; and
- give rapid and long-lasting immunity.

Novel approaches involve both non-living and living vaccines.

Non-living Vaccines

Non-cellular vaccines containing PA which give strong, protective immune responses are being trialled. Several aspects of these vaccines must be examined.

EPITOPE ANALYSIS. The structure and function relationships of the anthrax toxins (most notably PA), as well as the molecular interactions between the toxins, are currently being elucidated.[6] If those epitopes which produce strong immune responses can be determined, synthetic peptide vaccines may be feasible. Ideally, these vaccines would effectively stimulate cell-mediated immunity, but with negligible side-effects.

DEVELOPMENT OF SUITABLE ADJUVANTS. Many adjuvants are successful as immune stimulants in animal vaccines but are unsuitable for human use because of unacceptable side-effects. Current adsorbed PA vaccine has increased efficacy when used with complete Freund's adjuvant, Corynebacterium ovis, or killed Bordetella pertussis[18]. However, these adjuvants are associated with allergic reactions in humans.

Recently, potential biological adjuvants have been investigated, which give a high stimulatory effect, but are otherwise innocuous. A bacterial peptidoglycan moiety (N-acetyl muramyl-L-alanine-D-isoglutamine (MDP)) has been shown to be effective[19] and synthetic muramyl dipeptide derivatives have been made.[20] Other compounds, such as dimethyl glycine (DMG), threonyl MDP, monophosphoryl lipid A, trehalose dimycolate, and cell wall components of Mycobacterium phlei and M. bovis may also have potential.[21,22]

VIRUS-EXPRESSED PA. Two different approaches are being investigated, using either baculovirus or vaccinia virus expression systems.[23]

BACULOVIRUS SYSTEM. The PA gene is cloned into bac-

ulovirus genome and the virus is used to infect insect cell tissue culture. PA is produced and purified and injected into guinea pigs and mice.

VACCINIA VIRUS SYSTEM. The experimental animals are immunised with the PA-vaccinia recombinant which replicates and produces PA.

Both methods induced a high degree of protection in the animals against a highly virulent (Ames) strain of B. anthracis.

The PA produced was immunologically identical to the Sterne spore PA.

GENETICALLY ENGINEERED VACCINES. Site-directed mutagenesis of toxin genes may produce modified toxins (PA, OF, LF, and somatic antigens) which have an enhanced immunogenicity but a decreased toxicity. These could be used as either living or non-living vaccines.[21]

Live Attenuated Vaccines

Several mutant B. anthracis strains have been examined as possible live vaccines. Transposon (Tn) mutagenesis, which has proven successful with Salmonella typhimurium vaccines[24], is now being applied to B. anthracis. [25]

B. anthracis Tn916 mutants (aro mutants) of a non-encapsulated, toxigenic strain are unable to synthesise the aromatic amino acids phenylalanine, tyrosine and tryptophan, and only replicate a few times in the host. This self-limiting infection is enough to afford protection in guinea pigs against virulent strains of the pathogen.[21]

OTHER TRENDS

Research into antibiotic prophylaxis, particularly with regard to better delivery systems (such as liposome-encapsulated drugs for improved persistence in the host) is occurring. Passive immune approaches are not yet feasible for human use.

REFERENCES

1. Manchee RJ, Broster MG, Melling J, Henstridge RM. Bacillus anthracis on Gruinard Island. *Nature 1981*; 294:254.
2. Green BD, Battisti L, Koehler TM, et al. Demonstration of a capsule plasmid in Bacillus anthracis. *Infect Immunity 1985*;49:291.
3. Ivins BE, Welkos SL. Cloning and expression of the Bacillus anthracis protective antigen gene in Bacillus subtillis. *Infect Immunity 1986*;54:537.
4. Ivins BE, Ezzell JW Jr, Jemski J, et al. Immunisation studies with attenuated strains of Bacillus anthracis. *Infect Immunity 1986*; 52:454.
5. Swartz MN. Aerobic spore-forming bacilli. In: Davis BD, Dulbecco R, Eisen HN, Ginsberg HS. Eds. *Microbiology.* 4th ed. Philadelphia: JB Lippincott Co.; 1990:625-631.
6. Lappia SH, Friedlander AM, Cora EM. Proteolytic activation of anthrax toxin bound to cellular receptors. In: Fehrenbach FJ, Alouf JE, Falmagne P, Goegei W, Jeljaszewicz J, Jurgens D, Rappuoli R eds. Bacterial Protein Toxins. *Zentralbl Bakterial* Suppl 17. Stuttgart: Gustav Fishcer; 1986:113.
7. Ezzell JWE Jr, Ivins BE, Leppia SH. Immunoelectrophoretic analysis, toxicity and kinetics of In vitro production of the protective antigen and lethal factor components of Bacillus anthracis toxin. *J Bacteriol 1984*;45:761.
8. Bennett N McK. *Anthrax.* NBC course. Portsea; 1990.
9. Benenson AS, ed. Control of Communicable Disease in Man. Washington: American Public Health Association; 1990:17-20.
10. La Force FM. Woolsorters' Disease in England. *NY Acad Med 1978*;54:956.
11. Brachman PS. Anthrax. In: Wyngaarden JB, Smith LH. Eds. Cecil *Textbook of Medicine.* 16th ed. WB Sanders 1982:1526-1528.
12. Unknown. Section ii. Specific Threat Agents. 74-76
13. Doyle RJ, Keller KF, Ezzell JW. Bacillus. In: Lennette EH, Balows A, Hausler WJ Jr, Shadomy HJ. Eds. *Manual of Clinical Microbiology.* 4th ed. Washington: American Society for Microbiology; 1985:211-215.
14. Puziss M, Wright GG. Studies on immunity in anthrax X. Gel adsorbed protective antigen for immunization in man. *J Bacteriol 1963*;85:230.
15. Wright GG, Green T, Kanode RGJ. Studies on immunity in anthrax V. Immunising activity of alum-precipitated protective antigen. *J Immunol 1954*; 73:387.
16. Aleksandrov NI, Gefen NE, Garin NS, et al. Experience in massive aerogenic vaccination against anthrax. *Voen Med Zh 1959*;8:27.
17. Hambleton P, Melling J. Exploitation of the bacterial envelop: Rational design of vaccines. *Med Microbiol 1983*;3:231.

18. Turnbull PCB, Leppia SH, Broster MG, et al. Antibodies to anthrax toxin in humans and guinea pigs and their relevance to protective immunity. *Med Microbiol Immunol 1988*; 177: 293.
19. Stewart –Tull DES. The immunological activities of bacterial peptidoglycans. *Ann Rev Microbiol 1980*;34:311.
20. Takada H, Kotani S. Immunopharmacological activities of synthetic muramyl-peptides. In: Stewart-Tull DES, Davies M. eds. *Immunology of the Bacterial Cell Envelope*. Chichester: John Wiley and Sons; 1985;119.
21. Ivins BE, Welkos SL. Recent advances in the development of an improved anthrax vaccine. *Eur J Epidemiol 1988*;4:12.
22. Ivins BE, Welkos SL, Kittle SF, et al. Immunisation against anthrax with Bacillus anthracis protective antigen combined with adjuvants. *Infect Immunity 1992*;60:662-668.
23. Iacano-connors LC, Welkos SL, Ivings BE, Dalrymple JM. Protection against anthrax with recombinant virus-expressed protective antigen in experimental animals. *Infect immunity 1991*;59:1961-1965.
24. Holseth SK, Stocker BAD. Aromatic dependent Salmonella typhimurium are non-virulent and effective as live vaccines. *Nature 1981*;291:238.
25. Ivins BE, Welkos SL, Knudson GB, Le Blanc DJ. Transposon Tn 916 mutagenesis in Bacillus anthracis. *Infect Immunity 1988*;56:176

USEFUL REFERENCES

Hambleton P, Turnbull PCB. Anthrax vaccine development: a continuing story. *Advances Biotechnol Processes 1990*; 13:105 – 122.
Ivins BE. The search for a new generation human anthrax vaccine. *Clin Immunol Newsletter 1988*; 9:30-31.

HISTORY

Tudor Naval Medicine 1485-1603: Part Two[1]

Neil Westphalen[2]

INTRODUCTION

THIS IS THE SECOND OF A TWO PART ARTICLE on English naval medicine during the Tudor period. Both parts follow a previous article on medieval naval medicine, with the same aim of making comparisons with contemporary ADF practice in order to identify common issues.[1] Like the previous article, they are based on information from the first of a four-volume history of naval medicine, written by Surgeon Commander J.J. Keevil RN (Rtd) in the late 1950s.[2]

The first part described Tudor medicine from a naval viewpoint and Tudor ships from a medical viewpoint[3]. This part will discuss the medical aspects of Tudor naval operations.

TUDOR CAMPAIGNS AND DEPLOYMENTS

After 1450, the ability to keep ships at sea was only limited by recurrent failures with their victualling and/or hygiene. By 1565 the daily standard ration for an English sailor was a gallon of beer, a pound of bread or biscuit, with beef, pork or fish, plus butter and cheese, supplemented where possible by fresh food at the men's own expense. The meat was preserved by drying and packing in salt pickle, but poor or skimped technique led to frequent preservation failures.[4]

Early English naval medicine was also influenced by trade in the Mediterranean from 1457. In 1504, Henry VII hired his ships Sovereign and Regent to merchants for a voyage to the Levant,[2] where they encountered the Venetian quarantine regulations which had been established in 1485. Quarantine was first introduced at Marseilles in 1383, while Pisa had established the first quarantine station in 1464.[2]

Meanwhile, Portuguese and Spanish royalty had sponsored Bartholomeo Diaz' voyage to the Cape of Good Hope in 1487, Columbus's passage to America in 1492 and Vasco da Gama's journey to India in 1498.[2] However, as Henry VII wished to avoid conflict, it was not until 1496 that he allowed John Cabot to explore northern America with five ships, where he discovered Nova Scotia and Newfoundland.[2] Further English expeditions were restricted by Henry VIII's wars with France and it was not until Elizabeth I's undeclared war with Spain that the merchant adventurers reached their full potential.

As Elizabeth's own fleet was unable to defend England themselves, private citizens were encouraged to sponsor long voyages for trade, exploration, and/or plunder. As a result, Tudor maritime power was based upon these privateers rather than the Queen's ships, such that 80% of the 197 ships opposing the Spanish Armada were either armed merchantmen or privately owned warships.[2] Besides safeguarding England from Spanish invasion, the Armada campaign also demonstrated that the ocean trade routes were open to those who fought for them. Within a dozen years, several European nations had also formed their own East India trading companies.[5] It took another century, however, for England's navy to dominate maritime affairs and it was not until 1815 that the Royal Navy "ruled the waves".

These longer voyages were soon accompanied by the associated medical problems, although given the epidemics, starvation, poor hygiene and lack of medical care in Tudor England, it is perhaps debatable whether they were more or less dangerous than staying home. Although a likely reason for English maritime supremacy is that it learned how to conserve its seamen sooner than their Portuguese, Spanish, Dutch and French competitors, this still did not occur until after the 1750s.

Vasco da Gama returned to Europe from India in 1499, having lost half of his ships and two thirds of his men, who represent the first documented victims of the scurvy that wreaked so much havoc over the

1. Westphalen N. Tudor Naval Medicine 1485 – 1603: Part Two. *Aust Mil Med 2003*; 12(1): 40–47.
2. CMDR Neil Westphalen is the Senior Medical Officer at HMAS STIRLING.

next three centuries.[2] The most bewildering aspect of scurvy was how the cure was repeatedly found and lost, although it was also frequently used as a plausible cause to justify the failure of a particular expedition.[2] The humoral theories of disease also militated against finding a cure, as these depended on imbalances of nature: as man was derived from the four basic elements, scurvy was the result of excessive time at sea. Against this, the application of actual practical experience had little effect.

The 19 deaths from scurvy during Magellan's circumnavigation in 1519-1522 may have encouraged shorter transatlantic efforts but, if so, this made little difference.[2] Having discovered Canada the previous year, during the winter of 1535, Jacques Cartier lost 25 men from scurvy while exploring the St Lawrence River. He was left with only three men who were fit enough to go below and, had it not been for antiscorbutic advice from the locals, no one would have survived.[2] Following a suggestion by Sebastian Cabot, Sir Hugh Willoughby left with three ships in 1553 to search for a route to China via Russia. Cabot had framed the first known written set of hygiene rules, including Item 15 and 18:

"Item 15: No liquor to be spilt in the ballast, nor filthiness to be left [in] board: the cook room and all other places to be kept clean for the better health of the companie..."[2]

"Item 18: The sicke, diseased, weake and visited person within boord, to be tendred, relieved, comforted and holpen in the time of his infirmitie, and every maner of person, without respect, to beare another's burden."[2]

However, despite having three surgeons and these instructions, only one ship made it to Archangel, while the others were frozen in off eastern Lapland, where they were found by Finnish fishermen the following spring with no survivors.[6]

Even so, the ability to promulgate and apply these hygiene rules to the royal ships was limited. Not only were there no administrative arrangements for their dissemination, but the Divine Right of the sovereign meant that any attempt to apply instructions not directly emanating from the Crown was considered treasonous.[2]

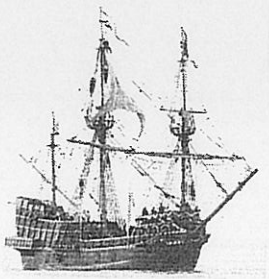
The first recorded example of disease influencing a naval campaign was in 1544, when a French fleet was defeated, not by Henry VIII's ships, but by dysentery which prostrated entire crews on both sides. Besides losing the Mary Rose the following year, the 1545 campaign was noteworthy for a "plague" in 11 of Henry's ships, affecting one quarter of his 12,000 men. He had gathered his fleet with great haste, resulting in a requirement for large quantities of poorly preserved provisions at short notice. While the need to avoid moving men between ships was recognised, there were no quarantine procedures, no link was made with the victualling and no medical advice was sought. Henry wisely responded by demobilising his fleet.[2] Another period of naval neglect led to the decimation of an English expedition to France by an epidemic in 1558, probably related to another victualling failure.[2]

Thomas Wyndham's expedition to Benin (West Africa) in 1553 was left with only 40 survivors out of 140 due to yellow fever, while subsequent expeditions to the area introduced English seamen to malaria.[2] John Hawkins made slaving voyages for the Spanish market to West Africa in 1562, 1564 and 1568, initiating a trade with high risks, high profits and high mortality (especially for the "cargo"). Although his first voyage was disease free and only twenty men were lost on the second, his third voyage ended in disaster when he was ambushed by the Spanish at San Jan de Ulloa in the West Indies.[5] As a result, John Hawkins' younger kinsman Francis Drake learned to carry a surgeon on board and this was reinforced when Drake was wounded during a reprisal raid on Panama in 1572-3.[2]

In December 1577, Drake left England for the Pacific in five ships, carrying 164 men including two surgeons. On the way south, Drake asserted that it was the ship's captain rather than the gentry or soldiers who commanded at sea, by hanging the senior gentleman, Thomas Doughty, for mutiny.

On reaching the Pacific via the Straits of Magellan, his ship Golden Hind was alone. As her master surgeon had died and his mate was no more than "a boy, whose good will was more than any skill he had", it was Drake himself who treated nine wounded men, despite himself having been grazed under the eye by an arrow. Fortunately, like most seamen, his officers had some first aid knowledge.[2] Fifteen months after leaving England, Drake still had 85 men fit and well by obtaining fresh supplies as he plundered various settlements and treasure ships along the American west coast. No sickness appeared until April 1579 off California, where Drake abandoned his search for a Northeast Passage and crossed the Pacific to the East

Indies, taking 68 days with the inevitable scorbutic result. After a month to recover, he proceeded home, returning to Plymouth in September 1580.[2]



Left: *Replica of Drake's Golden Hind*
Length: 70ft (21.3m)
Beam: 19ft (5.8m)
Depth: 9ft (2.7m)
Displacement: c150t
Rigging: Three masted square rig with lateen mizzen
Armament: 18 guns
Complement: 80-85

The first English expedition to China and the East Indies via the Cape of Good Hope left in 1582. Despite being better equipped than many earlier expeditions, the four ships returned the following year, having failed to leave the Atlantic. The names of three surgeons have survived, including John Banester (1540-1610), who lost 45 men (one third of his crew), of whom only three were surgical cases. As previously recounted, in later years Banester lectured on his experiences to apprentice barber-surgeons.

In 1585 Elizabeth lent six ships to Drake for an expedition to the West Indies. All went well until he raided the Cape Verde Islands, where 300 out of 2400 sailors and soldiers died of malaria. The mosquitoes were brought on board, leading to more deaths en route to Dominica and the outbreak only ended in the colder latitudes on the way home. One third of the men died and the link between mosquitoes and disease was missed.[2]

On a more successful note, Thomas Cavendish left for the Pacific in July 1585 with three ships and 123 men. Although this was his first voyage, it seems he had learned from his predecessors, collecting lemons in West Africa and having no scurvy. The only death from wounds was a man shot by an arrow, who had only removed the shaft and refused to let the surgeons remove the head. Cavendish lost only two men from scurvy while crossing the Pacific and one death from illness (possibly dengue) between Java and the Philippines, before his two surviving ships returned home in September 1588.[2]

However, in 1589, James Lancaster left for the East Indies and made a disastrous voyage home from the Nicobars (off Sumatra) with only 33 survivors. A second attempt in 1591-4 with three ships was no more successful, with scurvy appearing early in the voyage forcing one ship to return with 50 invalids. Four men were killed by lightning and 32 by natives near Zanzibar, while Surgeon Arnold of the Penelope died from probable heat exhaustion. On the way home, dysentery forced more men to be landed at St Helena with the second surgeon, where they recovered. Both voyages were to stand him in good stead for his third voyage, in 1601 with the English East India Company.[2]

THE SPANISH ARMADA

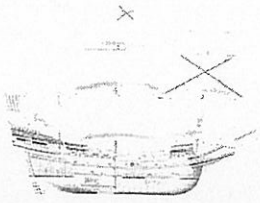
Preparations for a Spanish invasion of England had begun in 1584.[7] After Drake's attack on Cadiz in 1587 successfully delayed its departure, Elizabeth laid up the fleet to save money. The crisis the following year overtook a nation enfeebled by years of poverty and malnutrition. No preventive health lessons from 1545 or 1558 were learned.[2] No clothing was supplied, allowing lice and fleas (hence typhus) on board.[2] Landsmen aboard ship failed to conform to the basic hygiene standards now accepted by experienced seamen, while none were allowed ashore or to undress on board.[2] No arrangements were made for the sick and wounded, and the Company of Barber-Surgeons was not even asked for extra surgeons. By then sea-surgeons were in more or less regular employment and paid the same monthly scale as seamen (10 shillings per lunar month plus twopence per man),[5] but insufficient numbers led to the impressment of unqualified "quacks".[2] The wounded were taken below to the cable tier or laid on the ballast until the fighting was over. In this situation, sea-surgeons could often do little and the wounded were landed in accordance with the Laws of Oléron.[2]

Nevertheless, it was the victualling that led to an English medical catastrophe, with unsanitary conditions and toxic food poisoning taking their toll after as little as a fortnight at sea.[2] The Elizabeth Jonas lost 200 out of 500 men in three weeks while waiting for the Armada in Plymouth. After sending the survivors ashore, removing her ballast and disinfection, she took on a fresh crew, only to lose even more men while pursuing the Spanish fleet.[2] The Privy Council asked the College of Physicians for help and, although four physicians visited the fleet, they could do little. In the event it was the beer (drunk instead of water as it kept better) instead of

the victuals that received the blame.[2] The key problem for the English was that, despite Henry VIII's administrative innovations, their shore organisation remained inadequate.[7]

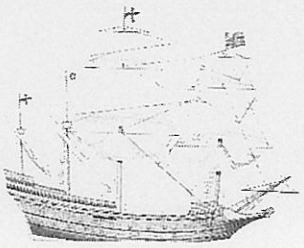
The Armada had 130 ships, of which only 25 were purpose-built warships,[7] while of its 30,000 men, only about 8,000 were seamen. It also had no less than 180 priests but only six physicians and surgeons each, albeit with 62 medical orderlies. The Spanish ships were of the old fashioned "high-charged" type, with high castles to facilitate boarding. The internal organisation of the Spanish ships was the same as their galleys and was comparable to a land fortress, with three classes: soldiers, gunners and sailors. As Spanish ship's captains were only the equivalent of English masters, they were therefore subordinate to the senior military authority, leaving the sailors with the ancient role of getting the ship where the soldiers could board the enemy.[5] As only a few Spanish ships displaced more than 500 tons, overcrowding was a significant problem,[7] yet there were too few seamen to handle the ships effectively.[5]

Armada flagship San Martin
Length: 122ft (37.3m)
Beam: 30ft 5 in (9.3m)
Depth: not known
Displacement: 1000t
Rigging: Three masted square rig with lateen mizzen
Armament: 48 guns
Complement: 350 seamen and gunners, plus 302 soldiers



This contrasted with the English, who had 197 ships with about the same number of purpose-built warships as the Spanish. However, of its 16,000 men, over half were seamen, thereby allowing better ship-handling. The seamen also fought their own guns, thereby avoiding the need for separate gunners who could not sail the ship. Furthermore, as their "race-built" ships were faster and more manoeuvrable than the Spanish ships, the English has the initiative. Finally, in English ships the few soldiers on board were subordinate to the captain, who intended to fight using long-range gunfire instead of boarding.[7]

aEnglish flagship Ark Royal
Length: 140ft (42.6m)
Beam: 37ft 5 in (11.2m)
Depth: 15ft (4.5m)
Displacement: 690t
Rigging: Four masted square rig with lateen mizzens
Armament: 38 guns
Complement: 304 seamen and gunners, plus 126 soldiers



The Armada was ready to depart Lisbon on 25 April 1588, but it did not get to sea until 30 May. Adverse weather and an inability to beat upwind meant it was not until 29 July that it entered the English Channel. These delays and poor food preservation meant, like the English, their huge store of victuals was also going rotten, but without the possibility of resupply. Water supplies were limited to three pints of water per day for cooking and drinking, even before it was found that many water barrels were empty or leaking. The Spanish soldiers were kept below, where they ate and slept in overcrowded and wet conditions, on the bare decks amid vomit and excreta. The effluvia were occasionally washed into the bilges with seawater, where it poured over their decomposing food and tainted water. The bilge pumps discharged their contents only as far as the upper deck, where it either found its way overboard, or was recycled back below. Gastrointestinal disease was therefore inevitable, along with typhus secondary to the lice and fleas that quickly made their way through the overcrowded ships.[7]

Meanwhile, the English searched for the Armada, but failed to make contact until after it entered the Channel. The English fleet sailed from Plymouth and began a series of running battles. Initially there were about 100 English ships, of which only 69 were galleons or galleon-built merchant ships. Despite the better manoeuvrability of the English ships, their shooting at long range proved ineffective, allowing the Armada to maintain its course and formation with the loss of only three ships (only one by enemy action).[5]

The Armada anchored off Calais on 6 August to rendezvous with a force from Spanish Holland for the invasion. Disaster struck the Armada the following evening when it was broken up by English fireships, after which it was driven east into the shallow water

off Gravelines. Having discovered close-range gunfire to be more effective, the reinforced English fleet quickly destroyed four ships and inflicted about 600 killed and 800 wounded before exhausting their ammunition.[5] In response, the Spanish gunfire was negated by poor ammunition, while their attempts to board were easily avoided by their more manoeuvrable "race built" opponents.[7] The Armada avoided total catastrophe only after a wind change allowed it to head north, when the decision was made to return to Spain via Scotland and Ireland.

The English left the Armada to its fate off the Firth of Forth on 13 August, having lost no ships and less than 100 men in action, although total losses from illness are unknown.[5] As they dispersed to various ports along the east coast, the naval administrative system broke down completely, while an epidemic of typhus revealed the limitations of the Laws of Oléron in dealing with large casualty numbers. On 29 August the English fleet commander, Lord Howard, wrote:

"It were too pitiful to have men starve after such a service. I know her Majesty would not, for any good. Therefore I had rather open the Queen majesty's purse something to relieve them than they should be in that extremity; for we are to look to have more of their service; and if men should not be cared for better than to let them starve and die miserably, we should very hardly get men to serve. Sir, I desire that there may be double allowance of but as much as I give out of my own purse, and yet I am not the ablest [wealthiest] man in the realm; but before God I had rather have never penny in the world than they should lack.[5]"

In the event, for many men Howard's plea came too late.

Meanwhile, the Spanish had 3,000 typhus cases as well as the wounded, while even in the best-provisioned ships, three or four men died daily from starvation and thirst.[5] Many ships disintegrated in the north Atlantic autumn and sank without survivors, while at least 26 ships were wrecked on the Irish and Scottish coasts. Many shipwreck survivors were murdered, either by the locals or by the English.[7] Up to half of the Spanish ships never returned home, while the dead probably totalled about 20,000. The dead included about 1,500 killed in action, 6,000 lost at sea, 1,000 by judicial or other murder ashore, and the rest by starvation and illness.[7]

AFTER THE ARMADA

In 1589, Drake led an expedition of over 140 ships to Portugal, but another victualling debacle created problems for his soldiers ashore. After re-embarkation, Drake cruised between the Azores and Vigo before returning to Plymouth with little accomplished, having lost half of his 13,500 men from disease. Despite advancing £253 for medical and surgical supplies, the medical resources had proved inadequate and the lack of experience and expertise of the surgeons was also severely criticised.[2]

In 1591, the Spanish caught an English fleet under Lord Howard off the Azores, with half of his men sick after yet another victualling failure, and cut off Sir Richard Grenville's Revenge from the rest of the English fleet. However, despite having 90 of her 190 men ill in her hold, Revenge held the Spanish off for 15 hours, losing 40 killed and most of the rest wounded, before exhausting her ammunition. After she surrendered, Revenge's hold flooded drowning her sick, and she later sank in a storm with all her survivors and prize crew.[2] The Spanish dead were estimated to be between 400 and 1000.[6]

Cavendish left Plymouth for the Pacific with five ships in August 1591 and this time was less lucky, with scurvy leaving him with one ship and 27 men alive out of 76, before they even reached the Straits of Magellan. Although they recovered by eating "scurvy-grass" and penguins, another 11 died on the way home (possibly from "wet" beri-beri), and with only five men able to work the ship, on arrival she had to be run ashore.[2]

In 1593, John Hawkins' son, Richard, sailed for the Pacific with three ships. Scurvy developed near the equator and, although he had seen "10,000 men with this disease", Richard still failed to link it to the cause. Despite recognising the value of fruit juice as a cure, this was lost within a plethora of theories, such as the sea air, having a dirty ship and lack of exercise. By the time Richard Hawkins reached Santos in Brazil, rats had eaten 80% of his victuals and he only had 24 men fit. His crew recovered with oranges and lemons and remained well until they met a Spanish fleet off Chile, where they had to surrender after a two day battle.[2] Although the English surgeons had lost most of their instruments, they lost no English wounded and they even treated the Spanish casualties after their surgeons proved incompetent. This was probably the first time naval surgeons had made such a positive difference in

treating the wounded. It was in such ships that the relationship between captains with strong medical views and surgeons with limited authority evolved into an effective partnership.[2]

In February 1595, Sir Walter Raleigh sailed with five ships to search for El Dorado in modern Venezuela and Guiana. The main medical interest was Raleigh's evidence that mosquito-borne disease had not yet been carried into this area.[2] However, concerns regarding his credibility were supported by another expedition to the area by Sir Olave Leigh in 1604, which led to nine deaths out of 46 from illness.[2] They were also: "mightily vexed with a kind of Worme (chiggers), which at first was like a Flea, and would creep into the feet especially and under the nayles, and would exceedingly torment us, the time it was in, and more in the pulling out with a Pinne or Needle if they were few. But one of our men having his feet over-growne with them, for want of hose and shooes, was faine to submit himself to the Indians cure, who tying one of his legges first with his feet upward, powred hot melted wax which is blacke upon it, and letting it lye upon it till it was thoroughly cold, the forcibly pulled it off; and wherewithall the Wormes came out sticking in the same, seven or eight hundred in number.[2]"

Another Caribbean expedition the same year was decimated by dysentery, which became an accepted inevitability of visiting the area. Like scurvy and fresh food, the link between dysentery and water quality was missed for centuries.[2] This was evident in the expedition of 21 ships and 2,500 men under Drake and John Hawkins, which left Plymouth for the West Indies in August 1595. The medical preparations seem to have been very good, with Chief Surgeon James Wood, several assistants and medical chests, as well as two spare chests costing £33.16s.2d. each. Slop (spare) clothing was available, as well as advice from Hugh Platt (1552-1608) regarding water and other stores.[2] Years later Platt wrote *Certaine Philisophical preparations of Foode and Beuerage for Sea-men, in Their Long Voyages*, extolling the virtues of boiling and then sealing food, anticipating the development of tinned food 200 years later. He also suggested macaroni as a cheap, fresh and lasting victual, which he thought might have had a useful role at sea.[2]

However, in spite of these preparations, John Hawkins died off Puerto Rico after a six-day illness in November 1595, and on 15 January 1596 Drake himself fell ill, lingering for a fortnight before dying at sea on 28 January, shortly after Wood. By 6 February another 500 men had joined them and the survivors sailed home after scuttling some ships to man the rest.[2] A fourth expedition that year had the same result, with the onset of a "bloody flux and other distempers" forcing a return to England.[2] This expedition's chaplain left a description of the illness:

"It was and extreme loosenesse of the body, which within a few dayes would grow into a flux of bloud, sometimes in the beginning accompanyed with a hot Ague, but always in the end attended by an extreme debillitie and waste of spirits: so that some two days before death, the arms and legs would be wonderfull cold. And that was held for a certain sign of neere departure. This sicknesse usually within a few dayes (for it was very extreme to the number of sixtie, eightie, and one hundred stooles in an artificiall day) brought a languishing weaknesse all over the body, so that one mans sicknesse (if he were of any note) commonly kept two from doing duties.[2]"

This suggests it was typhoid that killed Hawkins, Drake, Wood and so many others.

An expedition to Cadiz in 1596 under Admiral Lord Howard included physician Dr Roger Marbeck, possibly to ensure the care of the Queen's favourite, Lord Essex. The expedition was moderately successful with only a few wounded and no illness.[2]

Surgeons were carried in all these expeditions because the voyages were of great length and the men were exposed to enemy attack. However, as there was no central body for recording their experiences, there was no accumulation of knowledge, which meant the same mistakes were made again and again. It was the English East India Company that later provided such a repository, requiring its surgeons to write medical journals which allowed a scale of medical equipment to be developed for use at sea. The provision of surgeons to East Indiamen later became an important duty for the Barber-Surgeons as it was for the navy and army.[2] The East India Company received its Royal Charter on 31 December 1600 and the following year an expedition left Tor Bay with five heavily armed ships and 480 men under Lancaster. Each ship had two surgeons and a barber each, with each surgeon receiving an allowance of between £20 and £32 for their chests. Having a surgeon and a mate quickly became Company policy as they fought the Portuguese and Dutch for the East Indian markets.[2]

Although Lancaster was able to establish bases or "factories" in Sumatra and Java, the human cost was high, particularly in the Doldrums where calms led to 105 deaths from scurvy.[2] However, by issuing three teaspoons of lemon juice each morning, his own ship remained relatively scurvy-free. Having also used lemons to "purge the scurvy" in Madagascar, Lancaster is credited as the first seaman to use them for both prevention and treatment.[2] However, his success was lost in a plethora of other theories as to its cause, as was his linking of dysentery and water quality. In December 1601 his surgeon, Christopher Newchurch, took poison, not having either the training or anything in his chest to help his patients, while another surgeon died from natural causes. By the time he returned to England in mid 1603, Lancaster had lost over 180 men.[2]

CONCLUSION

The disruption of the English social order, combined with the decline and eventual abolition of the religious orders, destroyed many of the rudimentary health institutions that existed at the end of the Middle Ages. It is ironic that the demand for these institutions increased as English sailors ventured further overseas. Tudor overseas trade was fraught with health risks, both at sea and ashore. The seeds for destruction from scurvy, typhus and dysentery were often sown even before the ships left port, as a result of poor victualling and worse hygiene practices. Even if these had been better, it is probable little could be done regarding the exotic diseases (such as yellow fever and malaria) that wreaked so much havoc, given the inability to even differentiate, let alone diagnose them. There was also a lack of natural immunity to foreign illnesses, although indigenous peoples probably did even worse when exposed to exported European illnesses.

Furthermore, sea-surgeons were there only to treat wounds rather than illness, even when it was the latter that jeopardised the success of the various deployments. They were further hamstrung by legal constraints on their training, which actively prohibited their acquiring any expertise in internal medicine. However, even if they had the training, the level of therapeutic support was limited to hiding rather than treating the cause and, in any case, the physicians' reliance on humoral medicine further militated against their effectiveness. As a result, it is hardly surprising that mortality rates during these voyages sometimes reached suicidal proportions.

Nevertheless, despite the emphasis on theorising at the expense of experimentation and practical experience, some faltering advances were made. The treatment of scurvy had been recognised, and connections had also been made between water quality and dysentery, and mosquitoes and malaria. These connections were probably lost not once but several times, not only because of a lack of peer support, but also because as yet there was no naval medical administrative system.

The story of Tudor naval medicine is therefore one of multiple disasters among occasional successes, the latter including Cavendish's 1585-8 circumnavigation and the post-action casualty care for Richard Hawkins' expedition in 1593. Since the period essentially defined the medical problems associated with going to sea, it was up to their professional seaman and medical successors to develop the solutions.

Comparison of the Tudor period with the provision of ADF medical support in the 21st century suggests at least four common issues. Firstly, it is noteworthy that, despite advances in food technology over the last 450 years, gastroenterological illness remains one of the five major causes of morbidity in deployed forces.

Secondly, it has previously been discussed how the provision of non-operational health support was as much an issue in medieval England, as it remains in 21st century Australia.[1] It will be recalled that the Laws of Oléron focussed on paying for sailor's health care, rather than ensuring that the health care itself was actually available. As there were no internal health care providers, this was only available from the medieval equivalent of external providers. However, after 1500 this rudimentary health care system began to be overwhelmed by the sheer number of disabled seamen, at a time when the loss of the charitable institutions had curtailed the health care ashore for anyone, let alone sailors. At a time when life was cheap and early death inevitable, apart from the efforts of Drake, Cavendish, Richard Hawkins and Lancaster, a key failure during the Tudor period was in not conserving scarce personnel ashore in order to maintain fighting efficiency afloat. It was not until the 1650s that the need for effective health support to conserve personnel assets was first recognised.

Thirdly, the Tudor period illustrated how the relationship between commanders and health providers

began to evolve into an effective partnership. Even despite the limitations of Tudor medical knowledge, Richard Hawkins and his surgeons demonstrated the synergy that can be achieved when, health providers understand their commander's mission objectives and the commanders understand the health provider's requirements in order to facilitate meeting those objectives. Conversely, the Tudor period abounds in examples where either commanders and/or health providers attempted to function independently of each other, invariably to the detriment of the mission objective. It is suggested that this issue remains pertinent to the ADF.

Finally, it has also been previously noted that the need for deployed health assets to treat more than just battle casualties remains an issue for some ADF operational planners. This in turn still has ongoing implications for the status, remuneration, training and legal standing of ADF medical officers.

The low status of Tudor naval surgeons was compounded by low recruiting standards and the tendency for the hierarchy to employ and promote junior medical practitioners irrespective of their professional qualifications. Pay was linked to that of seamen, with an additional allowance that was intended to reflect their special skills but was without reference to civilian qualifications or remuneration. As early as 1588, Clowes had identified the importance of knowing how to improvise in austere environments and had developed the first (unofficial) naval Medical Allowance List (MAL). It is noteworthy that his MAL extended beyond that required to treat battle casualties and that he and his professional colleagues lacked the legal authority to prescribe some items.

Although one would hope recruiting standards have improved since the Tudors, the use of independent medical assistants in the Australian and other navies reflects the need to have some form of health support at sea even when there is no medical officer available. Both this need and the solution were first identified by Henry VIII's navy over 450 years ago. Pay for ADF MOs still reflects a modified "Officer's Commons Scale" that bears no relationship to civilian qualifications or remuneration. Although (unlike their Tudor forebears), permanent and reserve ADF medical officers can practice both medicine and surgery, they still share with them the fact that their professional predeployment preparation is often still less than ideal. Finally, medicolegal concerns continue with respect to providing health services to an acceptable civilian standard, despite the limitations of the deployed environment ashore and afloat.

REFERENCES

1. Westphalen, N. Medieval Naval Medicine: 1200-1500. *Aust Mil Med 2001*; 10(3):128-135.
2. Keevil JJ. *Medicine and the Navy 1200 - 1900. Vol 1* (1200-1649). London: E&S Livingstone; 1957.
3. Westphalen N. Tudor Naval Medicine 1485-1603: Part One. *Aust Mil Med 2002*; 11(2): 107-121.
4.. Stirland AJ. *Raising the Dead: The Skeleton Crew of Henry VIII's Great Ship, The Mary Rose.* Chichester, UK: John Wiley and Sons; 2000.
5. Kemp P. *The Campaign of the Spanish Armada.* Oxford: Phaidon Press; 1988.
6. Nelson A. *The Tudor Navy: The Ships, Men and Organisation 1485-1603.* London: Conway Maritime Press; 2001.
7. Howarth D. *The Voyage of the Spanish Armada: The Spanish Story.* London: Cassell and Co.; 2001.

ABSTRACTS FROM THE LITERATURE

Contributed by James Ross

Neri DF, et al. Controlled breaks as a fatigue countermeasure on the flight deck. Aviat Space Environ Med 2002; 73(7): 654-664.

BACKGROUND

A MAJOR CHALLENGE FOR FLIGHT CREWS is the need to maintain vigilance during long, highly automated night time flights. No system currently exists to assist in managing alertness, and countermeasure options are limited. Surveys reveal many pilots use breaks as an in-flight countermeasure, but there have been in controlled studies of their effectiveness.

HYPOTHESIS

We hypothesised that brief regular breaks could improve alertness and performance during an overnight flight. .

METHODS

A 6-hour uneventful night time flight in a Boeing 747-400 flight simulator was flown by 14 2-man crews. The 14 subjects in the treatment group received 5 short breaks spaced hourly during the cruise; the 14 subjects in the control group received 1 break in the middle of cruise. Continuous EEG/EOG, subjective sleepiness, and psychomotor vigilance performance data were collected.

RESULTS

During the latter part of the night, the treatment group showed significant reductions for 15 min post-break in slow eye movements, theta-band activity and unintended sleep episodes compared with the control group. The treatment group reported significantly greater subjective alertness for up to 25 min post break with the strongest effects near the time of the circadian trough. There was no evidence if objective vigilance improvement at 15-25 min, with expected performance deterioration occurring due to elected sleep drive and circadian time.

CONCLUSIONS

The physiological and subjective data indicate the breaks reduced night time sleepiness for at least 15 min post break and may have masked sleepiness for up to 25 min suggesting the potential usefulness of short duration breaks as an in flight fatigue countermeasure.

COMMENT

An impressively comprehensive study. 6 hours, however, is not the real test; the next generation commercial aircraft will have 20 hours duration. There should be locations for the crew to lie down and get good rest. This contrasts with current aircraft where, in most cases, the crew has to catch their nap in first class. Singapore Airlines was recently castigated for trying to send their resting crew to economy class to maximise returns. I know where I would rather have my pilot taking his needed rest.

Alkins SA, Reynolds AJ. Long distance air evacuation of blast injured soldiers from the USS Cole. Aviat Space Environ Med 2002; 73(7): 677-683.

BACKGROUND

The US military uses a Critical Care Air transport Team (CCATT) to air evacuate critically ill patients to facilities that can provide definitive medical care. CCATT is comprised of highly trained personnel and each team uses specialised equipment to allow for in flight intensive medical care of patients. CCATT has the capability of providing care over long duration and distance. This report describes our recent experience of long-distance fixed wing medical air evacuation of multiple critically ill sailors from the USS Cole.

CONCLUSION

CCATTs can safely transport multiple critical patients with blast injuries over long distance and duration by fixed wing aircraft. Blast injuries can have multi-system effects and patients with subclinical pulmonary injury may be symptomatic when hypoxaemic in a hypobaric environment.

COMMENT

I am a little intrigued as to why the authors talk about duration and distance. Surely the parameter is time and

time alone. It is irrelevant how far you are going in that time.... Still a useful update on the USAF experience with CCATTs, which arose from the doctrine shift of moving only stable patients to stabilised patients. It is also useful to compare this operation with Op Bali Assist.

Mixeu MS, et al. Impact of Influenza vaccination on civilian aircrew illness and absenteeism. Aviat Space Environ Med 2002; 73(9): 876-880.

BACKGROUND

Approximately 10% of the general population worldwide acquires influenza infection every year. Airline crews run a particularly high risk of contracting influenza and influenza-like viruses because they come into contact with hundreds of potentially infected individuals every day. Respiratory diseases are the inst frequent cause of absenteeism among flight crews in airline companies. Several studies have shown the efficacy of influenza vaccination in the workplace of healthy, working adults leading to increased productivity and lower absenteeism. We conducted a double blind, randomised placebo controlled study on flight crews of an airline company in order to determine the safety and efficacy of a trivalent inactivated influenza vaccine in reducing illness and absences from work.

METHODS

The 813 healthy members of a Brazilian airline company were randomly assigned to receive injections of either an influenza vaccine or a placebo, with a follow up period of 7 months after vaccination. Primary outcomes included influenza like illness episodes and absenteeism from work due to such episodes.

RESULTS

Demographic characteristics were similar in the two groups. No significant side effects occurred in either group. Compared to the placebo group, individuals receiving the vaccine showed 39.5% fewer episodes of flu-like illness ($p<0.001$) and 26% fewer days of work lost ($p=0.03$). the vaccinated group developed 33% fewer episodes of any severe flu-like illness ($p<0.01$). Conclusion: The data indicates that influenza vaccination is safe in airline flight crews and may produce health related benefits including reduced absenteeism.

COMMENT

After the reprinting of my article from 1992 in the last AMM, I had to include this. It is very true that frequent travellers will be more exposed to a variety of infective agents. Part of the issue is, however, travel out of the influenza 'season' of their home country and how this should be covered, and exposure to different strains to the ones anticipated and thus included in the typical trivalent vaccine.

Cairns J, Booth C. Salivary IgA as a marker of stress during strenuous physical activity. Aviat Space Environ Med 2002; 73(12): 1203-1207.

BACKGROUND

Immunoglobulin A in saliva (SIgA) has been proven to be decreased during periods of stress, a change that also correlates with increased disease risk. Hypothesis: Concentration of SIgA is negatively associated with dietary deprivation, negative moods and anxiety.

METHODS

SIgA was evaluated as a marker of severe stress during a 19-day Royal Australian Air Force (RAAF) survival course, during which students experienced hunger, thirst, boredom, loneliness, and extreme heat and cold combined with demanding physical effort. There were 27 men and 2 women who participated. Students kept daily food dairies, from which daily intakes of energy and macronutrients were calculated. Saliva samples were collected on day 9 for the measurement of the ratio of SIgA to albumin. Students completed a health checklist and the State Anxiety Inventory on the same day 9 and the Profile of Mood States on 3 of the says.

RESULTS

Dietary restriction, consumption of alcohol, body mass loss, occurrence of upper respiratory tract infection and negative emotions were negatively associated with SIga:Alb. Conclusions: SIgA:Alb is a useful marker of the severity of stresses encountered during stressful training.

COMMENT

This is a study that came out of the Defence Nutrition Research Centre in Scottsdale, Tasmania, sponsored by

Defence Health Service Branch. As a marker of stress and of risk of illness or reduced performance, there appears to be a considerable opportunity. Of course, there are many unanswered questions, such as predictive value, ease of measurement and what to actually do about a low result.

Pflanz S, Sonnek S. Work Stress in the Military: Prevalence, Causes, and Relationship to Emotional Health. Mil Med 2002; 167(11).

OBJECTIVE

This study examined the prevalence and sources of occupational stress for military personnel and the relationship between work stress and emotional health in the military population.

METHODS

Four hundred and seventy-two active duty military personnel stationed at F. E. Warren Air Force Base completed a 65-item survey that included items involving reported life events, perceptions about occupational stress, and perceptions about the relationship between work stress and emotional health.

RESULTS

These military personnel were significantly more likely to report suffering from job stress than civilian workers ($p < 0.001$). One-quarter (26%) reported suffering from significant work stress, 15% reported that work stress was causing them significant emotional distress, and 8% reported experiencing work stress that was severe enough to be damaging their emotional health. Generic work stressors were endorsed more frequently than military-specific stressors.

CONCLUSIONS

More than one-quarter of this sample of military personnel reported suffering from significant work stress and a significant number of these individuals suffered serious emotional distress. These results support previous research suggesting that work stress may be a significant occupational health hazard in the U.S. military.

COMMENT

I find it a little difficult to fathom why work stress should be so much greater in the US military than in the civilian population. The admittedly unrigorous surveys done in the ADF have not revealed anything like the same patterns in this country.

McCrory P. When to retire after concussion? J Sci Med Sport 2002; 5(3): 169-182.

The management of an athlete with recurrent concussions, whether persistently symptomatic or not, remains anecdotal. There are no evidence based guidelines upon which a team physician can advise the athlete. All doctors involved in athlete care need to be aware of the potential; for medicolegal problems, if athletes are inappropriately returned to sport prematurely or in the case of professional athletes held out of sport or retired on the basis of non-scientific recommendations.

COMMENT

McCrory is a neurologist in Melbourne and is the name in concussion in the world. Concussion is a vastly misunderstood phenomenon and has many myths around it. This article would benefit any military doctor who sees more than a fair share of sporting injuries.

McCrary B, Van Syoc D. Permanent flying disqualifications of USAF Pilots and navigators (1995-1999). Aviat Space Environ Med 2002; 73(11); 1117-1121.

BACKGROUND

The USAF devotes great financial and medical assets to the identification and evaluation of USAF aircrew who have been grounded from flying duties for medical conditions thought to be dangerous to the flying mission or personal safety. The purpose of his study is to update the literature and to demonstrate that USAF efforts during the past 19 years have improved our ability to retain experienced aviators.

METHODS

The USAF waiver file was reviewed to quantify the number of USAF pilots and navigators receiving permanent medical disqualifications from flying duties during 1995-1999. We identified 157 cases, which were stratified by age group and sex.

RESULTS

The number of disqualifications increased incrementally by age group. The most common diagnoses resulting in permanent disqualification were coronary artery disease, hypertension, back pain and disk abnormalities, migraine headaches, diabetes mellitus and substance/alcohol abuse.

DISCUSSION

These results are very similar to those reported in a 1984 USAF study and other studies of aviation populations. The rate of permanent flying disqualifications in this study was equal to 0.18% per year compared to 4.1% per year in 1984. This decrease in the rate of disqualifications could be due to modification of USAF standards, utilisation of clinical management groups, new technology or therapies, better screening of applicants and effective preventive medicine efforts throughout the Air Force.

COMMENT

4.1% per year permanent disqualification? That would amount to pretty much EVERY pilot being medically grounded by the end of a 20 year career. That is palpable nonsense, and this study returns figures to a realistic level. It must call into question the earlier study's methods. The USAF has a very comprehensive system whereby any aircrew member who requires medical evaluation is assessed by a specialist panel at the specialist consultation service at Brooks Air Force Base.

Buckingham R, et al. Vision readiness in Operation Restore Hope. Mil Med 2002; 167(7): 532-536.

Ensuring that our forces are vision ready for their mission is essential on today's battlefield. Vision readiness considers optical readiness (appropriate correcting eyewear) and visual readiness (adequate job-required visual acuity). A study of vision readiness among deploying personnel for Operation Restore Hope in Bosnia from December 1995 to September 1997 was conducted at Fort Benning, Georgia. Of the 10063 personnel screened, 3554 (35.3%) were not optically ready for deployment and 406 (4.0%) were not visually ready for deployment. Analyses indicted a statistically significant difference between the active duty and reserve components in optical and visual readiness. A more effective vision readiness process should be implemented before deployment to ensure that all personnel are deployment ready. Optometry personnel, commanders and deploying soldiers, sailors, airmen and marines must take a more active role in ensuring that our forces have the appropriate visual acuity and optical devices to deploy.

COMMENT

I haven't seen a similar study to before this. Over 10000 subjects is an impressive number. It doesn't matter what the standards are that are being screened for, the point is the percentage that do not meet whatever the standard is. Certainly enough to have us wondering in Australia about how ready our personnel are.

MISSING

AMMA MEMBERS

Name	Formally of:	State
COL GLENN WELLS	Mascot	NSW
FLTLT SCOTT SMITH	Yeronga	QLD
LEUT MARK BOLT	Williamstown	VIC
SGT STEWART ROBERTSON	Macleod	VIC
LTCOL STEPHAN RUDZKI	Texas	USA
LEUT MICHAEL STONE	Amaroo	ACT
DR BILL PASPALIARIS	East Melbourne	VIC
COL EDWARD/DAVID LEWIS	Townsville	QLD

If you know how we can contact any of the above people, please advise the AMMA Secretariat: Leishman Associates: (03) 6234 7488

AMMA UPDATE

MARCH 2003

News and Information for members of the Australian Military Medicine Association

SUCCESSES

THE FOLLOWING AMMA members have achieved success through honours, awards, promotions, publications, etc.
Members will note that these items are not complete. The Editor needs sources of information from the three Services and from our civilian members as well, so that this section of your journal can truly reflect the cross-section of our membership. Updates can be faxed to CAPT Andy Robertson on (02) 6266 2314 or emailed to andyandlaura@bigpond.com

DEFENCE FORCE PROMOTIONS

- CMDR Robyn Walker to CAPT and posted to J07 HQAST
- LTCOL Steve Rudzki to COL and posted to DPH
- LCDR Ken Walters to CMDR
- LCDR Hazel Smith to CMDR
- MAJ Ros Blakley to LTCOL

DEFENCE FORCE MOVEMENTS

- LTCOL John Turner to CO 2 HSB and LTCOL Len Brennan to CO 1 HSB
- CMDR Alison McLaren to DFMO
- WGCDR Tracy Smart has posted as OC IAM.

RETIREMENTS

- COL David Hutton has retired to Lismore as CEO Northern Rivers AHS.
- LCDR Dale and Alison Thomas have resigned and intend to stay in the Nowra area.

AWARDS & GRANTS

AMMA have a number of awards and grants available to members. Deadline for all awards is 30 June 2003.
For those wishing to do a research project within Defence, the project must be approved by ADHREC (The Australian Defence Human Research Ethics Committee). Information kits for new researchers are available from the ADHREC Executive Secretary on: Tel: (02) 6266 3818
Fax:(02) 6266 4982

Research Grant - $1000
A grant presented towards new or ongoing research.

Journal Editors Prize - $750
For best paper by an AMMA Member published each year in the AMMA Journal.

Patron's Prize - $250
Best article published in a peer-reviewed journal by an AMMA member – must be a health related article.

Australian Military Medicine Prize - $500
Best essay by an AMMA Member on a chosen topic. The topic for 2003 is: "*The Challenge for the Future. Recruiting and Retaining the Best People for Defence Health Operations*".

For further information contact the AMMA Secretariat or visit the website.

AMMA CONTACTS

For all general AMMA inquiries contact the Secretariat.
Leishman Associates:
Tel: (03) 6234 7844
Fax: (03) 6234 5958
Email:
secretariat@amma.asn.au
Website: www.amma.asn.au

AMMA WEBSITE

Visit AMMA's website at:
www.amma.asn.au
The web site is constantly evolving and any contributions are welcome.

AMMA CONFERENCES

2003 Conference
The 12th AMMA Scientific Conference will be held in South Australia from the 17th – 19th October 2003. Submit Call for Papers online now. The program will be posted to all AMMA members. Visit: www.amma.asn.au

JOURNAL

Journals for 2002/2003 will be published as follows:

Issue	Copy Deadline
June 2003	30/04/03
Sept 2003	31/07/03
March 2004	31/01/04

All queries regarding the Journal should be directed to the editor:

Andy Robertson
Tel: (02) 6266 4483
Fax: (02) 6266-2314
Mobile: 0410 626 829
Email: andyandlaura@bigpond.com

CONFERENCE AND MEETING CALENDAR

Date	Conference	Venue	Contact No.
24-27 April 03	Australasian College of Tropical Medicine	Melbourne	info@leishman-associates.com.au
2-3 May 03	Environmental & Occupational Health Conference	Brisbane	Meg Frugtniet Meg.Frugtniet@cbr.defence.gov.au
6-10 May 03	World Conference on Disaster and Emergency Medicine	Melbourne	RParry@meetingplanners.com.au
10-11 May 03	Controversies in Civilian & Military Trauma	Brisbane	www.traumalink.com.au
11-16 May 03	Asia Pacific Military Medicine Conference	Bangkok, Thailand	
26-28 May 03	RACP Annual Conference	Hobart	www.racp.edu.au/asm
11-16 Aug 03	6th Annual Force Health Protection Conference	Albuquerque, USA	http://chppmwww.apgea.army.mil/fhp
17-19 Oct 03	**AMMA 12th Annual Conference**	**Adelaide, SA**	**secretariat@amma.asn.au**
16-21 Nov 03	AMSUS Meeting	San Antonio, USA	www.amsus.org/
May 2004	Defence Health Syposium / APMMC	Brisbane	

AMMA ON THE NET

Conferences:	Medical Conferences	http://www.pslgroup.com/medconf.htm
Journals:	Medical Journal of Australia	http://www.mja.com.au/
	New Scientist	http://www.newscientist.com/
Military Medicine:	AMSUS	http://www.amsus.org/
	Armed Forces Infectious Diseases Society	http://www.wramc.amedd.army.mil/afids/links.htm
	Association of Military Osteopathic Physicians and Surgeons	http://www.amops.org/
	Defence Health Service	http://www.defense.gov.au/dpe/dhs/
	Navy Corpsman	http://www.corpsman.com/
	Finnish Museum of Military Medicine	http://www.travel.fi/int/mmm/
	Henry Jackson Foundation for the Advancement of Military Medicine	http://scoop.hjf.org/
	International Association of Military Flight Surgeon Pilots	http://www.geocities.com/Pentagon/2265
Professional Colleges:	Military Medical Links	http://flash.lakeheadu.ca/~cfms/links.html
	ANZCA	http://www.anzca.edu.au/
	RACGP	http://www.racgp.org.au/
	RACMA	http://www.racma.org.au
	RACP	http://www.racp.edu.au/
	RACS	http://www.racs.edu.au/

INSTRUCTIONS FOR AUTHORS

Australian Military Medicine welcomes articles and other contributions on all aspects of military health care. Articles submitted may be subject to peer review. Articles must be offered exclusively to *Australian Military Medicine* for publication. Articles which have been published elsewhere will only be considered if prior approval has been received from the original publisher and they are of importance to the field of military medicine. All accepted manuscripts will be subject to editing.
Contributions should be sent to:

The Editor
Australian Military Medicine
16 Gaylard Place
Gordon, ACT 2906
andyandlaura@bigpond.com

MANUSCRIPT REQUIREMENTS

One hard copy and one electronic copy of the manuscript should be submitted. The typed copy should be typed double-spaced and single-sided on A4 paper. The electronic copy should be on disk or sent by e-mail. The text in both hard and electronic copies should be unformatted. The electronic copy may be in any common word-processor format.

Contributions should be between 500 and 5000 words in length. Letters to the Editor should not exceed 500 words or 10 references. The Editor may consider any contributions outside these limits. Any articles reporting on human subjects involved in experiments must contain evidence of approval by the relevant institutional ethics committee.

The title page should include the article title; list of authors, including details of their full name, military rank, postnominals, position and institutional address; and, preferably, an abstract of the article (150-200 words). Contact details for the principal author, including postal address, e-mail address, telephone and fax numbers, should also be included.

Headings and sub-headings should be consistent throughout the article and conform with articles previously published in the Journal. No text, references, or legends to figures or tables, should be underlined.

Illustrations, figures and pictures should not be embedded in the document. Their intended position, however, should be clearly indicated. Illustrations and pictures should be saved as separate documents in high resolution (300dpi) TIFF or JPEG formats. Tables may be embedded in the paper.

Photographs may be black-and-white or colour. They should be provided in soft-copy, preferably as high resolution (300dpi) TIFF or JPEG files, but may be provided as hard-copy. Slides must be converted to soft-copy graphics files or to photographs.

Abbreviations mean different things to different readers. Abbreviations are only to be used after the complete expression and the abbreviation in brackets has appeared. For example, the Australian Defence Force (ADF) may then be referred to as the ADF.

SI units are to be used for all articles. Any normal ranges should also be included.

References should be in accordance with the "Vancouver" system (see *MJA* 1991; 155: 197-202, or www.mja.com.au/public/information/ uniform.html). References in the text should be numbered consecutively as they are cited and should appear as superscript numbers (e.g. text[1,2]). References are collated at the end of the article. Annotation of the references should accord with the abbreviations used in *Index Medicus*. Where there are seven or more authors, list only the first three then use *et al*. Authors are responsible for reference accuracy. An example of the reference system is as follows:

1. Quail G. Asthma in the military. *Aust Mil Med* 2000; 9(3):129-137.
2. Bowden M. *Black Hawk Down*. New York: Atlantic Monthly Press; 1999.

Reprinting of articles may be authorised by the Editor, with the author's consent, if an acknowledgment, quoting both the Journal and the original date of publication, is printed with the article.

AUSTRALIAN
MILITARY MEDICINE

MARCH 2003 – Volume 12 – Number 1 ISSN 1443 7058

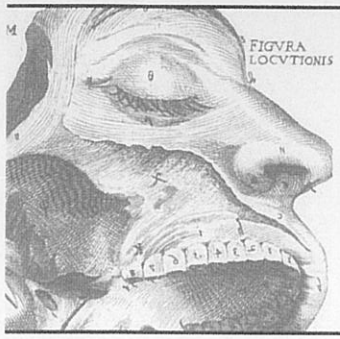


TABLE OF CONTENTS

*Peer Reviewed Articles