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The Army Resuscitation Bay [1]

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"Our patients did not choose us. We have chosen to treat them. We could have chosen another profession, but we did not. We have accepted the responsibility for patient care in some of the worst situations: when we are tired or cold when it is rainy and dark, and often when conditions are unpredictable. We must either accept this responsibility or surrender it. We must give to our patients the very best care that we cannot while we are daydreaming, not with unchecked equipment, not with incomplete supplies, not with yesterday's knowledge, and not with indifference."[1]

INTRODUCTION

The layout, equipment and personnel for Army Resuscitation Bays are currently governed by standardisation protocols outlined in the Land Command Health Services publication entitled *"The Resuscitation Standardisation Handbook"* .[2] Resuscitation bays at all levels of Army health support, be they Level 1, 2 or 3, are required by doctrine to be standardised in accordance with this publication. It is recognised that standardisation in the approach to the equipment and configuration of the resuscitation bays facilitate and expedite the care given at each level of health support within the Army.

Resuscitation involves the initiation of treatment for injuries or illness, to restore haemodynamic and respiratory parameters to normal until the defect has been controlled by a definitive intervention. For resuscitation to be effective in reducing mortality and morbidity from injury or illness, facilities and equipment must be appropriate for credible medical contingencies.

The resuscitation standardisation handbook makes reference to equivalent civilian Gold Standards for resuscitation, such as the Australian Resuscitation Council Guidelines, and the need for protocols for casualty resuscitation to conform to accepted management of medical emergencies. Unfortunately, the handbook does not include an analysis of medical emergencies that are considered likely to be encountered by ADF medical teams, either at home or abroad on operations. Therefore, there are deficiencies in the capability provided by current standardisation to meet 'credible' medical and surgical emergencies.

Medicine is a rapidly evolving field, which necessitates a frequent review of our current practice, particularly as it compares to equivalent civilian standards and best practice. The need for revision of the current capability within the resuscitation bays is well recognised by many ADF doctors. The topic is discussed frequently by ADF doctors, at conferences, informal gatherings and on the ADF doctors email chat group- ADFDOCS. There are also concerns about currency and competency of clinical training for doctors, nurses and medics in Army, but this is beyond the scope of this article. Rather, this article will focus on equipment and drug capabilities pertinent to resuscitation. This article has been written to provide a concise overview of, and justification for suggested changes to the current standardised resuscitation bay. The overall aim is to outline suggestions for capability upgrade to the existing standardised Army resuscitation bay.

APPROPRIATE BENCHMARKING

There is an expectation that members of the ADF will receive a safe standard of health care benchmarked against common civilian practice.[3] Resuscitation bays do not, and should not, endeavour to benchmark themselves

against definitive care facilities. In most cases, the subsequent definitive care of the patient would normally occur elsewhere. Army resuscitation teams need to be able to stabilise critically ill medical and surgical patients. Doctrinally, resuscitation bays are geared towards the resuscitation of up to two critically ill patients at any one time. Principles of trauma resuscitation are supposed to be in accordance with principles of the Early Management of Severe Trauma (EMST) as defined by the Royal Australasian College of Surgeons.

An appropriate benchmark for Army's resuscitation bays would be the treatment room or resuscitation bay of a small hospital servicing a rural or remote Australian community. Such a facility has similar constraints in terms of isolation, staffing and equipment, and the need to stabilise prior to retrieval to a more definitive facility. Clearly, the patient population demographics differ between Army and most remote communities but, in terms of the level of resuscitation capability, this would be an appropriate benchmark.

This, however, begs the question: "Would an Australian soldier be better off being treated for major trauma or serious medical illness in a remote Australian community hospital, or the standardised Army resuscitation bay?" At present, the equipment, drugs and protocols available in many remote hospital resuscitation facilities leave the Army's standardised resuscitation bays wanting. Whilst it is important to recognise that requirements for mobility and robust- ness do limit Army's health facilities, technology today provides ready solutions for matching benchmark capability within these constraints.

A similarly useful benchmark for resuscitation may be found in the Australasian College of Emergency Medicine (ACEM) policy document entitled "Minimum Standards of Transport of the Critically Ill".[5] This document details the capability requirements and standards for a small team tasked with the immediate resuscitation of a casualty prior to transport to a more definitive care facility. The document details the nature of medical and surgical emergencies that need to be within the capability of such a team. Some of the emergencies catered to by the ACEM document may be beyond the requirements of Army's patient population but the majority are not. For example, the document details the requirements for drugs and equipment to be able to handle cardiac arrest, hypotension, hypertension, cardiac arrhythmia, myocardial infarction, pulmonary oedema, anaphylaxis, bronchospasm, hypoglycaemia, hyperglycaemia, raised intracranial pressure, convulsions, agitation, pain, emesis and electrolyte abnormalities. There would be few doctors who would disagree that all of these medical emergencies, and others, are credible within Army's patient population.

RESISTANCE TO CHANGE

Before continuing with the article, it is important to discuss some of the barriers to change, which are outlined below.

Cost

The realities of the Profession of Arms mean that Defence expenditure needs to be directed at the greatest good for the greatest number. Clearly, the budget for medical facilities is not limitless. The proposed changes to be discussed in this paper are cognisant of this fact. Cost-benefit analyses for change need to look beyond fiscal considerations though, to consider the indirect costs of potentially preventable morbidity, mortality and loss of morale. Recent operations involving the Australian Defence Forces have thank- fully not been afflicted by large numbers of casualties. This is not to say the situation will stay that way for Australian soldiers deployed to higher intensity conflicts in the future.

Do Such Emergencies Happen Often Enough?

The frequency of medical emergencies must not be the sole determinant of resuscitation capability planning. In many areas outside of Health, the Army plans for and procures equipment to cater to, the worst-case scenario- no matter how infrequently it occurs. For example, Australian soldiers have rarely been threatened by hostile aircraft in the past 20 years and it is certainly true that Rapier anti-aircraft missiles are expensive! Nevertheless, the consequence of not having them, in the unlikely event they are needed, would be loss of life. So millions of Defence dollars are rightly spent on anti-aircraft capability. It is not good for morale if Australian soldiers are

required to place themselves in harms way, without the secure sense that credible contingencies are planned for, even if they are not daily occurrences.

Many ADF health professionals would echo the sentiments that good fortune, more than good planning, has prevented Australian defence personnel from dying, or suffering significant morbidity due to resuscitation deficiencies. This is not to detract from medical planning and the contribution of medical staff, who currently do the best they can with what they have. But it should be recognised that preventable death and disability may occur in the future as a result of problems with existing resuscitation capabilities. Perhaps recognition of this is evidenced by the fact that resuscitations teams that have deployed on recent operations, such as those in Timor Leste (formerly East Timor), have not been limited to standardised equipment. Rather, additional equipment and capability has been forthcoming. But a 'just in time' philosophy for the provision of resuscitation equipment doesn't allow for appropriate staff training and familiarisation.

The changes proposed in this article do not seek to transform ADF resuscitation bays into unwieldy definitive care facilities capable of resuscitating every known medical emergency. Consideration, however, must be given to the fact that there are credible medical emergencies for which Army resuscitation bays are not yet well equipped. The key features of the standardised bay, and proposed changes, will be now discussed in more detail.

AIRWAY

The current level of capability for immediate airway management within the resuscitation bays is quite acceptable overall. The standardised airway mask, however, for oxygen delivery is currently the Hudson mask. The problem with the Hudson mask is that it can deliver, at best, an inspired concentration of oxygen of only 60%. Its use is not in accordance with accepted principles of oxygen delivery into the critically ill patient. Rather, many authorities (such as EMSP) advocate the use of a non-rebreather mask for oxygen delivery, which can deliver closer to 90% inspired oxygen. The non-rebreather mask can be modified to become a standard Hudson mask, but the converse is not true. Hudson masks should be replaced by non- rebreather, bag reservoir masks.

More definitive airway management is well catered for in the standardised resuscitation bay, with equipment for airway adjuncts, orotracheal intubation and surgical airways being available. Laryngeal Mask Airways (LMA) are not currently included, and they are increasingly being accepted as important tools for airway management in the resuscitation of the unconscious patient.[7] LMA have been shown to be faster and easier to insert than orotracheal tubes [8] and have been found to be particularly useful tools in airway management in trauma where resuscitation teams are relatively inexperienced.[9] Interestingly, they have also been compared favourably to endotracheal intubation where he doctor is wearing nuclear, chemical and biological (NBC) warfare equipment.1° For reasons of airway protection from aspiration of gastric contents, the 'gold-standard' for airway management in the unconscious patient will probably continue to be a cuffed endotracheal tube for the immediate future. But there are definite moves towards the use of LMA in resuscitation. They are now being included in airway management teachings in both the EMST and the Prehospital Trauma Life Support (PHT1.S) courses. LMA should be included in the Army resuscitation bays.

BREATHING

Ventilation

Existing capability to ventilate within the resuscitation bays is rudimentary. Standardisation provides for a bag-valve-mask only. Some of the self-inflating ventilation bags in use in Army resuscitation bays do not have patient-relief ('pop-off') valves, which are designed to prevent barotrauma during ventilation. This in itself is a safety issue, because relatively untrained and inexperienced medics could be using the bag ventilator on an intubated patient, with no safety mechanism to prevent the generation of pressures in excess of 60 cm of water - thus causing iatrogenic barotrauma. Moreover, with the doctrinal requirement to manage up to two critical patients at once, the use of a medic for prolonged hand ventilation, pending evacuation, is a wasted resource.

A mechanical ventilator, such as the already in-ser-vice OXYLOG™ ventilator, provides a safe, effective alternative. The OXYLOG is already used in a number of resuscitation bays but it is not currently a standard item.

It should be. It is light, robust, simple and safe. Currently, all Australian Navy sick bays are equipped with an OXYLOG, in recognition of its role in resuscitation, stabilisation and preparation for transfer of the unconscious patient. The ACEM policy for minimum standards for transport of the critically ill patient explicitly outlines the requirement for a portable ventilator with disconnect and high-pressure alarms,' such as OXYLOG.

Capnography

Army resuscitation bays may well need to manage intubated and ventilated patients for 'short' periods of time before evacuation to a definitive care facility can occur. For a junior doctor managing such a profoundly unwell patient, any definition of 'short' would probably seem too long, particularly without adequate monitoring to detect changes in patient status. Nevertheless, the reality is that a ventilated patient may well be in the resuscitation bay for anything up to an hour, and occasionally even longer before appropriate evacuation assets can be rallied.

Responsible monitoring of the unconscious, ventilated patient mandates capnography. This is in accordance with EMST principles[4], as well as policy guidelines from ACEM[5] and the Australian and New Zealand College of Anaesthetists [11] Capnography is useful in trauma and other resuscitation not only for confirmation of correct endotracheal tube placement but also for the assessment of the adequacy of ventilatory parameters; circuit disconnections, leaks or valve failures; tube kinks or obstructions; adequacy of muscle relaxation and assessment of ventilation/perfusion difficulties. Rudimentary capnographic analysis is easily learned by junior doctors with basic anaesthetic experience.

At present the facility for capnography exists in Army, by way of 'mainstream' samplers that can be connected to PROPAQTM. Unfortunately, many of the PROPAQs currently in service have been procured without the necessary additional component to enable capnography. It is interesting to note that capnographic monitoring is usually available for ADF aeromedical evacuation (AME) teams, which is very appropriate. Having said that, it may well be that the doctor in the resuscitation bay has to manage the patient for greater length of time than the AME team. The existing facilities in the Army resuscitation bay do not allow for optimal assessment and monitoring of ventilation for critically ill patients.

CIRCULATION

Defibrillator

The treatment of circulatory collapse, or shock, is a vital component of capability for Army resuscitation bays. ln general, they are well equipped to deal with it; however, a key capability deficiency is in the existing in-service defibrillator- the HEARTSTART™ 3000. The problems with this system have already been identified to a degree and the system is currently being phased out, to be replaced by the HEARTSTART 4000.

The updated system offers important improvements in the ability of resuscitation teams to manage credible cardiac emergencies. For example, the HEARTSTART 4000 offers the option for synchronised DC cardioversion. Without this capability, Army resuscitation bays have no way to treat haemodynamically compromised supra-ventricular tachycardia. This emergency is one of the more common cardiac emergencies to confront any young patient population.

The HEARTSTART 4000 also offers the option of being able to conduct external cardiac pacing. The capability for external cardiac pacing provides potentially life-saving treatment for patients with circulatory compromise secondary to abnormally slow cardiac rhythms.

An alternative to HEARTSTART 4000, currently in use in most Queensland rural hospitals, is the LIFEPAK™.[2] This system offers advantages over the HEARTSTART 4000 in that it offers everything HEARTSTART 4000 offers, but includes capability for 12 lead ECG and monitoring, including capnography. Nevertheless, the HEARTSTART 4000 is a good system which offers a degree of capability enhancement over the existing defibrillator. To optimise the benefits of the HEARTSTART 4000, however, Army should invest in the optional extra equipment for external pacing.

MONITORING

The PROPAQ is an effective system but Army resuscitation bays should have the upgraded system that allows for capnography as outlined. A further problem with existing capability is that there is no facility in the standardised resuscitation bay to conduct a 12-lead electrocardiograph (ECG). This is considered a basic diagnostic ability. There would be few doctors' surgeries in the civilian sector that could not offer this basic test. PROPAQ offers only leads I, II and III. Many doctors would agree this is deficient. HEART- START 4000 will enhance ECG capability somewhat, but, for the diagnosis of cardiac emergencies, a 12 lead ECG remains an easily achievable Gold Standard. Modern ECG machines can be as small and portable as a palm top computer.

PATHOLOGY

Emergency resuscitation can be augmented by rudimentary pathology services. For Level 2 and Level 3 facilities, there is more than adequate capability by virtue of their organic pathology services. For Level l facilities, there is currently no provision for even basic pathology, such as analysis of blood gases, haemoglobin estimation, and simple electrolyte analysis. These parameters are provided in many remote civilian communities in Australia by the use of the ISTAFM pathology system. ISTAT is currently available in Army, but not provided to resuscitation bays. It is cheap, lightweight, portable and quite user-friendly. It would entail some additional training for medics, perhaps on their Advanced Medics Course, but would provide a useful capability upgrade for resuscitation bays. Recent experience with RAAF resuscitation teams deployed after October 12, 2002 in Bali highlighted the problems with treating patients, such as severe bums patients, without ready access to basic pathology.[12]

An additional pathology capability that may prove beneficial is that of the cardiac troponin bedside test kit. This is a simple blood test kit, analogous to a bedside test kit for pregnancy or malaria, which rapidly alerts the treating doctor to the presence of molecules in the blood that indicate cardiac damage. Cardiac troponins are reliably detectable from 4 hours following damage to the heart muscle, as may occur with a heart attack. The test kits are relatively inexpensive and are not much bigger than a credit card. The additional information obtained by this simple test may one day mean the expedient, lifesaving transfer of a patient with hitherto undiagnosed chest pain or atypical presentation of myocardial infarction.

RESUSCITATION DRUGS

Cardiac Dysrhythmias

A review of resuscitation drugs carried by ADF doctors in THOMAS medical packs is currently underway. The same issues that prompted the review pertain to the drugs in resuscitation standardisation. Currently, no drugs are available in resuscitation standardization to treat various cardiac emergencies such as supra-ventricular tachyarrhythmias. Likewise, recent advances in the drug treatment of cardiac arrest have not been reflected in resuscitation standardisation protocols. Amiodarone, in particular, would be a useful drug for both contingencies, in accordance with accepted treatment guidelines.[13]

Acute Coronary Syndromes

Resuscitation teams treating a patient having a myocardial infarct are obliged to expedite transfer to an appropriate treatment facility, normally a hospital equipped with cardiac monitoring, intensive care and possibly invasive cardiac interventions.

Interventions in the resuscitation bay should never slow this process down. Nevertheless, on exercises and operations, there will be times when such patients will need to be managed in Army resuscitation bays for a time. It is not unlikely that such an emergency could be presented to a Level l facility deployed remotely, just as MI may present to a remote community hospital. The ability of a remote civilian hospital to initiate appropriate lifesaving treatment does not in any way obviate the need for evacuation to a more appropriate facility but the ability to provide appropriate early intervention may save lives. The same is true for remotely deployed resuscitation bays.

At present, MI could not be managed in the standardised Army resuscitation bay to anywhere near civilian equivalent Best Practice. Standard treatment for a patient suffering an acute coronary syndrome in a civilian rural hospital treatment room, or even in the back of many civilian ambulances, would be likely to include 12 lead ECG analysis, bedside troponin test- kit, aspirin and possibly anti-coagulation or thrombolysis. Currently, Army resuscitation standardization does not include aspirin. The failure to provide aspirin for acute coronary syndrome nowadays equates to indefensible medical incompetence. Aspirin must be on the resuscitation bay drug list.

With heart attack, the adage is that 'time is muscle'. Any delay in the initiation of interventions to reverse coronary thrombosis will result in a greater degree of cardiac ischaemic damage. Advances in the use of thrombolytic drugs in recent years have not been reflected in the current capability of the Army resuscitation bay. Agents such as reteplase (rapilysin) are easy to use, effective treatment for acute MI. Rapilysin can be stored between 2 - 30 degrees. A cheaper alternative for thrombolysis would be streptokinase; however, this drug is not as easy to use as reteplase.

Resuscitation standardisation should also include low-molecular-weight heparin, such as enoxaparin (clexane). This drug obviates the need for problematic anticoagulant monitoring and is now standard treatment for unstable angina. Clexane has the additional benefit of being standard treatment for venous thromboembolic problems, such as deep venous thrombosis (DVT), which do not occur infrequently in Army's patient population.[3] The drug has a storage life of two years below 25 degrees, which is achievable even at Level l facilities, which usually deploy with a small 12 or 24-volt car fridge.

PAEDIATRIC AND OBSTETRIC EMERGENCIES

Recent operational experience has highlighted that ADF resuscitation teams frequently find themselves treating a range of medical emergencies that would normally be regarded as outside their primary role. Certainly paediatric and obstetric emergencies fall into this category. Nevertheless, the increasing tendency to humanitarian and peace-related operations have necessitated some rethinking of the level of resuscitation that should be available for such emergencies. At pre-sent, resuscitation standardisation is not geared at all to obstetric and paediatric emergencies. For the most part, this is appropriate. But units likely to be involved in the treatment of civilians at short notice should have on their Single Entitlement Document (SED) a Paediatric and Obstetric THOMAS pack. Such units would include those with roles in Services Protected Evacuation (SPE) or Services Assisted Evacuation (SAE), such as the Health Support Company in support of 3 Brigade. These THOMAS packs are currently available through the Army supply system.

THE RESUSCITATION BAY TENTAGE

Army resuscitation bays presently use anything from Trellenborg inflatable shelters to standard canvas 11x11 tents. Lighter tents have been advocated to standardise with the rest of the supported unit or formation, to reduce the supply chain burden for resupply, to enable swift deployment of the resuscitation bay, and to minimise weight and size for transport purposes. The argument that standardisation of resuscitation shelters with other tentage should occur to reduce supply chain burden does not hold weight. The supply system needs to supply specialised equipment for specialised roles. Army does not strap 1OSmm gun barrels on to Landrovers just because Leopard Tanks don't standardise with the vehicle fleet. Specialised roles mandate specialised equipment supply.

Unfortunately, 11x11 tents do not provide a medically appropriate shelter for advanced resuscitation. They are not dustproof. Simple standards of infection control and maintenance of sterility are therefore not possible. The tents are not able to be climate con-trolled, meaning that a patient being resuscitated for heat illness in a sealed tent with blackout curtains in a tropical environment may well fare worse for the trip into the resuscitation bay.

There is an endorsement for a change in the resuscitation bay shelter arrangements at senior Army Health levels,[15] but as yet the appropriate shelter hasn't been identified. DRASH has been proposed and is being trialled in Army in various units with specialized roles but is an expensive option. It may turn out that a locally designed

and manufactured canvas shelter, with a sealed floor, climate control facilities and dustproof layout may prove as effective. As yet such a shelter has not been designed or suggested for proto-typing or tender process.

CONCLUSION

It is time for a review of the current level of capability provided by the Army standardised resuscitation bay. The management of many medical emergencies is a challenging experience for the majority of ADF doctors, nurses and medics who are relatively inexperienced in such emergencies. To make matters worse, the current level of capability of Army resuscitation bays does not allow clinicians to implement basic lifesaving measures to the degree to which they are trained.

The changes discussed in this article are not expensive. The primary role of the Army resuscitation bay, and its need to be flexible, light and portable has been given due consideration. If appropriate changes are implemented, then potential medical and surgical emergencies, beyond the current level of capability, will be managed appropriately in the future. It would be a tragedy for Australian soldiers to die unnecessarily due to outdated and poorly equipped resuscitation standardisation.

In summary, the following changes to Army resuscitation standardisation doctrine are recommended:

- Army resuscitation bays benchmark their level of capability against appropriate civilian equivalents, such as well-equipped emergency departments for remote communities.
- Non-rebreather oxygen delivery masks replace Hudson masks.
- Laryngeal Mask Airways be included in Airway stores.
- Concerns regarding safety of bag-valve-mask devices without patient relief valves, and their use by relatively untrained medics, be put to the ADF consultative group for Anaesthesia.
- Each resuscitation bay have an OXYLOG ventilator or similar.
- Each resuscitation bay has a PROPAQ fitted for the capability to conduct mainstream capnography.
- The resuscitation bay be equipped with the capability to perform l2 lead ECG.
- The HEARTSTART 3000 be replaced in all resuscitation bays with a HEARTSTART 4000, or equivalent, such as LIFEPAK 12
- HEARTSTART 4000 be procured with the option for external cardiac pacing.
- ISTAT be incorporated in resuscitation standardisation.
- The resuscitation standardisation drug schedule be updated.
- Aspirin, amiodarone, enoxaparin and a cardiac thrombolytic agent be included in the drug schedule.
- Consideration be given to the most appropriate method for equipping resuscitation teams with timely equipment and training for credible paediatric and obstetric emergencies in the event of deployments which may involve such emergencies.
- Tentage for resuscitation bays be designed or put to local tender, to provide a dust-proof, climate-controlled, lightweight, rapidly deployable facility.

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