ADVANCING MARITIME MEDICAL SUPPORT FOR THE REPUBLIC OF SINGAPORE NAVY

By **COL(DR) Chow Weien & LTC(DR) Liow Ming Han Lincoln**

ABSTRACT

Historic naval medical support has often been described as futile, with naval surgeons lamenting their impotence due to resource constraints and rapid accrual of severe injuries on afloat platforms. However, a silver lining shone brightly amongst these dark clouds when James Lind pioneered naval hygiene for the Royal Navy in the 18th century. His work was forward-looking, progressive and advanced naval preventive medicine. Rapid growth of the Republic of Singapore Navy (RSN) in the 1980s enabled the RSN to secure our Sea Lines of Communications (SLOC) and ensured maritime security. Navy Medical Service (NMS) has over the years advanced maritime medical support capabilities and has also positioned herself as a regional leader in the niche area of underwater medicine. This will ensure that comprehensive medical support will be provided across the full spectrum of RSN operations to ensure mission success. The aim of this article is to detail the evolution and future directions of naval medical support in an increasingly complex maritime operating environment.

INTRODUCTION

During the war of Jenkins Ear in 1740, Commodore George Anson successfully led the British in the capture of an Acapulco galleon. Returning to Britain in 1744 by way of China and thus completing a circumnavigation, the voyage was infamous for the horrific number of disease-related deaths, with only 10% of the original 1,900 crew returning.[1]

Historically, naval surgical support has often been described as futile, with naval surgeons lamenting their impotence due to resource constraints and rapid accrual of severe injuries on afloat platforms.[2] As recent as Operation Neptune, Surgeon Airth vividly recalls the seemingly impossible odds and his frustration during the Normandy beach landing:

> *"This has indeed been D-day; Dawned-Day, Death-Day, Destruction-Day, Disappointment- and Disillusion-Day."*[3]

However, a silver lining shone brightly amongst these dark clouds when James Lind pioneered naval hygiene for the Royal Navy in the 18th century. He was instrumental in discovering the cure for scurvy for sailors and was also recognised for his shipboard public health initiatives, which are still practised today, such as enforcing cleanliness of shipboard linen, ship ventilation and fumigation practices. His work was forward-looking and progressive and it advanced naval preventive medicine.[4]

On a separate front, whilst facing impossible odds, Lieutenant Commander (LCDR) Sam R. Sherman who was wounded in

battle, exemplified the resolve and courage of a naval surgeon by attending to a mass casualty situation when the USS Franklin was incapacitated by Japanese bombers during the Pacific War.[5] These examples demonstrate tenacity and steadfastness of the naval surgeons in ensuring the best care for the sailors under their care during peace to war.

With RSN ships deploying further and longer, Naval Medical Service focused on the development and provision of frontline maritime medical support for our Naval combatants. They conduct realistic, simulation and operational training for non-medical RSN personnel to empower them to function as first responders on all RSN platforms.

Naval medical support continues to be very challenging. Today, the Navy Medical Service (NMS), of the RSN has evolved into a world class medical service which: (1) provides comprehensive medical support for RSN's full spectrum operations; (2) ensures and optimises the health of the Navy and (3) has positioned herself as a regional leader in underwater medicine.

EVOLUTION OF NAVAL OPERATIONAL MEDICINE

The rapid growth of the RSN in the 1980s enabled our Navy to secure our Sea Lines of Communications (SLOCs) and ensure maritime security. With RSN ships deploying further and longer, NMS focused on the development and provision of frontline maritime medical support for our Naval combatants. They conduct realistic, simulation and operational training for non-medical RSN personnel to empower them to function as first responders on all RSN platforms. NMS also provides medical training for divers, allowing these cross-trained diver medics to provide medical support during diving operations.

Realistic shipboard medical evacuation training in the early days.

NMS medics, Independent Duty Corpsmen (IDC) and Medical Officers (MO) provide primary healthcare and manage emergency situations in the austere maritime environment. The RSN is currently the only service which raises, trains and sustains IDCs.

The IDC is a highly trained Medical Military Expert (MME) who is able to function independently on surface and underwater platforms. With the introduction of the Naval Helicopters, NMS MOs and IDCs also undergo basic aviation medicine training to support RSN naval aviators.

The first Naval afloat surgical team was established in 1987 and operated on board the *Endurance*-class Landing Ships Tank (LST). The RSN also acquired her 1st Generation surgical containers.

During the 2000s, Damage Control Surgery (DCS) was recognised to be able to maximise survivability in trauma casualties by prioritising physiological recovery over anatomical repair through the prevention of the lethal triad of acidosis, hypothermia and coagulopathy.[6] Interestingly, the concept of DCS was actually adopted from Naval damage control procedures, which aim to restore the watertight integrity, stability or offensive power of a warship.[7] As part of the 3rd Generation transformation of the RSN, Shipboard Surgical Sections were created and trained to perform damage control surgeries in confined spaces on the frigates. Through ingenious design, the medical centre on board the new *Formidable*-class frigates was dual-roled into an Operating Theatre (OT), and the dining room can be rapidly converted into an Intensive Care Unit (ICU). These innovative solutions increased operational flexibility, and expanded the frigate's mission profiles.

MINDEF

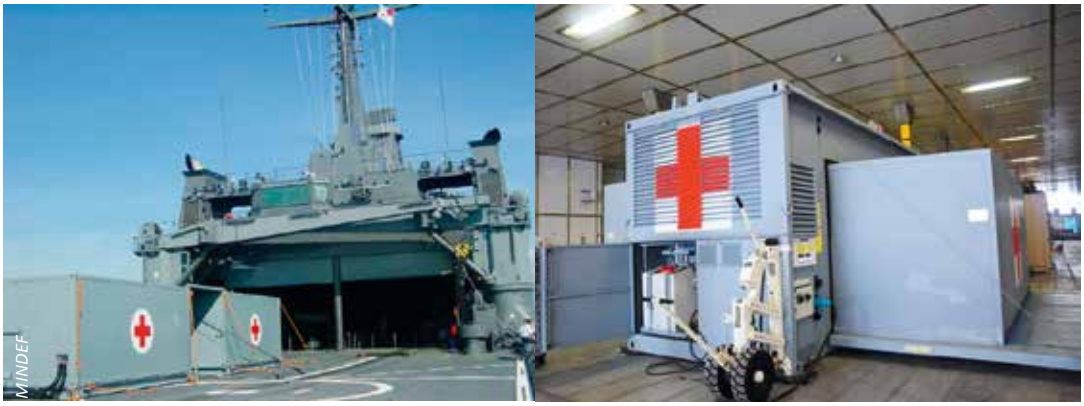
First generation RSN maritime surgical containers.

Operating theatre on board a Formidable-class frigate.

Today, maritime operations may have to be conducted at considerable distance from a land-based surgical facility. The Rapidly Deployable Maritime Container (RDMC) was designed by NMS to provide a modular and scalable maritime surgical capability for the RSN. A 2-men team can rapidly deploy the standard 20-foot ISO RDMC in 10 minutes into an OT or ICU, thereby providing in-theatre afloat surgical support. Key features of the RDMC include: (1) Operational flexibility that allows deployment on land or at sea on military or commercial ship platforms; (2) Corrosion resistance for enhanced survivability at sea; (3) Adaptability through a universal coupling system that allows the RDMC to tap on the vessel's electrical, water and sewage systems for continuous operations, and (4) Hospital grade High-Efficiency Particulate Air (HEPA) filter and laminar air flow system, which reduce the risk of infection, enhance patient safety and maximise survivability of casualties. With its continual support of active operations, the RDMC has strengthened RSN's value proposition as a strategic partner and will enable greater interoperability with foreign navies.

FUTURE CHALLENGES IN NAVAL OPERATIONAL MEDICINE

The evolving nature of conventional and hybrid threats, terrorism and piracy culminate in a complex maritime environment. The eventual large-scale operationalisation of autonomous drones, self-navigating mines, unmanned underwater and surface fleet swarm technology will result in significant changes in the fundamentals of naval warfare and its supporting medical support concepts. The RSN will need to continue to



RDMC deployed on RSN Landing Ship Tank and USNS Millinocket.

safeguard Singapore's SLOCs and perform increasingly complex tasks to ensure the seaward defence of our homeland.

The evolving nature of conventional and hybrid threats, terrorism and piracy culminate in a complex maritime environment.

NMS will need to ensure sustainability of medical resources by further optimising National Servicemen resources, enhancing medical deployability and minimising attrition of RSN combatants. Further enhancements to the existing medical support system, focusing on modularity and scalability with the capability to rapidly deploy for operations, must be developed to support RSN full spectrum operations throughout the peace-to-war continuum. NMS will also leverage advanced medical technology to improve medical and surgical care and maximise survivability for RSN combatants. Some examples include the incorporation of Point-of-Care Test (POCT) kits and advanced imaging and diagnostic equipment.

EVOLUTION OF UNDERWATER MEDICINE

Underwater medicine is a niche military medicine specialty, which comprises diving, hyperbaric and submarine medicine. The need for diving and hyperbaric medicine in the RSN arose from the establishment of the Naval Diving Unit in 1970s, with NMS pioneering underwater medicine practice in Singapore. In 1973, the acquisition of the British 10-men hyperbaric chamber enhanced diving medical support for our divers. As the NMS had the only capability for Hyperbaric Oxygen Therapy (HBOT) at that time, it extended the facilities to treat a wide range of patients, from fishermen with Decompression Illness (DCI) to civilians with poor healing wounds.[8]

From 1984 to 1987, NMS provided essential compressed air works consultancy and on-site recompression treatment using a COMEX hyperbaric chamber during Singapore's Mass Rapid Transit (MRT) tunnelling project. These experiences formed the foundation from which Regular Navy MOs built their clinical expertise in diving and hyperbaric medicine.

Acquisition of the first multi-place hyperbaric chamber (British Chamber) in 1973.

THE 'NEW AGE' OF DIVING AND HYPERBARIC MEDICINE IN SINGAPORE

With the NMS's foresight the Hyperbaric and Diving Medicine Centre (HDMC) was setup in collaboration with Singapore General Hospital (SGH). In 2008, RSN and SGH signed a Memorandum of Understanding (MOU). Work in the SGH HDMC included treating military and civilian divers, providing education and training for medical personnel and conducting underwater medicine research. The SGH HDMC is also integrated within the national healthcare system.

Since then, NMS has trained all the diving and hyperbaric medicine physicians in Singapore. This has led to the improvement in diving medical support not just for Singapore, but also the surrounding region.

In 2009, NMS and SGH HDMC co-organised the inaugural Singapore Hyperbaric and Diving Medicine Course (SHUMEC). The course achieved international accreditation by the Diving Medical Advisory Committee (DMAC) in the following year, bearing testament to the high quality of underwater medicine education. Since then, NMS has trained all the diving and hyperbaric medicine physicians in Singapore. This has led to the improvement in diving medical support not just for Singapore, but also the surrounding region.

Going forward, NMS will continue to build deep underwater medicine expertise together with the national and international hyperbaric and diving medicine community. In addition, NMS will identify potential research areas to enhance combatant performance and extend the operational diving envelope.

THE ADVENT OF SUBMARINE MEDICINE

The commissioning of RSS *Conqueror*, a Challenger-class submarine in 2000 marked the advent of Submarine medicine in the RSN. The health and safety of RSN submariners was of paramount importance and NMS was charged with the development of organic submarine medical support, submarine-related occupational health safety polices as well as submarine escape and rescue procedures.

NMS introduced the RSN IDC programme in 2000, which was based on the United States Navy (USN) submarine IDC programme. The programme allowed a select group of MMEs to undergo a demanding one-year academic course at the USN Naval Undersea Medical Institute to obtain the skills and knowledge

MINDEF

Commissioning of the LST-based SHCV on RSS Perseverance.

to function independently on a submarine. NMS IDCs are also trained as submariners and undergo rigorous currency training to maintain their medical proficiency. It continues to be an honour to be selected as an IDC. Despite the huge responsibility and onerous nature of the task, NMS IDCs continue to serve RSN's submarine force with distinction.

Distressed Submarine (DISSUB) scenarios due to underwater incidents or technical failure will require collective rescue or individual escape of its crew. With that, the RSN developed and operationalised the LST-based Submarine Hyperbaric Chamber Vessel (SHCV). In 2009, RSN operationalised the state-of-the-art, custom-built submarine rescue suite on MV Swift Rescue (SWR). The rescue suite included a submersible (DSAR6) which was capable of mating with a DISSUB and rescuing up to 17 crew at once; a remotely operated vehicle capable of underwater search and delivery of life-support supplies to a DISSUB; recompression chambers on MV SWR which allowed Transfer-Under-Pressure (TUP) from DSAR6; an eight-bed high dependency and ten-bed general ward; and a patient elevator and helipad to facilitate helicopter-evacuation. RSN's submarine rescue suite has since drawn accolades from the international submarine rescue community, resulting in several submarine rescue agreements with regional navies. RSN has positioned herself as the submarine rescue hub in the region. NMS will continue to deepen her expertise in submarine medicine, and enhance interoperability in submarine escape and rescue operations with other navies.

ENHANCING NAVAL HEALTHCARE AND COMBAT PERFORMANCE FOR A STRONGER NAVY

NMS is committed to deliver quality medical care and enhance force health for the RSN. The Healthy Eating and

Active Lifestyle (HEAL) programme and the ShipBoard eXercise (SBX) programme were implemented to enhance the health of our servicemen. Occupational health programmes and initiatives were also strengthened to ensure a safe working environment for our RSN sailors. NMS will continue to improve the medical selection of our sailors, reduce medical attrition and maximise deployability.

NMS is committed to deliver quality medical care and enhance force health for the RSN.

NMS also conducts performance optimisation research for elite underwater combatants. The use of the respiratory muscle trainer has led to significant improvement in aerobic endurance on land and underwater. NMS continually works with the surface and submarine crews to address fatigue management, with the aim of improving combat performance through optimisation of the shift cycle on board RSN platforms.

CONCLUSION

The provision of comprehensive naval medical support for the RSN will continue to be challenging, especially in today's new maritime operating environment. NMS must remain flexible, nimble and forward-looking in the provision of medical support to protect the health of our servicemen and to ensure mission success for our Maritime Force, in a Maritime Nation. By providing robust medical support for RSN's full spectrum of operations, enhancing the Navy's health through performance optimisation, deep specialisation in niche areas of diving and submarine medicine, lending a helping hand and building trust with strategic partners through peace-support operations and socio-civic missions, and daring to dream big and develop innovative solutions such as the RDMC, NMS has set herself apart and

Submarine rescue submersible (DSAR6).

stands poised to build on her legacy and continue as a regional and international leader in maritime medicine.

ENDNOTES

1. Cambridge, Encyclopaedia Britannica 11th Edition: "*George Anson, Baron Anson*" (UK: Cambridge University Press, 1911), 83-84.

2. Lavery B. *The Royal Navy officer's pocket-book,* 1944. London: Conway Maritime, 2007:144 p.

3. Beevor A. D-day : the Battle for Normandy. New York: Viking, 2009:xv, 591 p.

   Osborne M, Smith JE. *Action Stations! 100 years of trauma care on maritime and amphibious operations in the Royal Navy*. J R Navy Medical Service 2015;101-1:7-12.

4. Bown SJ. Scurvy: *How a Surgeon, a Mariner, and a Gentleman Solved the Greatest Medical Mystery of the Age of Sail*. Booklist 2004;100-14:1251.

5. Tait N. *The Heritage of Naval Surgery*. ADF Health 2011;12-1.

6. Schreiber MA. Damage control surgery. Crit Care Clinic 2004;20-1:101-18.

7. Ball CG. *Damage control resuscitation: history, theory and technique*. Can J Surg 2014;57-1:55-60.

8. Edmonds C, Bennett M, Lippmann J, Mitchell S. Decompression illness or "caisson's disease" was first described by Andrew Smith in 1873 during the construction of the Brooklyn bridge due to inadequate decompression of the compressed air workers. During this project, decompression sickness became known as "The Bends" as affected patients were characteristically bent forward at the hips, reminiscent of a fashionable stooped posture and dance move known as the Grecian Bend. "Diving and subaquatic medicine". Fifth edition. ed. Boca Raton: CRC Press, Taylor & Francis Group, 2016:xvii, 835 pages.