



# AUSTRALIAN MILITARY MEDICINE ASSOCIATION

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## 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.

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**ERRATUM**

**Volume 15 No. 1 – Page 15**

The Authors of the article Employment in the Australian Army after Anterior Cruciate Ligament Reconstruction – A Pilot Study of 3 Year Postoperative Outcomes

Should be CAPT **Patrick** Weinrauch and COL Peter Sharwood.

Apologies to Patrick for the incorrect name.

# IN THIS ISSUE

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In this final edition of the Australian Military Medicine Association's scientific journal -- *Australian Military Medicine* -- there is a wealth of material which will give you an opportunity to see what the future holds for the Association's new journal which will be launched in June, the *Journal of Military and Veterans' Health*.

Neil Westphalen's paper on a workplace assessment of smoke used during Navy damage control training, demonstrates that the risks to the servicemen are not limited to those related to combat. It also demonstrates the rigorous processes that the Defence Health Services are involved in when identifying, researching and advising on hazards and risks to defence personnel. Given that the health effects of chemical substances people are frequently exposed to often do not become apparent for many years, this process of workplace assessment is critical in ensuring that people are protected not only in relation to their immediate health but also that Defence works to ensure that there are no repetitions of some of the well publicised long-term health impacts from activities that personnel are required

to perform.

In this month's republished article, Art Smith, who presented on medical command during sea-based operations at the 2005 Conference in Launceston, has written a paper covering this subject which was first published in the Naval War College Review. Medical command and control in maritime operations is always a challenge, related to limited access to communications, long distances, limited logistics and the priority of operations over health support. In his paper, Art demonstrates that without proper forward medical command during maritime operations there is a risk that the standard of health care may be reduced to the deplorable state that occurred during the Gallipoli Campaign.

This edition of the journal is rounded out with two short papers by Corporal Ky Wittich and Private Charles Stevenson who submitted their papers as their applications for the 2006 Conference Scholarship. The second group of essays submitted will be published in the next journal.

# EDITORIAL

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This is the last issue of the Australian Military Medicine Association journal to be published in the current format and under the name *Australian Military Medicine*.

*Australian Military Medicine* as an entity arose from the Association's newsletter which has been published since 1991. It has grown and developed into a journal that publishes scientific and professional work in the areas of military medicine and health. It is also the vehicle by which the Association keeps in contact with its members.

As a result of considerable work by a newly formed Editorial Board, the Association is now ready to launch a new journal that will take this subject area into a new dimension in a way that will promote military medicine and health and also the Association.

This initiative has come about through the close cooperation between the Association, the Defence Health Services and the Centre for Military and Veterans Health. At a meeting held some 18 months ago, the leaders of these groups met and agreed that there was a need to consolidate and strengthen the medium for the provision of the scientific and professional publication to advance the knowledge and understanding of military medicine and health issues in Australia.

It was agreed that the best means to do this was to focus this effort into one broadly published independent journal. The Association as representing this broad and independent base and with a Constitution that requires it to publish a journal was eager and willing to take the leading role in and ownership of such a publication.

Following from this meeting, the Association has taken the lead in establishing an Editorial Board with representatives from each of these groups and representatives from some of the key institutions that are involved in military and veterans' health research and support.

The Editorial Board is currently constituted of the

following members:

- Russ Schedlich – AMMA (Editor-in-Chief)
- Scott Kitchener – AMMA
- Peter Leggat – Defence Health Services
- Graeme Cannell – CMVH
- Keith Horsley – Department of Veterans' Affairs
- Malcolm Sim – Monash University
- Bob Stacy – University of Ballarat

The Board has taken the view that the presentation of the new journal must be such as to give it the opportunity to achieve a leading status both regionally and internationally in the areas of military medicine and health. It believes that this can only be achieved by taking what might be regarded as a "cradle to grave" approach to the subject. In this context, it is now well recognised that there are major military health effects that last well past a service person's discharge from active duty and that result from insults that occur during service.

As a first step, the Board recommended and the Association's Council agreed that the title of the journal should be the *Journal of Military and Veterans' Health*.

The journal will aim to include content related to both contemporary military medicine and health issues as they impact on the serving member whilst also focusing on the longer term issues that affect both the older serving member and those who have retired or moved to other activities.

The journal will be published four times per year and will be supported by limited online publication through a new web site: [www.JMVH.org](http://www.JMVH.org)

The first journal in the new form will be published in July 2007. I am sure that it will build on the work of Australian Military Medicine in promoting military medicine and health but at the same time will take it to a new dimension for the future.

**Russ Schedlich**

# PRESIDENT'S MESSAGE

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Once again a new year is upon us, and in the blink of an eye we are nearly one quarter of the way through it. It seems like only yesterday that we were enjoying the conviviality of networking and the mentally stimulating environment of the 2006 Defence Health Services/ Australian Military Medicine Association Scientific Conference in Brisbane.

This second of the joint symposia/conferences was equally as successful as the first in 2002. Over 500 delegates attended, and were treated to four days of high-quality, well researched and well thought out papers. There were a wealth of international speakers and delegates, but as always the work of our local people was to the fore.

As one would expect from the State whose motto is “beautiful one day perfect the next”, Brisbane turned on its usual warm sunny climate, but with just a dash of rain to give us hope that perhaps the drought will not last forever.

We continue to see in the world abroad the ongoing commitment to the various military operations which require significant health support. The Defence Health Services continue to be in the forefront of the effort to support Australia's contribution to these activities.

In recent weeks we have again been reminded of the potential for our troubled region to impact on our lives

and require the commitment of health professionals to support Australia's nationals in difficult working environments.

While the recent earthquake in Sumatra did not directly impact on our people, the tragic air crash at Yogyakarta involving some 10 Australians, five of whom lost their lives, once again mobilised Australia's health services in support. As always, the involvement of the ADF was significant in both deploying teams into location and in evacuating the wounded home.

2007 will be highlighted for the Association in two significant events. First, the launching of the Association's new journal – the *Journal of Military and Veterans' Health* – which will occur in June, and whose formation is detailed in the Editorial.

The second event will of course be the Association's Conference, to be held in Melbourne from 19 to 21 October 2007. While this conference will not be on the scale of the 2006 joint conference, I have no doubt that both the quality of papers and the ability to significantly network will make it just as valuable and exciting. Details of the conference venue are included in the Journal, and I look forward to seeing you there.

**Russ Schedlich**

# REPORT ON THE 2006 AUSTRALIAN MILITARY MEDICINE ASSOCIATION/ DEFENCE HEALTH SERVICES CONFERENCE

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The 15th Australian Military Medicine Association scientific conference was held in conjunction with the Defence Health Service conference at the Brisbane Convention and Exhibition Centre from the 19th to the 22nd of October 2006.

The genesis of the concept of a joint conference occurred in the latter part of 2005 when discussions occurred between the Head Defence Health Services, Air Vice Marshal Tony Austin RAAF, and the President of the Association, Dr Russ Schedlich. An appropriate management plan and cost- and risk-sharing arrangement was developed and agreed and this allowed planning of the conference to progress expeditiously, with management and secretarial support being provided by the Association's Secretariat.

Under the guidance of Organising and Scientific Committees, the conference rapidly developed into a four-day event with over 130 papers being presented by a variety of international and Australian speakers.

Over 570 delegates attended the conference, with representatives from the United States, United Kingdom, the People's Republic of China, Indonesia, New Zealand and the Papua New Guinea Defence Force.

The conference was honoured by the presence of the Hon Dr Brendan Nelson MP, Minister for Defence, who gave a very personal and inspirational speech covering the historical and contemporary commitment of health professionals in supporting military personnel who are deployed to operations, as well as providing disaster and humanitarian relief when called upon to do so. Dr Nelson's speech was warmly received by the delegates with a standing ovation. Dr Nelson also indicated that he would accept an invitation by the President to become a member of the Association, recognising his unique position as a health practitioner and the executive head of the Defence Force.

Through the course of the subsequent four days, delegates were addressed in plenary and concurrent sessions by Australian and international keynote speakers as well as others who had researched and put together papers.

The Association was honoured to have the annual Australian Defence Force Nurses Conference held in conjunction with the event, and accordingly there was a

significant contribution by the ADF nursing profession. Keynote presentations were made by Professor Mary Chiarella from the University of Technology Sydney and Professor Judy Lumby the President of the National College of Nursing.

Another significant theme running through the conference was that of mental health.

The psychological impact of both combat and humanitarian relief operations are only now coming to be widely recognised and accepted. Papers presented at the conference covered the historical aspects of these conditions, covering also contemporary practices and looking to the future. The heavy burden of psychological illness on veterans from recent war was elucidated and discussed.

Keynote speakers covering mental health issues included Professor Harry Holloway from the Uniformed Services University of the Health Sciences in the United States, Prof Lars Weisaeth from the Norwegian Centre for Violence and Traumatic Stress, and Professor Sandy McFarlane from the Australian Centre for Post Traumatic Mental Health.

Another key theme running through the conference was leadership. This issue was addressed by the Head Defence Health Services, Tony Austin, as well as the Surgeon General, Rear Admiral Graeme Shirtley. Other contributors included the former President of the Australian Medical Association, Dr Bill Glasson.

Thought provoking papers were also delivered on matters around the health workforce in supporting ADF operations as well as the challenges that face Defence and the community in redesigning the health workforce and models of care to meet health care needs, and addressing the age-old tension between the medical and nursing professions.

The final session on the closing day was an Ethics Panel Discussion, with leading papers covering whistleblowers, privacy and ethics in Defence Force research. The highlight of this, and one of the highlights of the whole conference, was an address by Toni Hoffman, the Nurse Unit Manager of the Intensive and Coronary Care Units at Bundaberg hospital who "blew the whistle" on Dr Jayant Patel in 2005. This was a powerful and personal presentation of the challenges

and dilemmas facing somebody who, having identified a matter of grave concern, must address and overcome conflicts between what is right and what is seen by others is being an abuse of the organisation.

On the social front, a Welcome Reception was held on the first evening, and the Conference Dinner on the Saturday evening, which was attended by well over 500 delegates and partners, was addressed by noted writer and broadcaster and former Wallaby, Mr Peter FitzSimons. Peter delivered a superb and entertaining after-dinner speech which covered not only the rather more humorous side of rugby union, but also the much more sober and serious issues that are intertwined in his important military historical books on Tobruk, Kokoda, and Nancy Wake. These themes included a significant focus on health matters.

There is no doubt that this conference was one of the best the Association has ever held. The only larger conference that has been held was a similar combined Defence Health Services conference in 2002 where over 600 delegates attended. The quality of the papers, supplemented by the significant opportunities for networking among serving, supporting and retired Defence Health professionals no doubt contributes to the further advancement of the art, science and practice in military and veterans' health.

In closing, I must pay tribute to the Organising and Scientific Committees, whose members are listed below, and who worked tirelessly and largely in their own time to develop a conference and scientific program that was second to none. I also thank our sponsors, who contributed significantly to the financial viability of the conference. And of course, but for the Association Secretariat, Paula Leishman and her team, there is no doubt that this conference would not have occurred but for their efforts.

This year's conference will be held in Melbourne from the 19th to the 21<sup>st</sup> of October 2007. I'm sure we'll maintain the same quality of papers as in last year's conference, and I encourage all members and non-member attendees at this conference to help make it a great event by being there. I look forward to seeing you.

#### **Russ Schedlich**

#### **President**

**AMMA**

#### **Organising Committee**

Dr Nader Abou-Seif  
Col Beverley Wright  
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Mr Geoff Robinson

Brig Tony Gill

Dr Helen Kelsall

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# 16<sup>th</sup> ANNUAL AMMA CONFERENCE

You are invited to attend the  
**16<sup>th</sup> Annual AMMA Conference** to be held  
at the Sebel Albert Park (formerly Carlton  
Crest), Melbourne Victoria from  
**19-21 October 2007.**



The Keynote Speaker is Prof Simon Wessely, Professor of Epidemiological and Liaison Psychiatry King's College London, Head of the Department of Psychological Medicine, Institute of Psychiatry and Director of the King's Centre for Military Health Research.

*Please visit the AMMA website at [www.amma.asn.au](http://www.amma.asn.au) for further information, including call for papers and registration.*

# Workplace Assessment 2005-1 - Shell Ondina<sup>®</sup> Oil 15 RAN School of Ship Safety and Survivability – West (SSSS-W) HMAS Stirling

N Westphalen<sup>a</sup>

## INTRODUCTION

The School of Ship Safety and Survivability – West (SSSS-W) at HMAS STIRLING is one of three Royal Australian Navy facilities responsible for shipboard damage control training. For many years these facilities used diesel fuel for realistic firefighting training, however concerns regarding environmental issues, and trainee and instructor exposure to diesel smoke, resulted a change to LPG fire sources and separate smoke generators from 1995, the latter using Ondina<sup>®</sup> Oil 15 from Shell Australia.

This workplace assessment (WPA) results from concerns expressed vide Reference A after a SSSS-W occupational health and safety audit in July 2004, regarding the use of Ondina<sup>®</sup> for this purpose, given the proximity between the smoke outlets in the Gas-Fired Firefighting Unit (GFFFU) to naked flames, in temperatures of up to 300°C. Although both trainees and instructors use Open Circuit Compressed Air Breathing Apparatus (OCCABA), the latter were also interested in perhaps using full-face respirators as an alternative to OCCABA, to facilitate better communication within the GFFFU.

## AIM

The aim of this WPA was to assess the hazards to instructors associated with Ondina<sup>®</sup> smoke, using full-face respirators as an alternative to OCCABA.

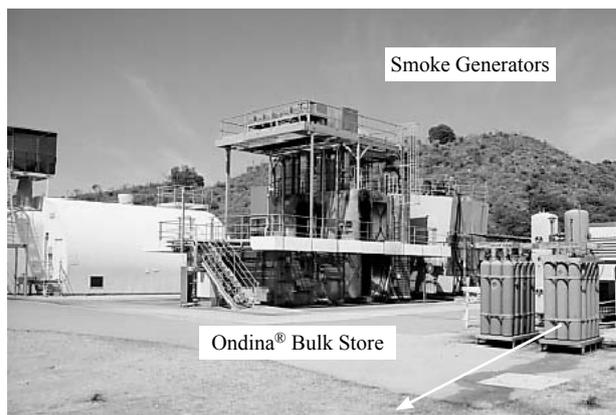
## SCOPE

The scope of this WPA does not include Ondina<sup>®</sup> handling or storage, or the use of respirators with other chemicals at SSSS-W, such as triethylene glycol in the submarine damage control trainer, or O-Chlorobenzylidene Malonitrile (CS gas) for nuclear, biological and chemical training.

### Description of SSSS-W Firefighting Processes

**Physical Description.** SSSS-W is 1.4 km north of Fleet Base West. The GFFFU is approximately 200m southwest of the SSSS-W office/ classroom building. Ondina<sup>®</sup> is piped from a bulk stowage to six smoke generators atop the GFFFU (one per GFFFU compartment). Each generator heats the oil to produce smoke without combustion, which is blown a fan via ducting to the compartment. SSSS-W staff advised that 4.5 litres of Ondina<sup>®</sup> is consumed for every hour of constant running of all generators. GFFFU training entails one instructor monitoring all compartments from a central passageway, the door to which is used by trainees to enter to GFFFU to begin firefighting.

**Exposure Rates.** SSSS-W has eight staff, all of whom work in the GFFFU. There are up to 24 trainees per course, which include:



*The SSSS-W GFFFU, showing the smoke generators and Ondina<sup>®</sup> bulk store*

**1. Advanced Course.** Advanced courses are provided approximately eight times per year (ie 192 personnel per year).

**Damage Control Instructor's (DCI) Course.** DCI courses are provided approximately five times per year (ie 120 people per year).

**Pre-Workup Training (PWT).** PWT is used to work up entire ship's companies (up to 220 people) prior to deployment. As each ship undergoes PWT at least annually, about 1660 personnel are exposed.

Instructors are therefore exposed at a rate of approximately 80 to 85 courses per year. Notwithstanding the use of OCCABA some smoke exposure is inevitable, not only in the GFFFU but also the immediate area outside. Most trainees are exposed

<sup>a</sup>CMDR Neil Westphalen, HMAS Stirling, WA

for up to 20 minutes (once only each), while instructors may be exposed for up to four hours at a time, in three or four 20 minute blocks.

**SSSS-W SAFETY RECORD**

Review of SSSS-W’s incident log from February 2003 to September 2004 showed a total of 19 incidents, all of whom only involved trainees. Most injuries consisted of minor burns and soft tissue injuries; none involved Ondina® smoke.

**ONDINA® DESCRIPTION**

The Shell Australia Technical Data Sheet (TDS) describes Ondina® as a white mineral oil that has been refined to virtually eliminate Polycyclic Aromatic Hydrocarbons (PAH). It complies with US and UK pharmacopoeia regulations, and US Food and Drug Administration food additive regulations. It is not classified as dangerous per the Australian Code for the Transport of Dangerous Goods.

The only relevant section of the Shell Australia Materiel Safety Data Sheet (MSDS) for Ondina®, is that with a flash point of approximately 170°C, it is combustible only if preheated. The upper and lower explosive limits are the same (0.45 % v/v). The only reference with respect to hazardous combustion products is that they contain carbon oxides.

**LITERATURE SEARCH**

The Shell Technical data Sheet (TDS) states that the use of Ondina® for smoke generation is not recommended, although the reason was not specified.

References B-D are occupational health assessments of Australian and UK naval firefighting training facilities during the 1980’s. As Ondina® was not used at the time their relevance in the current context is marginal. As these assessments are 20 years old, an update may be useful.

The US Army document vide Reference E describes ‘fog oil’ as an oil smoke produced by injecting mineral oil into a heated manifold. The oil is vaporized on heating and condenses when exposed to the atmosphere, producing respirable particles. The specifications for fog oil were changed in 1986 to require the removal of all carcinogenic components or additives. The US Army Centre for Health Promotion and Preventive Medicine estimates that the maximum permissible TWA for fog oil is 5 mg/m<sup>3</sup>, 15 minutes is 360 mg/m<sup>3</sup>, one hour 90 mg/m<sup>3</sup>, and six hours is 15 mg/m<sup>3</sup>.

Reference F studied the use of mineral oil and other chemicals for theatrical smoke, with 439 adult actors in 16 musicals in 1997-99. It concluded:

- a. No evidence of serious health effects was found to be associated with exposure to mineral oil smoke.
- b. Elevated exposures to mineral oil smoke are associated with increased reporting of throat symptoms.
- c. There was no evidence of an additive or multiplicative increase in effect from exposure to more than one of the types of theatrical effects evaluated in this study.
- d. Other factors besides theatrical effects associated with increased symptom reporting included perceived levels of stress, performance schedule, and level of physical effort.
- e. Based on the observed association between increased signs and symptoms of respiratory irritant effects and exposure to elevated levels of mineral oil, it was recommended that exposures not exceed peak concentrations of 25 mg/m<sup>3</sup>, and TWA exposures should be kept below 5 mg/m<sup>3</sup>.

However, a major limitation of References E and F is their lack of relevance in the SSSS-W context, where Ondina® smoke coexists with high temperatures and naked flame.

**HAZARD IDENTIFICATION**

**Hazard 1: Particulate Inhalation.** The means by which Ondina® is used to make smoke suggests that the particulates mostly consist of amorphous carbon (carbon soot, or carbon black). The International Agency for Research on Cancer (IARC) noted that, although there is *sufficient evidence* of carcinogenicity in experimental animals for carbon black and its extracts, there is *inadequate evidence* in humans. IARC therefore classifies carbon black as a respiratory irritant and a Group 2B (*possible*) human carcinogen.

Besides its own properties, carbon soot usually contains complex organic molecules, including PAHs and other carcinogens. Although the dose of Ondina® smoke required to (possibly) cause cancer is far more than for diesel smoke because the former lack PAHs, the presence of LPG combustion byproducts at temperatures of up to 300°C may result in the formation of PAHs and other carcinogens. However, Shell Australia has advised that this only occurs at temperatures exceeding 800 to 1000°C.

f. The nature of the task means that the unmitigated probability of inhaling Ondina<sup>®</sup> smoke particulates at SSSS-W (within or without the GFFFU) is almost certain. With respect to unmitigated hazard severity:

**g. Particulates Within GFFFU.** As only enough smoke is produced within the GFFFU to limit visibility without total obscuration; it is likely that these probably do *not* exceed the NIOSH IDLH limit of 1570 mg/m<sup>3</sup>. The unmitigated hazard severity is therefore at most major.

**Particulates Outside GFFFU.** NIOSH has a Recommended Exposure Level (REL) for mineral oil smoke of 3.5 mg/m<sup>3</sup> Time Weighted Average (TWA), compared to Reference F, which recommended that TWA exposure should be less than 5 mg/m<sup>3</sup>. SSSS-W's incident reporting suggests that the unmitigated hazard severity outside the GFFFU is at most minor.

**Hazard 2: Toxic Gases.** The Ondina<sup>®</sup> MSDS states that the main combustion products are carbon oxides (ie CO and CO<sub>2</sub>). CO can cause harm via its greater affinity for the haemoglobin molecule compared to O<sub>2</sub>, while the latter is only toxic because it can displace O<sub>2</sub> from the air.

**a. CO Within the GFFFU.** The NOHSC exposure standard for CO is 30 ppm TWA, with no STEL. The unmitigated hazard severity for CO is considered critical, while exposure to CO within the GFFFU is almost certain.

**b. CO Outside the GFFFU.** As it can still cause

harm outside the GFFFU, the unmitigated hazard severity for CO is still considered at least minor. Exposure to CO outside the GFFFU remains possible.

**c. O<sub>2</sub> Depletion Within the GFFFU.** NOHSC has no exposure standard for CO<sub>2</sub>, stating only that the only requirement is that a sufficient O<sub>2</sub> concentration be maintained. If this is not achieved within the GFFFU, the unmitigated hazard severity is considered major.

**d. O<sub>2</sub> Depletion Outside the GFFFU.** As CO<sub>2</sub> is highly unlikely to displace enough O<sub>2</sub> to cause health problems outside the GFFFU, the unmitigated hazard severity is considered insignificant.

**2. Hazard Quantification.** With respect to the use of respirators by instructors as an alternative to OCCABA, the most important hazards were considered to be CO and O<sub>2</sub> depletion within the GFFFU. It was considered that quantifying smoke particulates was required only if the CO and O<sub>2</sub> results did not preclude the use of respirators.

3. These were quantitatively assessed using a calibrated Sentsortec Impact Pro gas analyser from Zelweger Analytics, which measures O<sub>2</sub> flammables, O<sub>2</sub> and H<sub>2</sub>S. Measurements were taken at either end of the instructor's passageway with the entry door shut or open (but covered by a fire hose on the 'waterwall' setting, and with the GFFFU shut down, with smoke only, and with smoke and flames. The results are as follows.

GFFFU Status	Passage End	Entry Door	O <sub>2</sub> (% air)	Flam	CO (ppm)	H <sub>2</sub> S (ppm)
Shut Down	Door	Shut	21.9	0	0	0
	Non-door	Shut	21.9	0	0	0
	Door	Open (waterwall)	21.9	0	0	0
	Non-door	Open (waterwall)	21.9	0	0	0
Smoke only	Door	Shut	21.9	0	0	0
	Non-door	Shut	21.9	0	0	0
	Door	Open (waterwall)	21.9	0	0	0
	Non-door	Open (waterwall)	21.9	0	0	0
Smoke & Flame	Door	Shut	<b>18.0</b>	0	<b>36</b>	0
	Non-door	Shut	<b>20.3</b>	0	<b>12</b>	0
	Door	Open (waterwall)	<b>19.6</b>	<b>1</b>	<b>25</b>	0
	Non-door	Open (waterwall)	<b>19.5</b>	<b>1</b>	<b>12</b>	0

2. These results suggest that both O<sub>2</sub> depletion and CO are a *not* a concern in the instructor's passageway unless the GFFFU is fully functional. The reason for this relates not to the intrinsic properties of the Ondina<sup>®</sup> smoke, but from O<sub>2</sub> consumption and CO production from the LPG burners. For this reason, **respirators are not considered suitable for instructor use when the GFFFU is fully operational.**

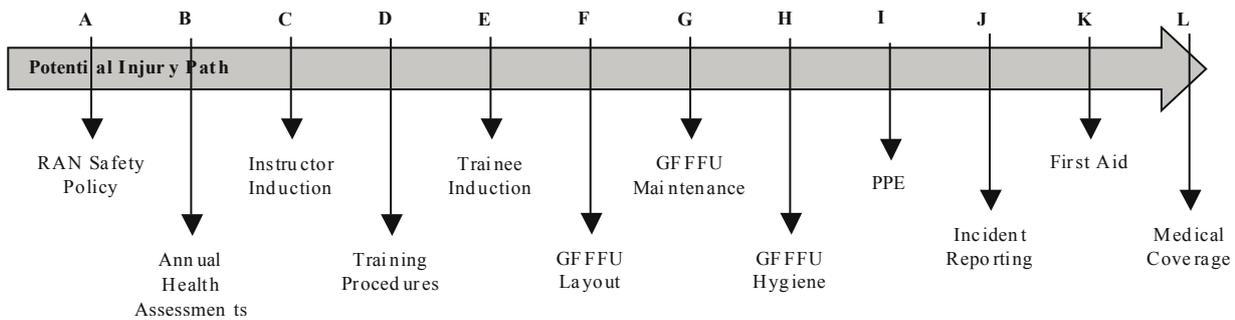
**UNMITIGATED HAZARD RISK ASSESSMENT**

The *unmitigated* hazards per the hazard assessment tables at Appendix E to Reference G (repeated vide Annex A) are assessed per the following table:

Hazard	Unmitigated Hazard Probability	Unmitigated Hazard Consequences	Unmitigated HRI
1a. Particulate inhalation within GFFFU	Almost Certain	Major	EXTREME
1b. Particulate inhalation outside GFFFU	Almost Certain	Minor	HIGH
2a. CO within GFFFU	Almost Certain	Critical	EXTREME
2b. CO outside GFFFU	Possible	Minor	MODERATE
2c. O <sub>2</sub> depletion within GFFFU (CO <sub>2</sub> )	Likely	Major	HIGH
2d. O <sub>2</sub> depletion outside GFFFU (CO <sub>2</sub> )	Rare	Insignificant	LOW

**HAZARD CONTROLS**

SSSS-W’s hazard controls identified in this WPA are summarised per the following diagram. There may be other controls that have *not* been identified in this WPA.



- a. Control A: Safety Policy.** RAN safety management policy is at Reference G. SSSS-W safety management is part of the RAN SHORESAFE program.
- b. Control B: Annual Health Assessments.** All RAN personnel undergo an Annual Health Assessment. However, as at present this is limited to identifying lifestyle rather than occupational health issues, its effectiveness (particularly for instructors) is limited. Other workplaces besides SSSS-W have similar concerns.
- c. Control C: Instructor Induction.** All instructors have completed damage control training and undertake a further one week instructor’s course. Other induction processes includes SSSS-W standing orders and workplace instructions, knowledge of emergency shutdown procedures, and location of materiel safety data sheets.
- d. Control D: Training Procedures.** SSSS-W

- training procedures are comprehensively documented and under continual review. The training entails safety briefs and observation of practical demonstrations.
- e. Control E: Trainee Induction and Supervision.** The course is designed such that trainees are required to demonstrate satisfactory performance prior to progressing to the next stage of their training. They are therefore closely monitored by instructors throughout their training.
- f. Control F: GFFFU Layout.** The GFFFU is laid out to facilitate rapid casualty evacuation. Casualty exercises are performed quarterly.
- g. Control G: GFFFU Maintenance.** SSSS-W maintenance is performed by a contractor on behalf of Defence Corporate Services and Infrastructure Group (CSIG), as for all other facilities at HMAS STIRLING. Staff have expressed concern that they lack visibility on CSIG management processes for the GFFFU. The GFFFU is also cleaned of soot accumulation

quarterly by the instructors, who wear respirators and disposable impermeable overalls whilst doing so.

- h. Control H: Hygiene Facilities.** SSSS-W has emergency showers and eyewash stations in addition to the normal ablution facilities.
- i. Control I: PPE.** PPE during the training include overalls, gloves, hoods boots and OCCABA. The training includes instruction on proper fit and use. As previously indicated, respirators are not

suitable in the GFFFU.

- j. Control J: Incident Reporting.** The RAN has a comprehensive process for OHS incident and accident reporting.
- k. Control K: First Aid.** All RAN personnel undergo first aid training.
- l. Control L: Medical Coverage.** Medical coverage is provided by Fleet Base West Health Centre, which has an ambulance and medical response covering all of HMAS STIRLING

## POST-MITIGATED HAZARD RISK ASSESSMENT

The *post-mitigated* hazards per the hazard assessment tables at Annex A, using SSSS-W's *current* controls identified previously, are assessed as follows:

Hazard	Pre-Mitigated HRI	Hazard Controls and Mitigation	Post-Mitigated Hazard Probability	Post-Mitigated Hazard Consequences	Post-Mitigated HRI
1a Particulate inhalation within GFFFU	EXTREME	A, C, D, E, F, G, H, I, J, K, L	Possible	Minor	MODERATE
1b. Particulate inhalation outside GFFFU	HIGH	A, D, H, I, J, K, L	Possible	Insignificant	LOW
2a. CO within GFFFU	EXTREME	A, C, D, E, F, G, H, J, K, L	Possible	Minor	MODERATE
2b. CO outside GFFFU	MODERATE	A, C, D, E, F, G, H, J, K, L	Possible	Insignificant	LOW
2c. O <sub>2</sub> depletion within GFFFU (CO <sub>2</sub> )	HIGH	A, H, I, J, K, L	Possible	Minor	MODERATE
2d. O <sub>2</sub> depletion outside GFFFU (CO <sub>2</sub> )	LOW	A, H, I, J, K, L	Rare	Insignificant	LOW

## REVIEW OF HAZARD RISK ASSESSMENT

**Hazard Risk Assessment Limitations.** It should be noted that the pre- and post-mitigated HRI's are based on Annex A, which is taken directly from Reference G. Noting that Reference G states that the measures used should reflect the nature of the organisation and the activity being assessed, it is possible that this may *not* be the case with respect to the measures used in this WPA. SSSS-W may therefore prefer to apply the process used in this WPA using its *own* hazard risk measures.

**Effectiveness of Controls.** Comparison of the pre- and post-mitigated HRIs for suggest that SSSS-W's current controls for Ondina<sup>®</sup> smoke are generally adequate with two significant deficiencies, neither of which are within its ability to control.

Firstly, it is noted that the current health surveillance process for RAN personnel is not suitable for SSSS-W instructors. Noting the lack of efficient biological surveillance for CO<sub>2</sub> and CO, it is suggested that any process for SSSS-W instructors should focus on particulate exposure.

A literature search has so far been unable to *confirm* whether in fact the low hazard associated with Ondina<sup>®</sup> smoke *is* in fact altered by the presence of high temperature and naked flame.

**Other Hazard Mitigation Measures for Consideration.** Options for further mitigation using the following hierarchy of controls include:

- a. Elimination.** The safest option is not to use 'real' smoke and flame for firefighting training at all: no hazard means nothing to mitigate.

However, SSSS-W's role is considered to have been validated in real incidents, in particular the fire aboard HMAS WESTRALIA in 1998.

- b. Design or Substitution.** This refers to the use of less hazardous materials or processes. This has already occurred with respect to ceasing the use of diesel fuel for this purpose in the mid 1990's.
- c. Engineering Controls.** Examples include isolating hazardous equipment or other hazards, the use of mechanical aids as an alternative to manual handling, and machine guards. The GFFFU engineering controls appear to be of a high standard; what is less clear is SSSS-W visibility on CSIG's GFFFU management processes.
- d. Administration.** This refers to how SSSS-W organises its work, via documented work procedures and instructions. Present arrangements appear to have been validated (particularly with respect to the use of OCCABA instead of respirators), however they require ongoing monitoring.
- e. Training.** This refers to ensuring that SSSS-W staff have the appropriate skills to perform their work efficiently and safely, and awareness of the associated hazards. Present standards appear adequate for the task but require ongoing monitoring.
- f. Personal Protective Equipment.** Although the cheapest option, PPE is the least effective solution, as it entails employee compliance with equipment that may be difficult to use, uncomfortable to wear, and impede job performance. However, as one of the main reasons for SSSS-W's existence is to train RAN personnel in PPE use (not just for firefighting but also NBC incidents), not using PPE would defeat SSSS-W's purpose.

Finally, the hazards associated with Ondina<sup>®</sup> smoke should be set in two wider contexts:

- a. Firstly, although they have not been eliminated, the hazards are significantly reduced when compared to the use of diesel fuel ten years ago, and
- b. Secondly, SSSS-W hazards should be balanced against the preventable morbidity and mortality associated with actual fires aboard RAN ships.

## CONCLUSION AND RECOMMENDATIONS

The hazards associated from Ondina<sup>®</sup> smoke at SSSS-W are most likely limited to carbon soot and CO. Both pose significant threats within the GFFFU, however the mitigating controls appear acceptable. The risk outside the GFFFU also appears acceptable. It is recommended that:

- a. Current health surveillance processes for SSSS-W instructors require review, with a focus on monitoring particulate exposure.
- b. Until it can be confirmed whether the low hazard associated with Ondina<sup>®</sup> smoke is in fact altered by the presence of high temperature and naked flame, measures to reduce instructor exposure to as low as is reasonably achievable should be maintained. An assessment of particulate exposure in and around the GFFFU may be part of this process.
- c. The risks associated with Ondina<sup>®</sup> smoke appear to be less than that from the LPG burners with respect to CO production and O<sub>2</sub> depletion. This means that instructors should continue to use OCCABA in the GFFFU.

## ACKNOWLEDGEMENT

I would like to express my sincere thanks to SSSS-W staff for their time and assistance with this WPA.

## ANNEX:

- Hazard Assessment Tables
- 2.

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## REFERENCES:

- A. SSSS-W Minute 96/07/102 26/04 dated 10 Sep 04
- B. Commonwealth Institute of Health Minute 81/398 dated 22 Mar 82
- C. Flag Officer Naval Support Command Minute RANH(P) C23(b) N86-3-113 dated 03 Mar 87
- D. Searing, C.S.M., Smith, R.J., Pethybridge, R.J., Goad, R.F., Legg, S.J. Lung Function in Royal Naval Firefighting Instructors. *Journal of the Royal Naval Medical Service* 1986; Vol 72 pp 94-103.
- E. US Army Center for Health Promotion and Preventive Medicine (USAHPPM) fact sheet 65-021-0503 *Fog Oil – Medical* (17 Feb 05)
- F. Moline, J.M., Golden, A.L., Highland, J.H., Wilmarth, K.R., Kao, A.S. *Health Effects Evaluation Of Theatrical Smoke, Haze, And Pyrotechnics*, prepared for Equity-League Pension and Health Trust Funds dated 06 Jun 00
- G. ABR 6303 *NAVSAFE Manual: Navy Safety Management* dated 29 Jan 02

## **HAZARD ASSESSMENT TABLES**

### **Reference:**

- A. Standards Australia AS/NZS 4360:1999 Risk Management dated 12 Apr 99

Note: Reference A states that the measures used should reflect the nature of the organisation and the activity being assessed. As the information in this Annex is taken directly from Reference A, this may not reflect SSSS-W's own hazard assessment.

### **Qualitative measures of consequence or impact**

LEVEL	DESCRIPTOR	DETAIL DESCRIPTION
1	INSIGNIFICANT	No injuries, no loss of production capability, low financial loss
2	MINOR	First aid treatment, short-term partial loss of production capability, medium financial loss
3	MAJOR	Medical treatment, long-term partial loss of production capability, high financial loss
4	CRITICAL	Extensive injuries, short-term total loss of production capability, major financial loss
5	CATASTROPHIC	Death, long-term total loss of production capability, huge financial loss

### **Qualitative measures of likelihood**

LEVEL	DESCRIPTOR	DETAIL DESCRIPTION
A	ALMOST CERTAIN	Is expected to occur in most circumstances
B	LIKELY	Will probably occur in most circumstances
C	POSSIBLE	Might occur at some time
D	UNLIKELY	Could occur at some time
E	RARE	May occur only in exceptional circumstances

### **Qualitative Risk Analysis Matrix**

Hazard Probability	Hazard Severity				
	INSIGNIFICANT	MINOR	MAJOR	CRITICAL	CATASTROPHIC
ALMOST CERTAIN	HIGH	HIGH	EXTREME	EXTREME	EXTREME
LIKELY	MODERATE	HIGH	HIGH	EXTREME	EXTREME
POSSIBLE	LOW	MODERATE	HIGH	EXTREME	EXTREME
UNLIKELY	LOW	LOW	MODERATE	HIGH	EXTREME
RARE	LOW	LOW	MODERATE	HIGH	HIGH

**REPUBLISHED PAPER**

Captain Art Smith USNR attended and spoke at the 2005 AMMA Conference in Launceston. The following paper arose out of his workshop and was initially published in the *Naval War College Review*. It is here reprinted with the Editor's kind permission.

**Medical Command and Control in Sea-Based Operations<sup>a</sup>**

Arthur M. Smith<sup>b</sup> and Captain Harold R. Bohman<sup>c</sup>

*Medical support of the sick and wounded is a complicated, resource intensive, and vital aspect of any over-the-horizon operation. It needs to be considered as a major subordinate command element just as the Ground Combat Element, the Air Combat Element and the Combat Service Support Element are.*

**A NAVY COMBAT SURGEON**

During World War II it took the Navy and Marine Corps years to confirm and refine their pre-war doctrine for amphibious attack. The labour began with the first U.S. landings at Guadalcanal in August 1942; the resulting doctrine, organization, tactics, and techniques were subsequently used by the Army in Europe. Early operations in both theatres highlighted the enormous difficulties associated with essential medical elements, and it was not until late 1944, perhaps 1945, that these problems were adequately solved. During future major expeditionary operations, will it take that long for a latent functionally effective medical support system to evolve? Will medical support of the anticipated "sea base" concept of operations, for example, be obligated to recapitulate the same sad evolution of repetitive mistakes committed during prior conflicts over the past century? It is imperative that those who bear responsibility for ensuring that prompt and competent care is provided to the combat injured examine the lessons emerging from historical precedent. Likewise, it would be reasonable to consider the "revolutionary" concept of establishing a "medical command and control element" in joint expeditionary operations, to obviate the often-validated reality that those who choose to ignore the lessons of history are destined to repeat them.

In late 1992, the Navy formally shifted the focus of its planning from a Cold War scenario for opposing Soviet naval forces in mid-ocean toward a concept of countering land- and sea-based forces of potential regional aggressors in heavily defended littorals. It moved the focus of Navy planning from a geographical environment where the force would operate primarily by itself to one of joint or combined expeditionary/amphibious warfare from a sea base independent of any land-based logistic lodgement. Today, in attempting to transform itself to meet twenty-first-century needs, the Navy is emphasizing not only

increased readiness but also the ability to deploy naval forces quickly in response to crises and conflicts around the world, notwithstanding homeland defence needs.

Since every option for transformation involves human assets, the potential for sickness and injury must be factored into any operational equation. From a medical perspective, a series of questions need to be answered, such as what specific forms of threat conjoined joint medical forces will likely face, and what role Navy medical resources will play in enabling the rest of the joint/combined force. What are the specific medical readiness goals for Navy medical assets functioning in a joint environment, and what resources will be necessary to reach them? Concurrently, what form of information architecture will be required? Who, in the final analysis, will be responsible for ensuring compliance with goal expectations? Historical evidence of dysfunctional medical support during the last century of conflict is profoundly discouraging; some medical command and control mechanism in such joint/combined operations will be necessary to ensure functional compliance with readiness and operational objectives. Let us look first at the operational future.

**SEA BASING AND ITS PROPOSED MEDICAL SUPPORT**

A series of innovative proposals followed the adoption of the sea-base concept. New naval formations, such as the expeditionary strike group (amphibious ships combined with surface combatants, attack submarines, and land-based P-3 maritime patrol aircraft), were implemented. It has also been proposed to launch expeditionary operations, complete with command, control, and support infrastructures, directly from sea bases, to be formed, without necessarily establishing an intermediate land base, by a combination of amphibious

<sup>a</sup> *Naval War College Review*, Summer 2006, Vol. 59, No. 3

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<sup>c</sup> MC, US Navy Reserve

and sealift-type ships. (The sea-basing concept responds to a concern that fixed overseas land bases in the future will become increasingly vulnerable to enemy anti-access/area-denial weapons such as cruise missiles and theatre range ballistic missiles.)<sup>1</sup> Computer technology will potentially tie together the personnel, ships, aircraft, and installations of the sea base in a series of highly integrated local and wide-area networks capable of rapidly transmitting critical information, under the rubric of “network-centric warfare.” An additional key program relating to sea basing is the notional Maritime Prepositioning Force (Future), or MPF(F), ship, which would replace the Marine Corps’s current “black bottom” maritime prepositioning ships operated by the Military Sealift Command utilizing civilian mariner crews. The MPF(F) ships are to be specifically designed to support the sea base while under way. Implementation of the sea-basing concept will also possibly affect integration with future ships of the *San Antonio* (LPD 17) class of amphibious dock landing ships (which are replacing the old LPD types and five older LSD-36 dock landing ships) as well as the LHA Replacement (LHAR) program meant to retire the older *Tarawa*-class amphibious assault ships. Furthermore, it is anticipated that the legacy T-AH hospital ships will be replaced by a medical support system incorporating advanced-level medical facilities within the MPF(F)s and the expeditionary strike group.

Under current consideration is the operational expectation that the component parts of a sea base could “close” — arrive and begin operation — anywhere in the world’s oceans within ten days of the executive order, by strategic air and sea lift, to be followed overnight by the insertion of two battalions of an expeditionary brigade into an operational objective, one by air and another by sea, all without any formal logistical support lodgement ashore. The goal is to complete the entire “ship-to-objective manoeuvre” within thirty days. The return of the force to the sea base (“retrograde reconstitution”) would take an additional thirty days. The seagoing platforms of the sea base would comprise the ships of an expeditionary strike group and a carrier-based strike group, united with ships of the Maritime Prepositioning Force. The assemblage would sustain ground, sea, and air operations with logistic support, command, control, communications, computers, intelligence, surveillance, and reconnaissance. It is envisioned that MPF(F)s themselves will meet all logistic requirements, including berthing for over sixteen thousand personnel, as well as extensive medical modules with surgical-specialty

capabilities (known as “echelon level three” care). The medical modules would operate under “established hospital standards of care,” utilizing appropriate nursing operating procedures. They would require specialized and trained personnel, equipment, and quantities of supplies as necessary to match the operational exposure of combat personnel.

Under the sea-basing blueprint, a ground combat component inserted ashore would have a minimal “footprint,” including a minimal medical support structure. It might be augmented by forward resuscitation and surgical (FRSS) units or some functional equivalent, providing limited surgical capability beyond that intrinsic to operational battalions. Even so, the limited depth of medical resources ashore will mandate prompt evacuation for the bulk of casualties — generally by air, or when required by high-speed seagoing “connector” vessels — to the ships of the sea base, primarily the ships of the expeditionary strike group and MPF(F)s. If afloat resources are to be continuously available for new casualties, there will have to be an additional mechanism for evacuating initially treated casualties from the sea base to higher-level medical facilities, perhaps thousands of miles away.

An important question is: Will it work?

## HISTORICAL MEDICAL LESSONS FOR SEA BASING

### *Gallipoli*

History has adjudged the British attempt to take the Dardanelles at Gallipoli to be an amphibious fiasco, a failure owing in large degree to a lack of coordination between attack and supporting elements, including the medical services. Among the many medically related issues was the paucity of medical communications and a poorly coordinated mechanism for transfer of casualties out to ships, many of which were scarcely able to care for them, if at all. Many deaths ensued, as did profound morbidities. The implication today for the likely result of poor coordination of medical assets under the sea-base concept is obvious.

On 26 April 1915 Surgeon General Birrell, director of medical services for the combined attack of the British and the Australian and New Zealand Army Corps (ANZAC), requested that he and his deputy be allowed to join the general headquarters on board the battleship *Queen Elizabeth*, where the operational commander was, to supervise casualty evacuation. His request was refused, and he was embarked instead on

board *Arcadian*, a ship that possessed neither wireless communications with the shore nor medical assets.

On 28 April Birrell was sent the message: “*Lutzow* [a transport being used as a hospital transport ship] filling up rapidly. Request name of next hospital ship. Where is the advanced depot of medical stores? Running short of supplies.” Another message read, “Wounded arriving rapidly—about 500. Probably require another hospital ship.” To these messages there was no reply. The director of medical services never received them. He was isolated—all signals from shore were conveyed by wireless to *Queen Elizabeth*, where the general’s staff, which was supposed to be coordinating the wounded evacuation, remained silent.<sup>2</sup>



*Private John “Simpson” Kirkpatrick and his donkey “Murphy” evacuating casualty with leg wounds, Gallipoli*  
Australia War Memorial, J06392

Casualties were transported to the beach on the backs of pack animals, as immortalized in ANZAC legend by the donkey “Murphy” and his bearer Private “Simpson” Kirkpatrick (see photo). These animals were

variously led by members of irregular groups, such as expatriate European Jews (many driven by the Ottomans out of Palestine to Egypt) organized by the British into transportation units known collectively as the “Zion Mule Corps”<sup>d</sup>.

The great numbers of Commonwealth casualties practically stopped operational activity on the beaches, and the devastation these drovers found at the water’s edge was graphically described by Colonel John L. Beeston of the Royal Australian Medical Corps: “The whole beach is filled with wounded of all kinds and descriptions. It has quite unnerved me for a time. Some of the wounds are so ghastly, whole abdomens blown away and the men still living. They are in such numbers that it is difficult to get along, and there is only one hospital ship in the bay.”<sup>3</sup>

At least twenty-two converted “hospital ships,” twenty troop ships, and other transports and merchant ships had been set aside for the reception of sick and wounded, but fear of Turkish coastal artillery and German submarines prompted many of these vessels to lie well offshore or in island ports some distance away. From the beaches, casualties were towed seaward in small craft, each carrying thirty patients, often in a frantic search at night for a ship to accept them. Concurrently, as troopships landed their complements on the beaches or transports unloaded their cargoes, they were rapidly filled with casualties. These “carriers” then moved to the hospital ships or other vessels lying offshore and likewise transferred the casualties at sea, under occasionally difficult, even dangerous, conditions. As described by one historian, “the wounded were evacuated in large horse barges with sterns that could be let down for easy access; stretcher cases were placed in big boxes and hoisted into ships with the aid of derricks.”<sup>4</sup> Some were swung on board by means of cargo nets dropped over the side.<sup>5</sup> At a later stage, minesweepers partially fitted for medical purposes were brought into use for evacuating casualties, and the British Red Cross provided six motor launches specially equipped to tow barges from the Gallipoli beaches (see photo). Ultimately, the large number of casualties at Gallipoli led to overcrowding, rendering many ships unsuitable as base hospitals. They became, in essence, casualty-clearing stations, providing interim and often merely token treatment of patients. The more serious cases were transferred to distant shore bases in Egypt, Malta, and in some cases England itself.

Could the casualty-management breakdown

<sup>d</sup> This paragraph has been altered from the original with permission from the authors

witnessed at Gallipoli occur again under the modern banner of sea basing? Will a proposed diminution of medical assets (a “reduced medical footprint”) accompanying expeditionary forces inserted from sea bases allow critical, life-threatening wounds to be attended to adequately? If all that is available ashore is a meagre casualty-sorting capability, and no efficient medical regulating network is established, will the results be any different from those experienced at Gallipoli?



*Seaward evacuation of wounded by barge from Anzac Cove, Gallipoli*  
Australia War Memorial, C02679

### ***The U.S. Invasion of Grenada***

On 21 October 1983, with the designation of Commander Joint Task Force 120, intensive operational planning was begun for Operation URGENT FURY. However, no combat support planners, including medical representatives, were invited to participate. Consequently, no estimate of logistical supportability was completed prior to execution, and the required medical support system did not develop. The short lead time and the absence of a designated task force surgeon to coordinate medical services at the joint level left each service to plan medical support within the scope of its own organic assets, with little or no joint coordination of such activities as casualty care management, whole blood procurement, and aeromedical evacuation. Erroneous assumptions may have been made as well. For example, the commander of the 82nd Airborne Division was informed that two amphibious ships, USS *Guam* (LPH 9) and *Trenton* (LPD 14), which were in the vicinity of Grenada, could provide significant medical and surgical support. The record is unclear, but this inaccurate information may have been responsible for his ultimate decision to keep Army medical support to a minimum.<sup>6</sup>

The hostilities lasted ninety-six hours—123 casualties and eighteen deaths were recorded—and brought combat wounded to both *Guam* and *Trenton*. No significant or sustainable tactical medical asset was established within the combat zone during the hostilities, nor were there triage facilities ashore. Without trained and experienced triage corpsmen or officers, casualties were not sent in an orderly and logical flow to the proper receiving facilities. There were no established medical communication nets between the Army and Navy, let alone with *Trenton* and *Guam*; Army helicopter pilots, unfamiliar with the Navy ships and their silhouettes, brought casualties to whichever flight deck was most convenient. On several occasions the better-equipped *Guam* was overwhelmed with both minor and lower-priority delayed casualties, while *Trenton*, which had no surgical capability, laboratory, or blood bank, was sent critical casualties. In essence, medical assets were squandered and overutilized simultaneously.<sup>7</sup>

### ***Beirut 1983***

The U.S. Marine compound at the Beirut International Airport was bombed on 23 October 1983. The tragedy presented an opportunity to evaluate in detail the American military medical system’s ability to react to such incidents or, by extension, to a larger conflict. Among the principal components tested that day were medical command and control, casualty evacuation, medical regulating procedures, capabilities of facilities, joint medical readiness mechanisms, and the transition from routine peacetime to contingency operations.

A medical review group chaired by Rear Admiral James Zimble later evaluated the medical response to the bombing. Its 1984 report detailed serious deficiencies in medical readiness, attributing them in large part to a lack of medical evacuation resources, shortages of equipment and personnel, and inadequate joint planning for wartime or contingency requirements. The problems, it found, were also the result of the low priority habitually assigned to medical readiness in the planning, programming, and budgeting processes. As the report declared, “Had the ratio of killed-outright-to-wounded been reversed, so that over 200 casualties had required treatment, rather than fewer than 100, the medical system might well have failed.” The report recommended greater investment in essential medical readiness resources and refinement in the command and control over wartime support and operation of these resources.<sup>8</sup>

During contingencies, smoothly running casualty support operations are critical; a lack of joint planning

obviously hampers the sharing of limited resources and creates confusion over responsibilities. As the Zimble Report noted in 1984—in a finding that raises problems that might be associated with future sea basing—there was no comprehensive joint plan for the use of the medical assets that were already in place. The services' contingency medical plans were “stovepipe documents”—that is, their orientations were purely “vertical,” or intraservice—and bore little relationship to each other. This was a direct result of the tendency of the services' medical components to support their respective line units as if they were the only ones, and likewise a consequence of the lack of a joint medical staff structure to arbitrate differences. There was no mechanism for achieving efficiency through interservice sharing in peacetime, coordinating operations in wartime, or resolving inconsistencies among the components' plans.<sup>9</sup>

### **OPERATIONS DESERT SHIELD AND DESERT STORM**

An important element of the medical evacuation process, familiar in both military conflict and civilian mass-casualty disasters, is medical regulation, to which we have already referred. “Medical regulators” manage the process by selecting sources of care, matching patients' medical requirements with the reported capabilities of treatment facilities. They must also ensure that the receiving medical facilities are not over- or underutilized—an essential matter when numerous and dispersed facilities are involved. During the Persian Gulf War of 1990–91, medical communications problems represented the greatest limitation in medical regulation, followed by failures of regulating systems to exercise effective oversight of casualty movement. The result was that casualty evacuation was effectively compromised on many occasions.

#### ***Communications Problems***

Troops on the battlefield could not communicate with ambulances. The radios used by medical regulators had an operating range of only fifteen miles, whereas, for example, the XVIII Corps area was 250 miles deep and a hundred wide. The ambulance units operated with similar equipment and therefore experienced great difficulty in working efficiently with regulators or hospitals. As a result, they often took patients only to hospitals whose locations they knew, and those hospitals were not always the ones best able to assist the wounded. Air ambulances also had difficulty learning where casualties awaited. One helicopter company, in the words of the General Accounting Office (as the Government

Accountability Office was then known), “listened to the international disaster channel to find out where casualties were. . . . After patients were loaded, pilots flew directly to known hospital locations over Iraqi tanks and infantry. One pilot stated that if it had been a ‘shooting war,’ the company would have lost every Huey [helicopter] and its crew.”<sup>10</sup>

To overcome these shortcomings of communications equipment, VII and XVIII Corps restricted air ambulances to shuttle runs between designated collection points near the battlefield and drop-off points adjacent to hospitals. As a Navy medical officer with a Marine Corps tank battalion described his situation, “The locations of higher echelon medical facilities were not even available at the battalion or division level.”<sup>11</sup>

Communications between medical units and between the different levels of care (such as between aeromedical evacuation units and field hospitals) were made even more difficult by the prevailing variety of radio equipment and the use of commercial along with tactical telephone systems. Without adequate communications capability, some Army and Air Force facilities frequently had no warning of the quantity or type of casualties that they were to receive. Some field hospitals did not know that casualties were on the way until the aeromedical evacuation helicopter arrived. Obviously, for them, planning for patient-care needs was out of the question.<sup>12</sup>

During the movement into Iraq, some Army hospitals were left for several days with no method of communicating with either combat or evacuation units. The chief nurse of the Army 12th Evacuation Hospital found its communications in Saudi Arabia nonexistent; the equipment was too diverse and too limited in capability. Helicopters had FM radios with a range of only twenty miles; the field hospitals had AM radios, which in any case could not be used near a battlefield, since their transmissions were traceable by the enemy. Furthermore, while combat and command units had satellite equipment, that did not put them in direct communication with the medical units that lacked such capabilities. Also, due to either traffic saturation or inherent equipment limitations, none of the systems at aeromedical evacuation locations proved consistently reliable.<sup>13</sup>

Communications problems for combat and support units, of course, are not new. They were identified during the URGENT FURY invasion of Grenada in 1983, during the 1990 JUST CAUSE contingency in Panama, and during such Joint Staff exercises as PROUD EAGLE (worldwide), REFORGER (Europe), and TEAM SPIRIT (Korea).<sup>14</sup>

### ***Casualty Regulation Breakdown***

Communications problems among all services during DESERT SHIELD and STORM degraded the casualty-regulating mission. These were primarily related to limitations and mismatched capabilities on both the intra- and inter-service levels. Some medical facilities could not communicate with their control elements, with one another, with supported combat units, or with supporting logistical units.

The inability of medical regulators to manage the evacuation of patients could have led, had the projected numbers of casualties actually occurred, to the underuse of some hospitals and the overwhelming of others—a potentially tragic situation. A “lessons learned” report by the Air Force’s Air Mobility Command stated that as a result of communications problems, 43 percent of patients arrived at the wrong airfield and had to be rerouted to the appropriate medical facility.

While automated medical regulating systems existed, they were unfortunately not standardized, interoperable, or available in all theatres, and they could not track the location and status of individual patients. Each service had its own computer systems, and the incompatibility of those systems severely limited the ability of medical organizations to interoperate during the war.<sup>15</sup>

### ***Casualty Evacuation Problems***

The process of medical evacuation entails moving patients under medical supervision both to and between medical treatment facilities. The Army and Marine Corps provide most of the ground and helicopter lift for tactical medical evacuation. (The primary Air Force medical mission is to provide fixed-wing aeromedical evacuation within and between theatres.)

In the Persian Gulf conflict, problems arose in the effective use of both ground ambulances and helicopters in tactical evacuation of patients. Ground ambulances could not be used as often as had been planned because of the rugged terrain, a lack of navigational equipment, and the long distances. Even air evacuation was taxed by the distances from pickup points to the hospitals; refuelling was frequently required, and crews had trouble locating fuel sites. Some air ambulances landed near tanker trucks, tanks, and Bradley fighting vehicles to ask for fuel and for directions to the nearest proper supply.<sup>16</sup>

Lacking its own tactical medical evacuation assets, the Navy ordinarily relies upon returning (“retrograde”) combat support aircraft with primary missions other than medical. They serve as “transportation of opportunity” for moving casualties to medical facilities afloat and to land-based advanced-echelon medical facilities.

Obviously, because of other priority commitments, such aircraft are not always available in sufficient numbers when urgent medical evacuation requirements arise. In the Gulf in 1990–91, short-range Army and Marine helicopters were available for medical evacuation, but, as Army and Marine Corps officers acknowledged, too few of them—at least in part, as asserted by the Defence Department’s inspector general, because Navy aeromedical requirements had not been previously made known and the Army and Marine Corps had accordingly not arranged to support them. As noted by the Navy’s surgeon general, “lack of dedicated tactical aeromedical evacuation capability in naval services would have created difficulties had the theatre (Southwest Asia) matured as expected.”<sup>17</sup>

To have had any fewer or less capable Air Force aeromedical evacuation assets would have affected patient care as well. The commanding officer of the Air Force’s theatre aeromedical evacuation squadron later stated that insufficient aircraft were allocated to evacuating patients and that the predicted flow of casualties would have overwhelmed them. Further, even given sufficient aircraft, there were shortages of crews and in-flight evacuation equipment; the Air Force surgeon general was convinced that “we were fortunate that the medical evacuation system was not taxed.” If it had been, substantial shortfalls in strategic and tactical aeromedical evacuation would have materialized.<sup>18</sup>

Nobody should have been surprised. Like communications problems, deficiencies in aeromedical evacuation assets are nothing new. They were noted in several Joint Staff–sponsored exercises, including REFORGER in 1987 and WINTEX in 1988 and 1989. During the latter, in Europe, a lack of dedicated aeromedical evacuation assets paralysed the entire combat zone until three thousand exercise casualties could be removed.<sup>19</sup>

The Air Force, particularly aware before the 1990 Iraqi invasion that it did not possess sufficient personnel or equipment to manage patients needing individualized care during evacuation flights out of Southwest Asia, required that any hospital unit evacuating a patient needing constant attention was to provide an in-flight medical attendant and enough specialized equipment, such as respirators or cardiac monitors, to last five days. Two Navy fleet hospitals were required to provide for additional care at staging sites. These requirements, however, were not taken into account in fleet hospital and hospital ship manpower and equipment authorizations. Had casualty rates approached predicted

levels, the inventory of ventilators, intravenous fluids, medications, litters, and a host of other items would have been rapidly exhausted by these evacuation needs.<sup>20</sup>

In a 1993 report the Defence Department inspector general indicated that operation plans of the commanders in chief still, two years after DESERT SHIELD and DESERT STORM, did not promote the efficient use or sharing of medical assets. It indicated that the U.S. Central, European, and Pacific commands did not propose to integrate medical support at all, instead assigning each service component to provide for its own forces only. The report found further that such inconsistencies persisted because of poor testing of medical systems during joint exercises—exercises that included only token medical participation and could not validate readiness.<sup>21</sup>

### **OPERATION IRAQI FREEDOM**

Anecdotal reports from surgical staffs, as well as from tactical aeromedical nursing staffs, do not, unfortunately, offer much hope for the future.<sup>22</sup> Once again, they related discouraging examples of the state of medical regulation: inadequate coordination/communications between the extraction site and the flight controllers at the Direct Air Support Center–Patient Evacuation Team, as well as between the inbound casualty evacuation aircraft and casualty delivery sites.

#### ***Invasion Manoeuvre Phase***

The surgical teams related not only difficulty in communicating with evacuation controllers but also that they received no warning of incoming casualties. Likewise, occasional long waits at casualty evacuation pickup points were observed, as well as insufficiencies of personnel or equipment at casualty-drop-off landing zones. The limited communications and limited available airlift likewise made reinforcement or replacement of medical personnel difficult.

Concurrently, training deficiencies of medical personnel were reflected in the relaying of incorrect landing zone coordinates and erroneous patient priority status, as well as in frequent failure to report to controllers updates in the physical status of casualties prior to pickup. In addition, during the invasion of Baghdad, inexperience and lack of training led to “over-triage” of casualties by frontline medical responders. On the medical evacuation messages, all casualties had been designated as “urgent surgical,” some inappropriately, leading the flight controllers to direct all casualties to the forward collocated surgical teams, nearly overwhelming their capability. One forward-located surgical team

was obligated to care for seventy-eight significantly injured casualties in a forty-hour period, performing surgery upon fourteen in twenty-four hours. Indeed, the combination of communications deficits, lack of available resupply, insufficient return of nurses who had accompanied evacuation flights of casualties, and physical exhaustion all significantly degraded their capability. As noted at the time by one of the authors, “Only because of an unplanned fifteen hour break, return of the en route care nurses, and serendipitous arrival of supply blocks with commonly used medical consumables, were the teams able to meet another 30 hour period of sustained casualty flow.”<sup>23</sup>

Transfer of clinical data, including health and treatment status of casualties, from one treatment point to another was not easily accomplished either; charts were sometimes lost or illegible when received at higher levels of care. Attempts were made to convey information by writing on the skin or dressings, but in vain; the notes were often smudged, soaked, or illegible. Nurses assigned to provide en route care attempted to pass on information vital to ongoing care, but time was often limited. (Incomplete information transfer can lead to repeated, and possibly unnecessary, operations. For example, one combat support hospital backing up the surgical teams re-operated upon every casualty as a matter of policy, mistrusting even the information it had. Another such hospital used a policy of selective re-operation, depending on the information available, the status of the patient, and the perceived experience level of the forward surgeons who had first treated the casualties.) In addition, the forward surgical treatment units, lacking feedback on the outcomes of their interventions, could not know if their practices needed to be changed.

An additional issue consistently seen at this time was that of conflicting perspectives between tactical commanders and medical commanders on the geographic placement of forward medical assets.

#### ***Security and Stabilization Phase***

During redeployment of Navy medical assets in IRAQI FREEDOM II,\* the location of surgical assets was again often determined by ground combat commanders, who based their decisions upon evacuation times, attempting to ensure that every Marine was within one hour of an operating table, if needed. This once resulted in placement of a Navy FRSS team within twelve minutes’ evacuation time of an established advanced Army combat support hospital, thereby creating redundancy and wasting limited valuable resources that were needed

elsewhere, such as during the initial operations in Fallujah.

In May 2004, the Army surgeon general received from his trauma consultant a report regarding theatre trauma care that confirmed many of the above observations.<sup>24</sup> The consultant noted, first, disorganized delivery of trauma care on the battlefield, resulting in nonoptimal staffing and placement of surgical assets, and casualties occasionally being sent to the wrong location. Second, he found, medical records were not reliably reaching the next level with casualties, with a resultant impact upon clinical care and ability to capture aggregate experience.

Finally, he recommended the establishment of a "Joint Theatre Trauma System." A fully functional joint combat trauma system would embrace all aspects of trauma management, from prevention, training, and evaluation through all phases of care with command and control, as well as data collection, evaluation, research, and process improvement. It would also involve dedicated communications and ensure adequate standards and oversight of first-responder care at the point of injury, initial resuscitative care at the battalion aid station, forward surgery, en route care, definitive care either in the theatre or aboard MPF(F)s or ships of the expeditionary strike group, and finally strategic transport care beyond the combat zone. The system would be under the oversight of a "corps trauma surgeon," an experienced trauma physician who would:

- Negotiate with ground commanders regarding the optimal locations of facilities with surgical capability
- Minimize delays at forward locations and analyse time intervals between different levels of care
- Ensure continuous improvement of casualty care at forward levels, on the basis of data accounting for the great variability of care, outcomes, skills, and circumstances
- Optimize evacuation routes
- Ensure consistent policy regarding en-route interventions by aeromedical nursing staffs
- Ensure reliable communications
- Reduce geographic redundancy between medical units of various services with similar capabilities
- Ensure effective communications and logistical support.

#### **UNANSWERED QUESTIONS FOR SEA-BASE COMMANDERS**

Recent advances in development of body armour and changing tactical utilization of improvised explosive

devices by opposing forces may well have shifted the spectrum of wound survivability. The incidence of mortal wounds of the chest and abdomen may have diminished, thereby allowing greater numbers of casualties with severe injuries to the head, brain, and neck, as well as major blood vessel injuries of the extremities, to survive long enough to reach forward combat unit medical staffs, such as those of battalion aid stations. Granted, the resuscitation capabilities of battalion medical personnel on the ground, both corpsmen and physicians, are projected to grow. Nonetheless, will the treatment system envisioned under sea basing's concept of a minimal medical footprint ashore allow timely and competent treatment of these severe injuries?

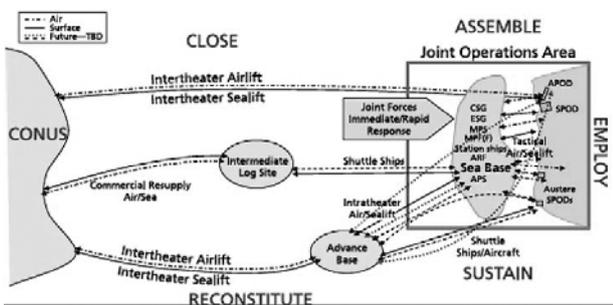
In 1973, during the Yom Kippur War, a surgical hospital erected by the Israeli Defence Force in the Sinai Desert received casualties in groups of from thirty-six to 140 (on one day 440 casualties), stabilizing them and transferring most to hospitals in central Israel.<sup>25</sup> Would not such a volume in a future major conflict quickly overwhelm a limited number of Navy/Marine forward resuscitation and surgical units or equivalent if they were available in combat service support areas? FRSS units each have only two surgeons, one surgical theatre, a small number of nursing personnel, and no appreciable patient-holding capacity. In a sea-base scenario accompanied by a large number of ground combat casualties, would not their inability to sort out types and levels of injuries rapidly, directing personnel needing advanced care to appropriate facilities and returning those with minimal injuries to their units, result in a mass, hurried, and necessarily indiscriminate transfer of casualties to an offshore medical facility, the sea base itself?

Failure to identify the most needy casualties for evacuation imposes enormous burdens upon transportation assets and afloat facilities. Military planners unfamiliar with the realities of combat wound management often consider medical evacuation but an exercise in logistics, in which numbers of anticipated casualties, quantifiable capacities of transport facilities, availability times of transport shuttles, and numbers of available beds are the primary considerations. That view ignores the realities of wound care and implies an acceptance of an overall increase in deaths, or at least disability, and a decrease in the return of men to duty (see photo).



Casualties being evacuated by CH-46, IRAQI FREEDOM U.S. Navy

How can patients evacuated from a battlefield to a sea-based medical entity be properly routed to the facility best suited to their specific needs? Absent a well practiced and smoothly functioning casualty-distribution system, supported by advanced and networked communications, the growing proportion of surviving casualties with severe wounds are likely to find themselves not in the seaborne medical facility best prepared to treat their specific injuries but in the less capable facilities of amphibious assault ships. Ideally, a sea base would include MPF(F) ships with modules capable of advanced neurosurgery to manage brain and spinal cord damage and of vascular surgery to treat complicated blood-vessel injuries. Clearly, time expended transferring patients with such devastating injuries, without knowledge of their specific needs, from a battalion aid station to a marginally staffed facility aboard an LHD could be fatal, or at least sharply lessen prospects for recovery, and consume limited resources unnecessarily (see figure).



- Key:
- APOD air point of debarkation
  - ESG expeditionary strike group
  - APS Army Prepositioned Stock
  - MPF(F) Maritime Prepositioning Force

	(Future)
ARF Army Regional Flotilla	MPS maritime prepositioning ship
CONUS continental United States	SPOD sea point of debarkation
CSG carrier strike group	TBD to be determined

Are the necessary medical-regulation capabilities regularly practiced during exercises? In 1994 one of the co-authors was the deputy amphibious task force surgeon in a major Pacific exercise, TANDEM THRUST, and in 1997 served as the deputy naval forces surgeon in a combined U.S./Australian TANDEM THRUST off the Australian coast. In neither exercise was medical regulation practiced. In fact, actual injured personnel from the afloat task force were flown ashore to a civilian hospital. A report generated by international colleagues who had held medical leadership positions in a later exercise, RIMPAC 2000, noted a similar lack of medical regulation “play.” Ironically, the report held that the most useful medical communications method in RIMPAC 2000 was unclassified e-mail, which worked throughout the exercise.<sup>26</sup>

**A COMMAND MEDICAL ELEMENT**

The historical record of dysfunctional medical support during armed conflict reflects persistent neglect of the fundamentals of managing the needs of the sick and wounded. In the setting of joint/combined sea-based operations, dissociated from a land base, therefore, serious consideration should be given to a command entity specifically responsible for operational control over joint medical functions. Such responsibility must be vested in a single entity or individual who is appropriately placed within the command structure, is assigned adequate staff to discharge these responsibilities, and has clearly delineated authority and accountability. Likewise, there must be a clear and functional chain of command within this entity that can develop as well as execute joint medical plans involving the sea base.

This “medical command element” would promulgate local doctrine sufficient to guide not only joint medical planning but also that of each service in the joint task force. Consequently, authority must be delegated by the chain of command to the command medical element to ensure that these principles are incorporated into operational medical planning at every echelon and that the plans developed by service components are both coherent and compatible.

***The medical command element would also:***

Ensure that the sea-base medical system can integrate with the joint strategic patient evacuation system in wartime as well as during contingencies.

Ensure that responsibility for control of the tactical and strategic components of the medical evacuation system lies within the same chain of command and that clear guidelines regarding aircraft destinations and patient distributions, as well as priorities for medical evacuation, are promulgated.

Ensure that the system of medical communications at the joint level, as well as within the various components of the sea base, are sufficient to support wartime medical operations, are simple and direct, and will work reliably during times of crisis.

Determine whether the sea base can accept biological, chemical, or radiological warfare casualties.

Ensure that adequate mechanisms exist in the medical planning system for assessing the capabilities of friendly nations to provide hospitalization and evacuation support in the event of mass casualties, and also for arranging that support via adequate means of swift communication channels.

Without a well developed medical support plan and methodical testing of its worthiness, the Navy and allied services may not be aware of all the possible impediments to the rapid surge and timely engagement

of their forces in response to crises within a sea-base context. A comprehensive set of goals, performance measures, time lines, milestones, benchmarks, and guidance documents are necessary to manage any joint medical response plan effectively and to determine if the plan is capable of achieving its goals. In any case, systematic testing and evaluation in the field of new concepts is an established practice for gaining insight as to how systems and capabilities will perform in actual operations. Commitment to the implementation of these most basic fundamentals of medical support in the field must be firmly established. It is to answer this call that a medical command-and-control entity is proposed. The medical people who are now practicing “good medicine in bad places” are far better prepared than ever before. Now, they need to be given a command structure and proper resources to do their job even better.

Will it work? We must not forget that military innovation and improvements are fostered by developing new concepts and organizational ideas, transferring them into operational reality, and employing them. Table-top and command-post exercises, war games, and experiments have traditionally been applied to these purposes, exploring military doctrine, operational concepts, and organizational arrangements. The concept of a deployable medical command element is surely worthy of similar consideration.

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## SHORT PAPERS

For the 2006 joint conference, three scholarships were offered to non-commissioned officers and ratings of the ADF and ADF reserves supporting individual attendance. To be eligible for the scholarship, applicants had to submit an essay on a topic of military medicine and health. The two papers that follow are two of those essays.

The Association intends to undertake a similar process of offering scholarships for attendance at the 2007 AMMA Conference.

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# The Role That Therapeutic Hypothermia plays in the Recovery of Hypoxic Patients in the Australian Defence Force

Corporal K. R. Wittich, AAMC

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*Oh. They've encased him in Carbonite. He should be quite well protected. If he survived the freezing process, that is.*

C-3PO, "Star Wars: Episode V-The Empire Strikes Back" (1980)

### INTRODUCTION:

There currently exists a great deal of small scale, independent research and anecdotal evidence that suggests Therapeutic Hypothermia (TH) is useful in the recovery of hypoxic patients. A collective overview of all relevant information is imperative if one is to make an accurate appraisal of the efficacy of TH in the Australian Defence Force (ADF).

### Aim:

This essay seeks to define the use of TH in hypoxic patients, review current research, review current protocols and equipment, and make recommendations in regards to the application of TH in the ADF.

### WHAT IS THERAPEUTIC HYPOTHERMIA?

TH is the cooling of a patients body core temp to between 32°C and 34°C in order to slow the patients' metabolic rate and improve their possible recovery outcome.

The use of TH was first described in the 1930s, but ceased without formal clinical trials. Interest and research in TH has been gaining momentum since the early 1990s. This revival in interest is due to promise shown in animal trials and preliminary clinical studies. These preliminary studies suggest that patient mortality can be decreased and overall patient outcome increased.

To date, canine, swine, and rat studies have been conducted to assess the efficacy of the use of TH in patients suffering traumatic cardiac arrest and the subsequent overall outcome. Though cooling induction methods, protocols and rules governing rewarming, duration, and patient selection have been many and varied, there is some promise shown which is evidenced

by Bernard and Buist (2003) who assert that: "Animal data suggests that the rapid induction of hypothermia may have a role in maintaining the viability of patients with major trauma who are exsanguinating before definitive surgery".

Based on this preliminary animal research and clinical human trials, some medical equipment companies have developed equipment designed for lowering a patient's body core temperature. Whilst the equipment is designed with the four mechanisms of heat loss in mind (Radiation, Conduction, Convection and Evaporation), their designs are many and varied.

### Table 1. Suggested methods of body core cooling:

- Peripheral cooling fans.
- Air circulating cooling blankets
- Ice packs
- Water circulating cooling blankets
- Immersion
- Cooling caps
- Water and alcohol spray
- Sponge baths
- Exposure of skin
- Core cooling intravascular catheters
- infusion of ice cold fluids
- Extracorporeal circulation
- Anti pyretic agents

### WHAT RESEARCH HAS BEEN COMPLETED?

Much of the research is centred on the use of TH in out-of-hospital cardiac arrest and the long term neurological outcome. This and other research has historically been with a very specific focus: "Firstly, uncertainty remains about the effectiveness of this therapy in patients with out-of-hospital cardiac arrest due to causes other than ventricular fibrillation." Therapeutic Hypothermia after cardiac arrest – Bernard, 2004. This makes much of the available material less than useful due to the lack of its academic application in pre-hospital theorems and in the infinitely broad definition

of hypoxia. To date, the most reliable research centred on patients suffering anoxic brain injury or traumatic cardiac arrest is sourced from animal studies.

**Table 2.** *Suggested positive outcomes from TH*

- Improved long-term neurological outcome post cardiac arrest (specifically ventricular arrhythmias)
- Post hypoxic injury following cardio-pulmonary resuscitation
- Anoxic brain injuries

Research suggests that TH may be useful for out-of-hospital cardiac arrest and the associated long term neurological recovery, and for post hypoxic injury following cardio-pulmonary resuscitation (CPR). With current research in mind, Nolan and Morley (2003) suggest “hypothermia is a two edged sword: although significant benefits can be achieved, there are many potential side-effects that, if left untreated can diminish or even negate the benefits”.

The relevance of the many and varied TH studies and trials are problematic due to the inconsistency of therapeutic algorithms implemented in study and test groups. It is also apparent that techniques for body core cooling are varied and protocols for re-warming a patient are contradictory and wide-ranging depending on the study evaluated.

It has been shown that TH can adversely affect drug metabolism and pharmacokinetics (K. Polderman, 2004). In support of this finding, Nolan, Morley and Vanden Hoek (2003) state that the use of anti-spasmodic and neuromuscular blockers are desirable in the maintenance of TH due to the effect of decreasing “shivering” and therefore oxygen consumption. None of the reviewed literature made any reference to, or suggestion of a researched protocol in regarding the appropriate use of drugs in a patient undergoing TH. In ACC protocol manual (MISCPUB 157), (1999) it states: “Be aware of the effects of cardio-active drugs, as metabolism will be reduced in the hypothermic patient”. This is also supported in the following quote: “Do not administer medications. They are poorly metabolized in hypothermia, due to the hypometabolic state. Administration may cause medications to persist in the body, resulting in toxic drug levels upon patient rewarming”. Paramedic Emergency Care, 3<sup>rd</sup> edition – Bledsoe, Porter, Shade. (1994).

TH has been associated with an increase in the incidence of pneumonia. This is evidenced by findings from the Alderson, Gadkary and Signorini study (2004): “We found 14 trials with 1094 participants...

Hypothermia treatment was associated with a statistically significant increase in odds of pneumonia”. In addition to this, post TH pneumonia rates in clinical human trials has been quoted as being as high as 45% by Bernard and Buist (2003). These and other researched, negative effects of TH are illustrated in Table 3.

**Table 3.** *Suggested negative effects of Therapeutic Hypothermia*

- Impaired coagulation cascade
- Electrolyte disorders (loss of K, Mg, P, and Ca)
- Hypothermia induced diuresis and therefore hypovolaemia
- Changes in drug effects and metabolism
- Insulin resistance
- Airway infections
- Wound infections
- Myocardial ischaemia
- Intracerebral haemorrhage

In all reviewed texts, there is, as yet, no suggested or implemented protocol for the use of TH in paediatrics, pregnant women, or geriatrics. Comprehensive protocols regarding TH are required for military application due to the vast increase of peace keeping operations where regular and close contact with all members of a society are commonplace.

13. Recent, concurrent peer review of TH has also illustrated the need for further research. This is evidenced by Alderson, Gadkary and Signorini (2004) as follows: Conclusions: “There is no evidence that hypothermia is beneficial in the treatment of head injury. The earlier, encouraging, trial results have not been repeated in larger trials... The effect of hypothermia on death or severe disability is unclear.”

**HOW IS THERAPEUTIC HYPOTHERMIA USED NOW?**

TH is being trialled in many health agencies across the world. Trials include conditions ranging from anoxic brain injury due to out of hospital cardiac arrest to newborn infant ischaemic encephalopathy.

In Australia, TH is being implemented predominately in ICU wards on a small scale with what appears to be, from anecdotal evidence, a good result. TH is also being implemented in a pre-hospital setting in some regional ambulance services (Victorian rural ambulance service). This application of TH is still in trial stage of assessment and research findings are pending, however anecdotal evidence suggests that TH is having a positive impact in this stage of patient care.

Currently, research into TH and its application is small scale and varied. In many other fields of specific medical interest, research results and burdens are shared, for example the human genome project. Information gathering and skill development in regards to TH could be expedited by the formation of an international governing body to help in the tasking of research.

## WHAT ARE AUSTRALIAN DEFENCE FORCE CONSIDERATIONS?

The ADF is comprised of the Royal Australian Navy (RAN), Australian Regular Army (ARA) and the Royal Australian Air Force (RAAF). As one can appreciate, the individual services have differing roles and therefore requirements. Examples of military specific requirements are identified in Table 4b.

Some considerations for each service may differ. For example, the ARA may require the equipment to be light and man portable where as this may not be so high on the priority list of the RAN. After an agreed protocol and equipment has been developed, individual personnel from their respective services would have to conduct formal feasibility studies with focus on equipment development and simple, easily taught protocols.

This investigation may result in one service being able to implement and use whereas another may find that TH is unworkable. It would be prudent to ensure that all three services medical personnel are trained in equipment and protocols for TH without regard to individual service TH policy as the three services are working closer together in

Australia's Tri-Service Defence environment. An example may be that a RAN sailor may be evacuated by RAN personnel to an ARA Medical Officer via helicopter from a ship to a level three health facility (definitions of medical support levels are identified in table 4a), and then by a RAAF Patient transfer flight by RAAF Aviation Medics back to a level 4 health facility in a short period of time. Given that studies show TH needs to be maintained, confusion could arise during patient handover from inadequacies in training and therefore a reduction in patient care.

A workable solution for this foreseeable training deficit would be to extend the Rotary Wing Aeromedical Evacuation Course (RWAME). This is a tri-service course and would allow for information and skills transfer between the three services. The nature of the tasks involved in RWAME implies that personnel may arrive early on a casualty scene and be able to transport the necessary equipment with relative ease. This

approach is consistent with the recommendations made in all of the reviewed literature that indicated the early implementation of TH is advantageous for the patient.

A breakdown of selected, specific issues faced by each service is as follows:

- a. Australian Regular Army: Due to the changing face of warfare over the last 30 years, it could be expected that the burden of extra equipment could hamper the Medic further in an infantry and mounted setting (level one and two health facilities). It could be envisaged that the earliest implementation of TH would be at a level three health facility due to weight and transportability of equipment.
- b. Royal Australian Air Force: The RAAF could, possibly utilise TH quite effectively given the transport capability and capacity. It could be envisaged that TH could be utilized and maintained at nearly every level of health facility provided by the RAAF.
- c. Royal Australian Navy: TH could be used by the RAN; however a review into specific ships and boats would be required due to storage space and experience of personnel posted to specific ships. It is possible that TH could be implemented and maintained at most levels of health facility provided.

**Table 4a.** *Levels of Australian Military Medical Support.*

- Level One – immediate first aid
- Level Two – Patient sorting, Limited Resuscitation, Limited patient holding
- Level Three – First Formal Surgery, patient holding, Medical officer available
- Level Four – Specialised surgery, Rehabilitation. Normally highest level of health care in an Area of operations
- Level Five – Highest level of care, research capability, located in Australia

**Table 4b.** *Military Specific Considerations.*

- Portability
- Weight
- Durability/robustness
- Ease of training and use
- Cost
- Logistic infrastructure required
- Size
- Noise, Thermal, Infra-red, radiation, acoustic signature
- Servicing intervals and requirements
- Helicopter, vehicle transportability and

interoperability

- Other uses
- Setup and pack down times
- Personnel required for use

The efficacy and value of TH in the recovery of hypoxic patients in the ADF is also questioned by one of the fields leading research medical officers, Mr. Stephen Bernard, MD: “There would be very little role for hypothermia in the Defence forces. The staff would be at very low risk for sudden cardiac arrest of cardiac cause. I would imagine that cases of near drowning are also very rare... You may also be interested to know that the US Army is funding research into resuscitation from traumatic cardiac arrest using deep hypothermia, but this is all at an animal stage.” - Original Message sent by: Stephen Bernard on 19/08/05 18:11:08, original sent to: Ky Wittich.

### WHAT FUTURE DEVELOPMENTS ARE BEING INVESTIGATED?

If the current trend of advancement in the field of TH continues, it is probable that the technology to induce hypothermia will improve greatly. Methods to cool more expeditiously, such as:

- a. The development of novel coolant fluids
- b. Use of cold IV fluids
- c. Cooling catheters will make therapeutic hypothermia more accessible to physicians and hospitals developing cooling protocols.

Ticherman and Samuel (2004) have initiated an interesting and novel approach to alternatives for TH: “The majority of soldiers killed in action in Vietnam without brain trauma had penetrating truncal injuries. They exsanguinated internally within a few minutes. Such casualties are still considered unresuscitable, although many have technically repairable injuries on autopsy. In 1984, Bellamy, a U.S. Army Surgeon and Safar met and pondered recent military casualty data and agreed a novel approach was necessary (i.e., suspended animation)”.

The above quote represents an exciting scope for future development. A suggested method for the induction of suspended animation includes the use of TH. Perhaps, TH would be rendered “old hat” if suspended animation could be achieved with few extra procedures?

### Conclusion and Recommendations:

Given the contradictory and incomplete research both in the methodology of TH and equipment, TH is not

currently a treatment that can be implemented reliably in the ADF at this early stage of development. Much research needs to be done before a feasibility study can be completed. This research would need to focus on the following:

- a. How to optimally cool a patient?
- b. When to cool a patient?
- c. How long to cool a patient?
- d. How to re-warm a patient?

It also remains an open question by what mechanism hypothermia improves outcomes after pronounced hypoxia or otherwise. An understanding of the mechanism could, ultimately lead to the development of more effective equipment and protocols in a pre-hospital environment.

Information and skills transfer could be expedited if an international body was formed to delegate and guide research aims so as to eliminate researchers working independently and in relative academic solitude.

Comprehensive protocols will need to be researched and developed. These will be of most use if paediatrics, geriatrics and pregnant women are included as considerations.

Detrimental side effects of TH will also need to be researched more thoroughly. Evidence regarding the incidence of post TH pneumonia is contradictory and as such should be investigated more thoroughly.

Drug metabolism in hypothermic patients is still an unknown and controversial area. Research needs to be conducted in this area as this would have positive benefits for existing hypothermia and hyperthermia protocols.

The ADF lacks the bulk of numbers that other Allied Defence bodies have. Participation or at least active liaison with Allied Defence Agencies would be of great benefit. This liaison could lead more ADF relevant research into TH following traumatic cardiac arrest and hypoxia.

It is foreseeable that TH could be applied in the ADF in the near future. To eliminate confusion between inter-service patient handover, it would be most prudent to conduct TH training during the RWAME course. As this course is tri-service and all ranks can participate; this would enable the widest possible dissemination of skills and information.

Once the methodology, equipment and protocols have been researched and implemented by our civilian counterparts, only then can it be determined if TH will have a role in the recovery in hypoxic patients in the ADF.

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# Current and future combat airway options available to the Advanced Medical Assistant (AMA)

PTE Stevenson C.N.

The consequences of ineffective airway control are obvious to all clinicians. With this in mind, can it be said that the AMA is adequately trained and equipped to manage the airways of combat casualties? In order to respond, we must first explore five other questions.

1. How common are airway injuries in combat?
2. Which challenges are specific to the battlefield compared with civilian prehospital models?
3. Which airway adjuncts are currently available to the AMA?
4. Which airway adjuncts are unsuitable for the combat casualty?
5. Which airway adjunct is seen in evidence based practice to provide the most effective airway to critical combat casualties?

Colonel Ronald F. Bellamy (US) of the Walter Reed Army Medical Centre, tells us that during the Vietnam war, US casualties sustaining upper airway injuries, and casualties sustaining central nervous system injuries causing airway problems accounted for 0.7% and 0.6% (respectively) of soldiers evacuated from the battlefield<sup>1</sup>. These figures, whilst pertinent today, fail to incorporate injuries sustained by contemporary weapon systems used today, such as Vehicle Borne Improvised Explosive Devices (VBIED) and suicide bombers. Penetrating wounds to the face or neck are the most likely causes of airway obstruction<sup>2</sup>.

Like all prehospital casualties, those encountered in combat are non fasted. The similarities between combat and civilian prehospital models end there. Although the incidence of aspiration pneumonitis is “exceedingly rare”, it can be minimized by the AMA with the aid of basic manoeuvres and prokinetic agents, which are discussed later<sup>3</sup>. Combat casualties coexist with challenges which may prompt a particular choice of airway adjunct, which in the civilian prehospital environment, would only be used ‘in extremis’. These challenges include: “darkness, hostile fire, resource limitations, prolonged evacuation times, unique casualty transportation issues, command and tactical decisions affecting health care, hostile environments and provider experience levels”<sup>2</sup>.

Currently the airway adjuncts in the AMA skill set include: airway opening manoeuvres, oro/nasopharyngeal airway (OPA/NPA), Laryngeal Mask Airway (LMA), naso/orogastric tube (NGT/OGT) and Metoclopramide.

Airway opening manoeuvre encompass chin lift, jaw thrust and posturing, with the focus being to prevent occlusion of the hypopharynx by the flaccid tongue<sup>4</sup>. Each has a particular place in airway management. For example, chin lift is best suited to rescue breathing, or to prevent anatomical obstruction in the spontaneously breathing casualty<sup>4</sup>. Jaw thrust is utilized during bag valve mask (BVM) ventilations, and unlike chin lift, it prevents hyperextension at C1/C2 and hyperflexion at C5/C6, which is of particular importance during spinal immobilization<sup>4</sup>. Chin lift is a skill which can be practiced in the recovery/post operative environment, while jaw thrust is best experienced in the preoxygenation stage of intubation. Posturing is the act of providing a gravity fed path of least resistance for secretions, vomitus and blood from the oral cavity/nares. This can take the form of: the lateral aka recovery position, sitting with the head forward, or the head down position of the fireman’s carry, if providing care under fire. The world witnessed the failure of posturing in October 2002, when 118 civilian hostages died as a direct result of inhalation of Fentanyl, which was pumped by Russian police into a Moscow theatre prior to the rescue operation. The hostages were left supine, with their airways anatomically occluded, and “with breathing problems and memory loss”<sup>5</sup>.

In the absence of head injury (HI), the NPA is the airway of choice for management during care under fire. It is simply and quickly inserted into both the obtunded and the semi conscious casualty, and “is unlikely to be dislodged during transport”<sup>2</sup>. The OPA is unsuitable for the semi conscious casualty, and, if the obtunded casualty regains his gag reflex, vomiting and therefore aspiration could compromise the airway. Ventilations via BVM with the OPA are difficult to achieve for the inexperienced medic, and it is dangerously simple to achieve gastric insufflation, again with the risk of aspiration. This pertains only to use of the OPA in the combat environment. Its use is proven in civilian prehospital and in hospital settings.

The LMA is a simple to insert, supraglottic device designed by Dr Archie Brain. It is known to have provided an airway to more than 100 million patients, and is proven to be less prone to causing gastric insufflation than BVM ventilations. Studies into the success of the LMA are well documented and are

discussed elsewhere. The use of cricoid pressure (first described by British anaesthetist Brian Sellick) following placement of the LMA prevents gastric insufflation, but is not recommended as it inhibits ventilation<sup>6,7</sup>.

Two striking issues surrounding LMA use which require review for the AMA are: choice of size, and the use of the OPA as a bite block. Five studies from 1998 onwards have concluded that basing LMA size on casualty weight is erroneous. What is recommended is gender based size selection. It is now understood that a size 5 LMA is suitable for men, and a size 4 LMA for women. One particular study tells us that the size 3 LMA “should never be used in adults”, and that a larger size LMA with a minimally inflated cuff provides the best use of the device<sup>8</sup>. Despite the recommendation from the Laryngeal Mask Co. Ltd. “Do not use an oral Guedel airway as a bite block”, this is the technique used in the ADF and in fact is commonly used in civilian practice<sup>8,15</sup>. The reason for this recommendation is that the “combination of LMA and Guedel airway probably prevents either from sitting in the correct position”<sup>8</sup>. What is recommended is the use of several gauze swabs rolled, inserted and taped securely in position<sup>8</sup>. Studies have shown that the OPA bite block technique has caused “ventilatory problems, bleeding, hoarseness, and sore throat”<sup>8</sup>.

The OGT/NGT has been included here, as its use can prevent gastric distention, leading to aspiration of gastric contents. The prokinetic agent of choice in use by the AMA is Metoclopramide (MCP) 10mg. Interestingly MCP only exerts its “anti-emetic” effect at doses far higher (1-4mg/kg) than those authorized for use by the AMA. It is the gastric prokinetic effects of an “increase in lower oesophageal pressure tone, along with accelerated gastric emptying through both more frequent and more intense antral and duodenal contractions” which are experienced by our client base<sup>9</sup>. It is worthy of mention that “the oesophageal and gastrokinetic effects of MCP are blocked with concurrent use of atropine 10mcg/kg owing to the involvement of intramural cholinergic modulation in the prokinetic pathway”<sup>9</sup>.

Some examples of airway adjuncts which are unsuitable for combat casualties are: endotracheal intubation, needle cricothyroidotomy, the safety pin through the tongue manoeuvre, and the use of promethazine 25mg as an antiemetic.

The clinical shortfalls of OPA use in combat casualties have already been discussed. Endotracheal intubation (ETI) is a procedure which has gained

popularity, courtesy of TV programs such as “ER” and “House”. However “there have been no studies examining the ability of well trained but relatively inexperienced military medics to accomplish endotracheal intubation on the battlefield”<sup>2</sup>.

Maxillofacial injuries can make for difficult ETI, and “oesophageal intubations are probably much less recognizable on the battlefield”<sup>2</sup>. There is also the issue of the white light of the laryngoscope, although some US Special Forces medical officers have documented their success with the use of night fighting equipment while intubating<sup>2</sup>. “Passing the laryngoscope and tracheal tube is a strong stimulus to the autonomic nervous system and to suppress it requires a sufficiently deep plane of anaesthesia”, or an obtunded casualty<sup>10</sup>. Rapid sequence induction is a procedure which remains unsuitable for the battlefield. Not only is it complex, requiring intensive skill maintenance, but it requires at least two skilled operators, which cannot be guaranteed in that environment.

In late 2005, needle cricothyroidotomy became a procedure which is no longer approved for use by the AMA. This is a particularly unsuitable procedure for the combat medic. At most it can only “provide up to 45 minutes of oxygenation of a patient with partial airway obstruction”<sup>11</sup>. Operational casualty evacuation times can very quickly extend beyond this vital 45 minutes from such factors as: air frame availability, weather, and terrain.

The Field Medical Service Technician (FMST) course in California, currently teaches the “safety pin through the tongue manoeuvre” for casualty care whilst taking effective fire<sup>12</sup>. This procedure (whilst physically capable of withdrawing the tongue from the hypopharynx) is likely to cause haemorrhage to the highly vascular tongue, which is sufficient enough to provide an additional source of insult to the airway. It is a skill made redundant by the concurrent use of the NPA, and posturing (either the fireman’s carry to withdraw from contact, or the recovery position). (Personal Communication-Dr M. Bowyer, Chief of the Division of Trauma and Combat Surgery, Bethesda USA).

The Committee on Tactical Combat Casualty Care recommends the use of Promethazine 25mg as an anti emetic during tactical field care<sup>2</sup>. This is likely to cause sedation and associated loss of upper airway control, which is a particularly unwanted effect in a casualty with an altered level of consciousness.

The only overwhelming deficiency in the AMA skill base is the Surgical Cricothyroidotomy.

“Cricothyroidotomy has been reported safe and effective in trauma victims” and “is felt to provide the best chance for successful airway management in this (battlefield) setting”<sup>2</sup>. A US study into the use of the cricothyroidotomy in civilian prehospital patients displayed that it “can be performed effectively with few complications after training on animal models”<sup>13</sup>. “Combat casualties who require airway management almost always have such destructive wounds that a surgical airway will be required”<sup>1</sup>. Without this skill the AMA has no retort for the “can’t ventilate” scenario. Such a scenario can arise from: the burned airway exacerbated by overzealous fluid therapy, anaphylaxis, or maxillofacial trauma. It is a simple technique which can be performed using improvised equipment if necessary. “Surgical cricothyroidotomy has a complication rate of about 6%” and “voice change is the most common complication”<sup>14</sup>.

The answer to the initial question of “is the AMA adequately trained and equipped to manage the airways of combat casualties” should come in the form of a recommendation. There is a valid place for surgical cricothyroidotomy in the AMA skill base (Personal Communication-Dr M. Bowyer, Chief of the Division of Trauma and Combat Surgery, Bethesda USA). The present inability to ventilate a casualty sustaining a compromised airway, demonstrates an overwhelming gap in the continuum of care, which can be provided in combat by the AMA. Factors such as delayed surface/aeromedical evacuation or prolonged extrication could feasibly translate from a training shortfall to a coronial inquest. Surgical cricothyroidotomy is battle proven, and as clinicians we must strive to adopt the approach of evidence based practice, and provided the best possible care for our critical casualties.

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# Primary Casualty Reception Facility<sup>a</sup>

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Health support is an important consideration in any joint or combined operation. From a practical perspective, health support, both preventative and therapeutic, exists to conserve the fighting strength of the forces, ultimately contributing to the maintenance of operational capability and the success of the mission. Health support is also influenced by Australian societal expectations that injured members of the armed forces will have access to competent medical care from the time of injury until completion of the rehabilitation process.

The level of health support to any Australian Defence Force (ADF) activity is based on a hierarchical system of casualty management (from Level One to Five)<sup>1</sup> that may be affected by numerous factors, including the nature of the activity itself, weapon systems and other technologies, medical and physical fitness of the force, emerging disease patterns, the availability of other ADF health services and evacuation assets, and the extent and availability of civilian health infrastructure. It is a principle of health support that no patient should be evacuated further than their physical condition requires, and the provision of health support facilities as far forward as tactically possible helps to ensure that the treatment and evacuation process remains continuous and rapid.

An established Primary Casualty Reception Facility (PCRf) comprising a Level Three<sup>2</sup> health capability deployed in a ship, enables the early treatment of casualties afloat. A PCRf is only activated in anticipation of casualties and allows a 'window of opportunity' to effectively treat an injured member prior to the establishment and securing of health provision ashore. Operational planning may incorporate a reduction in levels of health logistic support ashore where an Afloat Level Three Medical Facility (AMF) is in the Area of Operations (AO). Importantly, the presence of such a well-equipped and safe AMF in the AO also assists in the maintenance of troop and crew morale.

The capacity to make available surgery and postoperative support in the AO also limits the requirement for dedicated platforms and personnel to perform strategic aeromedical evacuation (AME).<sup>3</sup> Recent experience in Iraq (Operations IRAQI FREEDOM and ENDURING FREEDOM) has shown that the majority of wounded soldiers can be medically evacuated to definitive care, using helicopters for

forward AME, within half an hour of initial injury.<sup>4</sup>

In December 1993, the Australian Government approved the purchase of two United States Navy Newport class Landing Ships Tank, which were commissioned as HMA Ships Kanimbla and Manoora. The ships underwent extensive conversion to meet the requirement for a joint amphibious capability, including the fitting of dedicated communications and operations facilities to support tactical commanders, a hangar and flight decks capable of supporting up to four Army Black Hawk or three Navy Sea King helicopters, and two Army landing craft. Now classified as amphibious transports (LPA), the primary military role of each LPA is to transport, lodge ashore and support an Army contingent of 450 troops, their vehicles and equipment. In addition, they also contribute to a range of constabulary and diplomatic tasks, including peacekeeping operations, the protection and evacuation of Australian nationals within the region in the event of serious civil disturbance, and support to disaster relief operations both within Australia and the region.<sup>5</sup>

A fully equipped PCRf is an intrinsic capability in both vessels, incorporated in response to an anticipated increase in the need for the ADF to participate in a broad range of national and international tasks and to provide medical support for them. The PCRfs aboard Kanimbla and Manoora consist of a Casualty Reception Area located forward of the hangar; a modern Operating Theatre; an eight-bed High Dependency Unit, with two of those beds able to be utilised as Intensive Care beds; a 36 bed Low Dependency Unit and X-ray and pathology equipment; while dental services can be provided when required. Casualties are usually accepted by helicopter, but sea transfer can also be used if necessary.

Staffing is determined using a modular capability system. Medical capability elements that can be deployed include AME, resuscitation, primary health, intensive care, operating theatre, and command teams. Depending on the level of activation, up to 67 personnel will join the LPA, reducing troop carrying capacity by the same number.

The PCRf, although located adjacent to the ship's sickbay, are considered a separate entity, so the ship's senior Medical sailor manages the routine medical care of the ship's company. To prevent deterioration of costly medical equipment and unit infrastructure when not activated, the facilities are each permanently staffed

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<sup>a</sup> 'Reprinted from the Sea Power Centre - Australia's newsletter *Semaphore*, Issue 15, August 2006.'

with a RAN Nursing Officer responsible for sourcing and maintaining the equipment and medical stores. This ensures that the facilities are ready for rapid activation when required.



*PCRf in HMAS Kanimbla (RAN)*

A shore-based Operations Cell, which reports formally through the Amphibious and Afloat Support Force Element Group (AASG), supports the Nursing Officer. Logistic support for the PCRFs, when activated, is significant, and the vital components of a functioning medical facility are all provided, including waste disposal, laundry requirements, medical gases, drugs, and cleaning and sterilising agents. The PCRF maintains sufficient consumable stores at all times to provide care to a significant number of personnel for approximately five days. This provides adequate lead-time to re-supply should the activation be extended or conflict escalate, and for other appropriate contingency measures to be put in place.



*Commander Maritime Task Group talks with PCRf medical Personnel during Operation SUMATRA ASSIST (Defence)*

Balmoral Naval Hospital (BNH) provides the majority of personnel to fill PCRf billets when the facility is activated. The staff complement of the PCRFs is also augmented from time to time by active tri-Service specialists, usually orthopaedic or general surgery specialists and anaesthetists. In circumstances where only one PCRf has been activated, the Medical Officer in Charge (OIC) of BNH assumes the role of OIC PCRf for the duration of the operation wherever possible.

As a relatively new RAN capability, all aspects of the PCRf have matured and been further developed through operational experience. The PCRf Operations Cell was established formally in 2003 and provides dedicated personnel to examine logistic and personnel aspects of the units as their primary role, and to action recommendations from post-exercise/deployment reports. This cell moved from BNH under the OIC BNH to the AASG under the Capability Delivery section in October 2005.

Early lessons learned invariably focused on equipment, logistic supply of consumable items and a lack of allocated space to perform casualty triage. No medical equipment on board was specifically marinised and certain adaptations have been required to ensure safety of the equipment in a moving environment. Various methods of logistic supply have been investigated as management of medical consumables, often with a short shelf life, absorb considerable time and are better handled by personnel with medical knowledge. Ship's Operating Procedures were required to detail the dual functionality of the hangar space to ensure both medical and aviation requirements could be met.

The LPAs have substantially boosted RAN amphibious, logistic and training capabilities and provided the first deployable Level Three medical capabilities since the decommissioning of the aircraft carrier HMAS Melbourne in 1982. The PCRFs have contributed significantly to the ability of the ADF to respond to national and regional commitments either independently, or as an element of combined operations.

From the first activation during Operation GOLD for the 2000 Olympics, the PCRf has been utilised in numerous major deployments since, including for combat operations in Iraq and Afghanistan (Operations CATALYST and SLIPPER), in peacekeeping operations in the Solomon Islands (Operations ANODE and TREK), in border protection (Operation RELEX) and, most visibly, in humanitarian assistance in the wake of the Indonesian tsunamis and earthquakes in early 2005 (Operations SUMATRA ASSIST I/II). Foreign nationals

have been treated on board on two occasions (Operations RELEX and SUMATRA ASSIST I/II).<sup>6</sup> Most patients, however, have been ADF personnel who have been treated, stabilised and medically evacuated to definitive care ashore, or returned to duty.

The utility of the PCRf and its proven efficacy in boosting medical capability in various operational environments, demonstrated once more during the recent deployment of Kanimbla to East Timor for Operation ASTUTE,<sup>7</sup> has led to a similar requirement being identified in the planned acquisition of the two new RAN amphibious ships (LHDs) from 2012.

1. ADF Publication 53, Health Support, Defence Publishing Service, Canberra, 1998, pp. 1-1 & 1-2.
2. A Level Three facility is staffed and equipped to provide resuscitation, initial surgery and post-operative treatment. Care at this level may be the initial step towards restoration of functional health as distinct from procedures that stabilise a condition or prolong life; ADFP 53, Health Support, p. 1-1.
3. Strategic AME is that phase of evacuation that provides airlift for patients out of the AO; ADFP 53, Health Support, Glossary.
4. Forward AME is that phase of evacuation that provides airlift for casualties, from the battlefield to the initial point of treatment within the AO; ADFP 53, Health Support, Glossary.
5. Royal Australian Navy, The Navy Contribution to Australian Maritime Operations, Defence Publishing Service, Canberra, 2005, pp. 104-8.
6. Royal Australian Navy, Database of Royal Australian Navy Operations, 1990-2005, Working Paper No. 18, Sea Power Centre – Australia, Canberra, 2005; and ‘Operation Sumatra Assist Two’, Goorangai, Occasional Papers of the Royal Australian Naval Reserve Professional Studies Program, Volume 2, Number 1, April 2006.
7. Royal Australian Navy, ‘Operation Astute – the RAN in East Timor’.

# In Memoriam: Lieutenant Matthew Davey, RANR<sup>1</sup>

Author Geoff Day

*Lieutenant Matthew Davey RANR was tragically involved in the crash of a Navy Sea King helicopter in Indonesia in April 2005. The attached personal recollection was written by Commander Geoff Day RANR and published in Goorangai, the Occasional Papers of the Royal Australian Naval Reserve Professional Studies Program in April 2006. It is reprinted by kind permission of the Editor.*

I have been asked to write an 'In Memoriam' of the late LEUT Matthew Davey RANR. I could write about all of Matt's achievements throughout his life, and there were many, however I did not know Matt for long enough, or in the non-military setting, to have first hand knowledge of these. I feel it would be more true to Matt to write of the man I knew. This is only one aspect of him as a person, but it is the person I knew and saw on the day he died.

I first met Matt in April 2002 whilst we were both on course at Latchford Barracks, Bonegilla. During this course we spent many hours together discussing 'life'. I found him to be an exceptional person in so many ways. He was not only talented and intelligent, but a profoundly caring human being. It was also obvious that he had quite an adventurous streak. At this time Matt was an Army Reserve Medical Officer. He was eager to do operational and overseas postings, but also to get to sea. This led to lengthy discussions about him transferring to the Naval Reserve, a transition he ultimately pursued.

On Anzac Day 2002, always a special day, I was with Matt at the 'gunfire' breakfast followed by a day of course work, and then an enthusiastic evening out on the town with several other course participants. Matt was wonderful company, and true to form, he remained that touch more sensible and looked out for the rest of us. I will now move on to the Nias earthquake of 2005. Two days following this natural disaster I met up with Matt, Fabian Purcell (RANR Anaesthetist) and Annette Holian (RAAF Reserve Orthopaedic Surgeon) at Sydney Airport. We had all been called up for Operation Sumatra Assist II and had flown in to Sydney from different locations. Matt had in fact been recalled having arrived home less than 24 hours prior from Sumatra Assist I. Over the next two days the four of us spent most of our time together as we were transported by a multitude of means to the devastated region. Matt, as always, was enthusiastic about everything in life. He spoke so fondly of his partner Rachael and his desire to spend the rest of his life with her, of his family, of his civilian job as an Intensive Care Registrar in Canberra, and of his plans for anaesthetic training. We also

discussed whether he should deploy in late 2005 in HMAS PARRAMATTA for an Op Catalyst deployment to the Middle East. He had been offered the deployment and was quite eager, but had concerns of how big an impact it would have on his personal and civilian life. Once on location in Nias the work began in earnest for all of us. We saw little of each other except in the work environment. The last time I saw Matt was in the casualty clearing site adjacent to the landing zone in Telek Dalam (southern provincial town in Nias). We had four earthquake casualties requiring evacuation to HMAS KANIMBLA. Matt and his aeromedical team arrived in Shark 21. My most vivid memory is of Matt kneeling next to one of the casualties receiving my handover. He was quiet and totally focused on the task. None of our normal light hearted banter on this occasion, just absolute professionalism. I recall him looking up at one stage and giving me a smile. Not a smile of amusement but one of camaraderie, we were in this together. Two hours later as I stood on that very spot with four more casualties I awaited Matt and his team. We were expecting them within minutes of dropping another medical team in Amandraya. They became overdue, and then we were informed by radio that Shark 02 had gone down. Even then I had a profound sinking feeling that Matt had died.



*Matthew Davey in a C130 on route to Nias  
(Photo provided by CMDR F. Purcell)*

<sup>1</sup> Reprinted from *Goorangai* Volume 2 No 2 April 2006 - the Office of DGRES-N has been pleased to authorise its use

always will be. Published by: The RANR Professional Studies Program, Office of the Director General Reserves (Navy). The opinions expressed in this publication are entirely those of the author and do not necessarily reflect Navy, Department of Defence or Government policy. **Editor's Note:** This paper was written by CMDR Geoff Day, RANR who served with LEUT Davey on board HMAS KANIMBLA during OPERATION SUMATRA ASSIST TWO. In recognition of LEUT Davey and his service to Australia, the RANR Professional Studies Program's Overseas Study Grant has been renamed the Matthew Davey Award. It is fitting that the Award be named after a member of the RANR who gave his life on foreign soil while caring for those in need.

Health support is an important consideration in any joint or combined operation. From a practical perspective, health support, both preventative and therapeutic, exists to conserve the fighting strength of the forces, ultimately contributing to the maintenance of operational capability and the success of the mission. Health support is also influenced by Australian societal expectations that injured members of the armed forces will have access to competent medical care from the time of injury until completion of the rehabilitation process.

The level of health support to any Australian Defence Force (ADF) activity is based on a hierarchical system of casualty management (from Level One to Five)<sup>1</sup> that may be affected by numerous factors, including the nature of the activity itself, weapon systems and other

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## In Memoriam: Rear Admiral John Costell, AO RAN (Rtd)

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### **Rear Admiral John Cotsell AO RAN (Rtd) – *In Memoriam***

The following is a copy of a message dated 17 November 2006 from the Chief Navy.

It is with much regret that I inform the Navy of the death of Rear Admiral John Cotsell AO RAN (Rtd).

Rear Admiral Cotsell served in the Royal Navy during World War 2 as a medical officer. Following a short period in private practice, he joined the RAN as a Surgeon Lieutenant from the United Kingdom in 1951. He served in HMA Ships and establishments Rushcutter, Australia, Tobruk, Penguin, Cerberus and Melbourne. In 1956 he was appointed Honorary Surgeon to His Excellency the Governor General and in 1967 was appointed Honorary Physician to Her Majesty Queen Elizabeth II.

Rear Admiral Cotsell served as Medical Director-General in Navy Office from 1970 to 1976. In 1972, he was appointed as an Officer of the Order of Australia and promoted to Surgeon Rear Admiral.