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Whither the Field Ambulance?

Role 2 Land Health Service Support in the 21st Century Battlespace

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ABSTRACT

The Canadian Forces (CF) requires a deployable Health Service Support (HSS) capability that is valid across all 11 CF *Force Planning Scenarios*. Policy further requires that this capability be benchmarked to a Canadian civilian level of care, and be interoperable with our principal allies. Recent CF experience with the hub-and-spoke HSS paradigm during Peace Support Operations, whereby patients are aeromedically evacuated from point of injury directly to a Role 3 HSS facility, has led to discussion regarding the continuing relevance of the Role 2 Field Ambulance in deployed CF HSS. History and doctrine recognize, however, that the hub-and-spoke paradigm requires a permissive tactical environment, and that it is resource-intensive and has numerous technical limitations. These constraints indicate that an effective HSS system on the modern conventional battlefield will still require a robust forward surgical and evacuation capability, similar to that of our principal allies. These requirements are met by the evolved Role 2+ CF Field Ambulance, making it a key capability for land casualty management in the patient care continuum across the spectrum of conflict. A remaining shortfall, however, that is common to all Roles of CF HSS and must still be addressed by the CF, is that of a *dedicated* aeromedical evacuation platform.

A well-prepared and able military medical system conveys four powerful messages. It tells the (nation's) people that its leaders have prepared means to care for their sons and daughters who may have to be sent into harm's way; it tells our adversaries that we have a credible, sustainable fighting force; it tells our military commanders that we will sustain their forces; it tells our troops that we care. The last is the most vital: in the absence of medical readiness we can have no assurance that our troops, the flesh-and-blood elements of our weapon systems, will retain the will to fight, which is the crucial factor in the equation for victory.¹

1984, *RADM James A. Zimble, MC, USN, Senior Medical Inspector and future USN Surgeon General*

INTRODUCTION

The requirement for the Canadian Forces (CF) capability to undertake the treatment and evacuation of casualties is set forth at the strategic, operational and tactical levels by the VCDS document *Canadian Joint Task List*,² and must be effective and relevant throughout the 11 CF *Force Planning Scenarios*³ (Annex A) which describe the challenges to be met by the CF across the spectrum of conflict.

Health Service Support (HSS) is a key element of campaign planning, and military commanders have come to rely increasingly upon medical care resources being available and capable when and where needed.⁴ Moreover, HSS in theatre is ultimately the responsibility of the operational commander.⁵ In his recent paper entitled *Combat Health Service Support of the Transformation Force of 2015*, Gouge cautions that “providing care to early casualties will be critical to mission success at the time when the medical footprint is extremely limited.”⁶ Indeed, modern operations can result in high casualty rates before the HSS in the theatre is fully developed. Care for early casualties may then become a key component of the success of the operation and, as such, a centre of gravity.⁷ Further, in an era when nations are less and less likely to accept the possibility of casualties in support of national security, current indications are that they will not tolerate shortfalls in the provision of HSS to their deployed sons and daughters in uniform.⁸

CF HSS is based on a patient management continuum which extends from the point of injury through successive levels of HSS capability based on patients' needs and available resources, culminating in health care facilities in Canada.⁹ To enact this continuum, CF HSS is organized into Levels of Support (Annex B) which reflect command and control relationships at each level of organization and an increasing level of sophistication of clinical capabilities;¹⁰ these Levels are in

keeping with those expressed in NATO HSS doctrine.¹¹ In addition to Levels of Support, CF (and NATO¹²) doctrine is based on progressive categories of HSS capability referred to as Roles of Health Care (Annex C).¹³

A CF “Field Ambulance” is a unit-sized HSS organization that now provides Role 1 and 2 HSS to a Brigade Group at the tactical level, with ground evacuation from Role 1 elements. Informal and formal^{14,15} debate has taken place as to whether, with the establishment of the “hub and spoke” model¹⁶ of tactical air evacuation (which air-evacuates patients directly from Role 1 to Role 3), the currently-configured Field Ambulance would no longer be relevant and that forward surgical capability and rotary-wing aeromedical evacuation (AME) would become the norm. It will be argued that this is both correct and incorrect. The aim of this paper is to establish that the capability resident within an evolved Role 2 HSS organization is an essential element of the CF patient management continuum if we are to meet the exigencies of providing HSS that is relevant to all force planning scenarios.

A precept of CF HSS doctrine is that “health care shall be provided at all levels of accessibility and quality comparable to those being afforded to the Canadian public generally.”¹⁷ This capability has been benchmarked to the clinical capability available in a Canadian Level 2 (District) Trauma Centre.¹⁸ NATO doctrine on standards of care states:

Medical support to NATO forces must meet standards acceptable to all participating nations. Even in crisis or conflict, the aim is to provide a standard of medical care as close as possible to prevailing peacetime national medical standards, given the difficulties of doing so in an operational setting. Advances in medical and information technologies should be exploited to keep the operational standard of care as close as possible to peacetime standards and to deliver emergency care and emergency surgery as close as possible to the point of wounding.¹⁹

It then goes on to require that units and formations in NATO operations deploy and re-deploy with a coherent medical structure.²⁰ This paper will discuss that coherent medical structure, in a format intended for a general military readership and focusing on Role 2 capabilities, in the context of clinical concepts, allied doctrine and the history of military HSS.

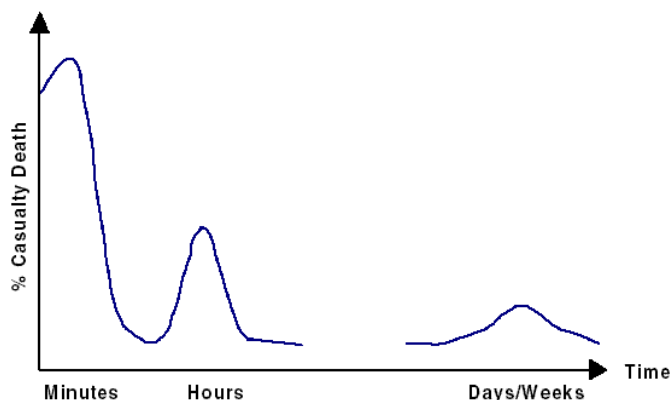
THE GOLDEN HOUR

The term “Golden Hour” was coined in the early 1970s to express that the first hour following injury is when definitive care is critical to a trauma patient’s survival.²¹ Although the specifics and supporting data for this concept continue to undergo debate²²⁻²⁴, it is accepted as a

benchmark in current trauma management,²⁵⁻²⁷ and is directly referenced in CF HSS²⁸ and NATO Joint Medical Support²⁹ doctrine. The American College of Surgeons publishes the widely-used Advanced Trauma Life Support (ATLS½) protocols, which describe the Golden Hour or “first hour” of care following injury as being “characterized by the need for rapid assessment and resuscitation.”³⁰

Trunkey described a Tri-modal Distribution of Casualty Death: the first peak at seconds to minutes for severely injured patients, the second peak at minutes to hours for patients with significant blood loss, and the third peak at hours to days, usually due to sepsis (infection) and multiple organ failure.³¹ This is illustrated graphically at Figure 1.³²

Figure 1
The tri-modal distribution of casualty death.



Combat mortality is divided into two categories: Casualties that die prior to entry into the HSS system are classified as KIA (Killed in Action), while those who die after having entered the HSS system are classified as DOW (Died of Wounds).³³ Smith reports in the *U.S. Naval Institute Proceedings* that “estimates indicate that nearly 20% of those who die during combat suffer from surgically correctable injuries and might have been saved except for delays in the application of definitive treatment.”³⁴ The importance of time in the treatment of battle casualties was known as early as the First World War. Military physicians recognized at that time that if the badly wounded patient who reached a treatment facility was given adequate shock therapy within one hour of being wounded, his chances of survival were 90%, as opposed to 25% after eight hours.³⁵ A recent U.S. study comparing civilian rural prehospital care of major trauma reported that victims were 7.4 times as likely to die before arrival if the emergency medical services’ response time was more than 30 minutes.³⁶

CF and NATO HSS doctrine emphasizes time, specifically that period of time which elapses between injury and the initiation of definitive treatment, as being a key factor in the morbidity and mortality (death and disability) of patients, and that resuscitation and stabilization should be undertaken within the first hour following injury. It distinguishes, however, between life/limb-saving surgery and that which must take place to remove contaminated tissue (debridement), which could otherwise result in a life-threatening infection within six hours. Hence, the doctrinal guideline for time to intervention is: “Life/limb-saving clinical interventions must be provided as soon as possible, ideally within the first hour, but completed not later than six hours following onset of life/limb-threatening injury.”^{37,38} However, the traditional first level of HSS where a “life/limb-saving surgery” capability was located was at the Role 3 field hospital. Thus, the solutions to the time-to-initial-surgery challenge have been focused on the movement of a surgical capability forward to the patient and/or the acceleration of the movement of the patient to the surgical capability via forward AME.

FORWARD SURGICAL CAPABILITY

HSS facilities are doctrinally located “as far forward as possible without interfering with operations or unnecessarily subjecting patients to hostile action”, with the positioning of resources such that initial surgery can be undertaken as rapidly as possible.³⁹ Smescribedhowo

surgical intervention that must be performed urgently and as far forward as the tactical situation permits, in order to save life and limb, and control haemorrhage and infection.”⁴⁴

The HSS doctrinal documents of all four U.S. services mandate a surgical capability, either integral or by augmentation, in their Role 2 elements (Roles are referred to as Echelons in U.S. HSS doctrinal parlance). The U.S. Army Echelon 2 organization is the Forward Medical Support Company which on its own is clinically a Role 2 capability but may be augmented to a Role 2+ capability with the attachment of a Forward Surgical Team to provide a resuscitative surgery capability.⁴⁵ The U.S. Air Force (USAF) Echelon 2 organization is the Air Transportable Clinic which supports the Squadron Medical Element; this has a Role 2 capability, and can be augmented to a Role 2+ or greater capability with the progressive modular deployment of elements of the USAF EMEDS (Expeditionary Medical Support) System.^{46,47} In the U.S. Navy (USN), the Echelon 2 HSS capability resides aboard the Aircraft Carrier of a Carrier Battle Group and the Casualty Receiving Treatment Ships of an Amphibious Battle Group, and has a baseline Role 2+ capability with integral resuscitative surgical capability.⁴⁸ The U.S. Marine Corps (USMC) Echelon 2 organization is the Medical Battalion, which has a baseline Role 2+ capability. Its resuscitative surgical capability resides within the Surgical Platoons of its three surgical companies and its eight Shock Trauma Platoons.⁴⁹ General JH Binford Peay III, Commander-in-Chief of U.S. Central Command 1994-97, summarized this aspect of his Concept of Operations as follows, “When casualties occur the battlefield will be cleared. Patients will be stabilized forward with light surgical teams then moved rearward, maintaining en route care and accountability.”⁵⁰

The Canadian Forces Health Services (CFHS) has undertaken a major phased review of CF HSS deployable clinical capabilities through its Standing Committee on Operational Medicine Review (SCOMR). At the tactical level, it was recommended that Forward HSS be provided by a Close Support composite Role 2+ unit, i.e., a Role 2 unit with integral Role 1 and augmentable with a surgical capability.⁵¹ The most recent CF HSS doctrine reflects augmentation of Role 2 with a clinical surgical capability module which is provided by the Role 3 HSS units, with such modular augmentation being undertaken in multiples if a continuous 24/7 capability is required. This module comprises a team of 5-7 personnel along with all basic equipment necessary to provide surgical care, and is the basic platform for the addition of sub-specialty modules.⁵² Elements ranging from a field surgical team to an advanced surgical center may be attached.⁵³

Future combat will likely be at a greater pace with a greater degree of dispersal of supported units, increasing the value of highly mobile HSS treatment assets. The increased range and

accuracy of weapons, combined with the possible lack of compunction of future adversaries regarding the targeting of HSS facilities, will make a potential target of the larger-footprint lower-mobility Role 3 organizations for which rear areas were traditionally a relative sanctuary.⁴ The traditional Role 2 Field Ambulance is a highly mobile HSS asset; it must be recognized, however, that with the benefit of increasing capability through modular augmentation comes an increased requirement for HSS personnel and materiel, and a consequent reduction in mobility.⁵⁴ The added value to the task-tailored modular augmentation of the evolved Role 2 HSS capability is that a flexible balance can be made, and adjusted as required, between clinical capability and tactical mobility for dynamic operational circumstances. Enhanced treatment capabilities notwithstanding, the historic and ongoing role of the Field Ambulance as a key element of Forward Medical Evacuation bears further exploration. USAF physicians on UNPROFOR, where Field Surgical Teams (FSTs) were deployed forward to augment Role 1, observed that FSTs partially “compensated for the deficiencies (in evacuation), but do not replace the need for Medical Evacuation”; however, they also advised that “a good Medical Evacuation capability will complement the FSTs but never replace them.”⁵⁵

HISTORY OF MILITARY CASUALTY EVACUATION

The rapid casualty evacuation system has been an integral part of military HSS during major conflicts since its development in 1795 by Baron Dominique Jean Larrey, a French surgeon during the Napoleonic Wars. Napoleon ensured that each of his Divisions had an ambulance corps comprising 170 men, a surgeon and purpose-built horse-drawn carriages to carry casualties to the rear for rapid surgical intervention.⁵⁶ In 1862, Maj Jonathan Letterman, Medical Director of the Army of the Potomac during the U.S. Civil War implemented an hierarchical evacuation system whereby ambulances would bring all casualties as quickly as possible to a clearing station immediately to the rear of each battlefield, where they were sorted. Seriously wounded patients underwent lifesaving surgery as soon as possible, and then were transported to hospitals in the rear. Lightly-wounded patients were treated later and kept near the front lines.⁵⁷

The foundation of the current echelon care system was implemented by the Allies during World War I: First Aid Stations (Role 1) located behind Regimental Reserves for rapid initial treatment (including basic surgery); Ambulance Squads (~Role 2 less clinical care) to then transport rearward patients who required further care; Field Hospitals (Role 3), located behind Divisional

Reserves, for urgent surgery, followed by railway evacuation rearward of patients who could not return to duty; civilian Hospitals (~Role 4), for convalescence and further care as required.⁵⁸

The first reported air evacuation is generally thought to have occurred during the siege of Paris in 1870 during the Franco-Prussian War, where 160 casualties were evacuated by balloon.⁵⁹ The first fixed-wing tactical evacuation was performed during the First World War in an aircraft of opportunity by the French from the Albanian Front in 1915; an aerial ambulance service using purpose-modified aircraft to evacuate combat casualties was initiated by the French in April 1918 in Flanders.⁶⁰ The first rotary-wing combat air evacuation mission was flown in Burma in April 1944 by the USAAF, with a number of further instances recorded in 1944-45 in the Pacific Theatre.⁶¹ Korea saw helicopter air evacuation become an established practice, with U.S. Army helicopter ambulance detachments assigned to Mobile Army Surgical Hospitals (MASH) for the rapid evacuation of seriously-injured soldiers from the front line to the appropriate level of medical treatment. Over 17,000 Allied casualties were evacuated by air evacuation pilots during the Korean War.⁶² Helicopter tactical air evacuation evolved significantly in the Vietnam war, and was responsible for the evacuation nearly 900,000 Allied sick and wounded; also of import is the fact that in Vietnam, most combat units were within a half hour's flight time from a Role 3 or Role 4 facility.⁶³ Although it must be borne in mind that there were significant advances in medical science and techniques between First World War and the Vietnam War, the concurrent improvements in casualty evacuation certainly contributed to the decreasing U.S. DOW rates: 8.5% in WWI, 4% in WWII, 2% in Korea, and 1% in Vietnam.⁶⁴

With the evolution of patient evacuation has come the evolution of differential terminology to describe it: CASEVAC (Casualty Evacuation) pertains to patient transport from the site of injury to a medical treatment facility using generic transport (e.g. "lift of opportunity") or without the provision of substantive en route medical care, and represents the "scoop and run" method employed in mass casualty situations. True MEDEVAC (Medical Evacuation) resembles the civilian medical transport model (including AME and ground MEDEVAC [GME]), with appropriately trained and equipped personnel providing en route medical care.⁶⁵

FORWARD AEROMEDICAL EVACUATION

The clinical requirement for universal civilian AME is still debated in the literature. Seven studies have been undertaken in various regions of the U.S. comparing mortality rates for trauma patients transported by rotary-wing AME versus GME. Four⁶⁶⁻⁶⁹ reported that mortality rates were

decreased for patients transported by helicopter, while three⁷⁰⁻⁷² reported no difference. It must be recognized, however, that these studies were undertaken in the context of an intact civilian infrastructure in peacetime.

CF doctrine defines Forward AME as providing airlift for patients within areas of tactical level operations, usually with tactical aviation resources, and as having the advantages of speed, range, comfort and flexibility of destination facility.⁷³ The doctrinal HSS staffing normally comprises one Medical Assistant Primary Care Paramedical (Enhanced Skills certified),⁷⁴ provided by the Field Ambulance,⁷⁵ and is in harmony with SCOMR clinical recommendations.⁷⁶ NATO doctrine states that Forward AME is normally a national responsibility,⁷⁷ and that AME aircraft must be medically equipped and crewed in line with the minimum requirements of STANAG 3204 (*Aeromedical Evacuation*) and national standards.⁷⁸

As previously stated, a precept of CF HSS doctrine is that “health care shall be provided at all levels of accessibility and quality comparable to those being afforded to the Canadian public generally.”¹⁷ The vast majority of the Canadian populace has access to rotary-wing AME for rapid transport (with in-flight sustaining care by a certified EMT-Paramedic) to a District Trauma Centre or higher medical facility. The key elements of this service are: dedicated pre-configured helicopter, dedicated and appropriately-qualified personnel on standby, and dedicated communication lines.⁷⁹ The Alberta STARS (Shock Trauma Air Rescue Society) AME crew comprises at a minimum one critical care nurse and one critical care paramedic, with the capability to augment with an ER physician or specialty teams as required. The Québec ÉVAC (*Évacuations Aéromédicales du Québec*) medical teams are composed of physicians and ER nurses. The Ontario Air Ambulance Service flight medical teams include critical care and advanced care paramedics.⁸⁰ The medical aircrew component of the standard U.S. Army air ambulance company MEDEVAC helicopter consists of a flight medical aidmen (flight medic), who is responsible for providing patient assessment and in-flight medical care.⁸¹ In a recent issue of the U.S. Army Medical Department Journal, Gerhardt (a U.S. Army Medical Officer) remarks in the *U.S. Army Medical Department Journal* that “in terms of our own [U.S. Army] definitions, official doctrine, and training standards, we are in fact providing a service that is closer to CASEVAC, rather than MEDEVAC”⁸¹, and recommends that the medical aircrew member be instead an EMT-Paramedic.⁸²

U.S. Army doctrine describes *dedicated* MEDEVAC systems (the more preferred option), whereby the aircraft is solely dedicated/equipped/manned for the mission of aeromedical

evacuation, in contrast to *lift of opportunity* systems (the less preferred option), whereby empty aircraft are used for CASEVAC during the backhaul following the completion of their primary mission.⁸³ Bauer, a USN Medical Officer serving with the USMC during the Gulf War, commented in the *Marine Corps Gazette* that “opportune lift is a random, unpracticed participant in what has to be an organized yet highly flexible system.” He recalled a USMC pilot during the Gulf War, who had observed that “it makes no sense for us to risk our necks just to have the guy die en route.”⁸⁴ Despite the fact that more than 33,000 medical personnel were deployed in OPERATION DESERT STORM, including at least 3,100 physicians in the Gulf theater of operations,⁸⁵ the USN Surgeon General noted that “the lack of dedicated tactical aeromedical evacuation capability in naval services would have created difficulties had the theater (Southwest Asia) matured as expected.”⁸⁵ A U.S. General Accounting Office report concluded that the Army would not have been able to provide adequate care if the ground war had started sooner, lasted longer, or if casualty numbers (458 wounded) had matched casualty estimates (20,000+).⁸⁶

The U.S. Army has integral air ambulance units that are freestanding company or platoon-sized elements commanded by a Medical Service Corps aviation officer (pilot). The standard company is composed of 15 UH-60 (Blackhawk) air ambulances and their associated aircrew.⁸¹ Each Air Ambulance Evacuation Platoon has three Forward Support MEDEVAC Teams of three UH-60s which provide MEDEVAC from the point of injury or Role 1 facility to higher levels of clinical care.⁸⁷ The USMC has no integral dedicated tactical air ambulance units; USMC rotary wing transport and utility aircraft are allocated to perform the Forward AME mission at the discretion of the commander.⁴⁹ The USN also has no organic capability for forward AME.⁴⁸ Smith notes in the *Naval War College Review* that the distances involved in littoral manoeuvre, as well as its inherent limitations in GME and forward casualty treatment capability, combined with the vulnerability of units ashore, indicate a requirement for dedicated AME for this type of operation.⁸⁸

In CF doctrine, none of the HSS units or formations have integral AME aircraft, and these must be coordinated by the HS Unit with the assistance of their air liaison officer.⁸⁹ All CF aircraft used in AME are “aircraft of opportunity” with no dedicated flight time for AME.⁹⁰ Forward AME is primarily undertaken using the CH-146 Griffin in support of the Army.⁹¹ SCOMR remarked a current HSS capability shortfall in this regard and recommended that a number of CF CH-146 Griffin helicopters (or other purpose-procured rotary-wing aircraft) be designated to meet these key requirements in order to provide a dedicated CF MEDEVAC capability.^{79,92} Given the lessons learned by our Allies in recent conflicts, and the CF mandate to provide a deployed health care

capability comparable to that being afforded to the Canadian public generally, the CF would be wise to give close consideration to this issue.

Although dedicated Forward AME is an essential element of an effective deployed HSS capability, it does have limitations. CF doctrine describes the disadvantages of Forward AME as including physiologic stress on certain categories of patients, susceptibility to weather, lack of available air space and/or AME assets as a result of enemy or friendly actions, the resource-intense nature of air operations (especially in the case of rotary-wing aircraft), the compromise of security caused by the presence of aircraft, and the tendency to evacuate patients further rearward than necessary.⁷³ Several of these will be discussed further.

Patient Stress

NATO STANAG 3204 describes a number of clinical criteria that preclude AME. Further unfavourable clinical ramifications of rotary-wing AME are identified, including vibration (causing resonance of damaged body structures) and turbulence (causing motion sickness), as well as noise and space/light limitations, which complicate en route care.⁹³

Weather

While there are myriad examples that could be provided, one that will be in recent memory of most is that of the Balkans. Although rotary-wing flying limits for recent OP PALLADIUM rotations have been 500/1 (500-foot ceiling, 1 mile visibility), as a planning figure, weather limits for wartime operational flying (including Forward AME) would be 300/1.⁹⁴ The following table shows the number of days by month in Velika Kladusa (VK) where conditions fell below 300/1 during the past year:⁹⁵

Sep01	Oct01	Nov01	Dec01	Jan02	Feb02	Mar02	Apr02	May02	Jun02	Jul02	Aug02
08	15	06	04	05	04	04	08	09	03	03	10

Figure 2 – Days below 300/1 in VK between Sep01 and Aug02.

Thornton and Neubauer, USAF Medical Officers, reported weather to have been a significant factor for AME during their tour on UNPROFOR Oct93-Sep94.⁵⁵ Krekorian described in the *Marine Corps Gazette* situations in Vietnam where adverse weather precluded AME upon which the installation was entirely reliant, leaving the Battalion Surgeon (General Duty Medical

Officer at Role 1 HSS) to provide whatever emergency surgical care possible, with mixed clinical outcomes.⁹⁶

Lack of Dedicated AME Aircraft

Beyond the previous discussion of the perils of using CASEVAC lift of opportunity versus dedicated MEDEVAC, excerpts from two published accounts from the Gulf War will serve to further illustrate this point. Davis, a USMC Officer, discussed the dilemma in his article *Cancel the Medevac, He's Dead*:

“The Marine Corps has only a limited number of assault support helicopters to undertake all the missions assigned...As this fleet of helicopters dwindles, mission priorities are set and (CASEVACS) do not always get top billing. Herein lies the Corps’ dilemma: what has more importance on the battlefield – an assault support helicopter or a Marine’s life and limb? To many of us there does not appear to be a choice at all. Life is paramount. This is definitely true in peacetime, but what about wartime? The helicopters assigned as (CASEVACS) cannot help the group commander who needs trooplift support for his counterattack force. They also cannot be employed for an ammo resupply mission...This is a hard question that most combat commanders will eventually have to answer.”⁹⁷

In his article entitled *The Future of Aeromedical Evacuation*, Bauer, a USN Flight Surgeon, describes his experience with having only lift of opportunity:

“There are no assurances that lift helos would be in the vicinity or tactically available for the (CASEVAC) of the wounded. Similarly, there would be conflicts or confusion if patient delivery points were not tactically convenient, and there would always be the risk that the helo could be suddenly diverted to a more ‘critical’ mission.”⁸⁴

In the *Naval War College Review*, Smith warns further that in future conflicts, “of the finite number of helicopters on hand, many will be unavailable because of tactical missions, bad weather, or technical constraints.”⁸⁸

Vulnerability to Enemy Fire

Historically, rotary wing military aircraft have encountered periods of significant misfortune during times of conflict. In Vietnam, despite a negligible air-to-air threat, the U.S. Army lost an estimated 5,086 helicopters.⁹⁸ In the first 18 months of the Soviet occupation of Afghanistan, *mujahedin* ground-based antiaircraft fire reportedly led to the loss of 250 Soviet helicopters.⁸⁸ The Royal Navy lost more than 20 helicopters during the 10-week Falklands War.⁹⁹ During the 1983 U.S. invasion of Grenada, seven U.S. H-60 Blackhawk and two AH-1 Cobra helicopters were lost, which represented over 10% of the 88 combat helicopters deployed on this operation.¹⁰⁰ Mullen

reports in the *U.S. Army Aviation Digest* that projected combat attrition for U.S. UH-60s in a conventional war scenario would far outstrip the industrial production capacity required to replace them, leaving this airframe in deficit for ~4.5 years from the initiation of conflict.¹⁰¹ Consequently, Smith suggests that “assumptions that place heavy reliance upon evacuation of the wounded by helicopter or the MV-22 Osprey tilt-wing aircraft may well require reexamination.”⁸⁸

“We would literally stop the war [in Vietnam], bring the helicopter in and pick up (casualties), take them away and start shooting again. We owned the air and could do as we pleased most of the time.”¹⁰²

1986, LTG James D. Stewart, former U.S. Army Surgeon-General

Numerous authors^{4,5,103-105} have recognized the clinical successes of casualty management in Vietnam that were attributable to rapid AME from point of wounding to a Role 3 or 4 treatment capability; they also maintain, however, that it was a phenomenon that will be irreproducible in future conflicts. Further, Smith described it as an “aberration”, which “approached the civilian concept of emergency care more closely than any war we had in the past, or are likely to have in the future.”¹⁰⁴ Kitfield argues that from a medical support perspective, the Vietnam conflict was unique and represented “the golden age of military medicine” which is not likely to be duplicated.¹⁰⁶ Eiseman describes the Vietnam medical support experience as the “halcyon days of American military medicine”, and contends that “control of the Vietnamese battlefield, which made rapid patient evacuation a reality, was based upon several factors: command of the air and sea; fire superiority; uninterrupted radio communications; episodic battle; plenty of helicopters; relatively low casualty levels; and an enemy that lacked shoulder-mounted homing missile-type weapons.”¹⁰⁷

It is this last factor, namely that “the quality and simplicity of small, shoulder-mounted homing missile-type weapons has increased greatly,”¹⁰⁸ that appears to be a common concern of many^{87,104,106,109,110} who have made projections about the role of helicopter forward AME in future conflicts. Smith postulates that “the modern battlefield may be too lethal for evacuation of the wounded exclusively by air” as “the survivability of helicopters is certainly not assured.”⁸⁸ He goes on to make the somewhat gloomy prediction that “instead of medical extractions in minutes, we may have to return to the hand litter, wheeled vehicles, or ‘walking’ casualties.”²⁵ Dorland, a former U.S. Army AME pilot in Vietnam, suggests in his book *Dust Off* that Letterman’s concepts from the U.S. Civil War, as described previously in this paper, still merit consideration on the battlefield of the future.¹¹¹

Allied air superiority may also become increasingly difficult to guarantee, which will hamper AME¹⁰⁴ and lead to increased mortality rates as reported by the British during the Falklands War.¹¹² Hooton has expressed concern in the *Marine Corps Gazette* that “because of (U.S.) dependence on aeromedical evacuation, (they) do not have the wherewithal for ground evacuation,”¹¹³ a concern shared by Smith and Llewellyn in *Naval War College Review* as it pertains to GME in future conflicts.⁵ Both Davis⁹⁷ and Bauer⁸⁴ described in detail the shortfalls in dedicated Forward GME that they observed while serving with the USMC during the Gulf War.

NATO doctrine states “to achieve its mission, a medical evacuation system must have...the ability to evacuate casualties to a medical facility 24 hours a day, in all weather, over all terrain and in any operational scenario.”¹¹⁴ Hence, an enhanced GME capability, the historic purview of the Field Ambulance, must be maintained in accordance with further NATO doctrine which states “ground transport evacuation means should always be planned to cover all situations where AME is not possible due to operational or geographic/climatic factors.”¹¹⁵

FORWARD GROUND MEDICAL EVACUATION

CF doctrinal responsibility for patient evacuation is from rear to front, with supporting HSS Units relieving supported HSS Units of their patients.¹¹⁶ A significant integral dedicated GME capability is inherent in both the historical and the evolved Role 1+2 Field Ambulance, and meets this doctrinal requirement to evacuate patients from point of injury to Role 1 and Role 2 facilities. Lund has recommended in *Naval War College Review* less reliance on AME, particularly rotary-winged, and improved ground ambulances.⁴ Hammick speculates in *International Defense Review* that “the bulk of movement in forward areas is likely to remain vehicular – either tracked or wheeled – and for maintenance reasons, these will have to retain commonality with the rest of the fighting-vehicle fleet.”⁴¹ He goes on to suggest that while combatants may respect the Red Cross/Crescent on military treatment facilities, as was the case in the Egyptian-Israeli conflict in the Negev in 1973, “this would not necessarily apply to the evacuation system which would still have to run the gauntlet of enemy interdiction, particularly at the forward edge of the battlefield.”⁴¹ Indeed, reports on the HSS of the Russian assault on Grozny indicate that the Chechen fighters respected neither, which likely came as somewhat of a surprise to most of the world’s populace in the closing years of the 20th century. It was reported that they attacked and destroyed a Russian field hospital,¹¹⁷ and deliberately targeted Russian medical units and evacuation helicopters.^{118,119} Antal describes in *Army* how the Russians often had to delay medical evacuation until nightfall, and rely

on ground evacuation.¹¹⁸ Grau and Thomas describe, in *The Marine Gazette*, the Russian evacuation system:

Wounded were normally evacuated to the regimental medical post by makeshift armored ambulances (BTR-80), since the Chechens fired on the soft-sided ambulances. Forward air evacuation was not used much, particularly after the Chechens shot down several MEDEVAC helicopters. The fighting in Grozny proved the need for a specially-designed armored ambulance.¹¹⁹

Hence, while there is a need for state-of-the-art soft-skinned ambulances¹²⁰ to conduct the bulk of the GME activity in the forward area overall, there is also a specific requirement for an armoured ambulance capability, as described in NATO doctrine: “In forward areas, armour-protected ambulances are used to afford some degree of protection for casualties and medical personnel.”¹²¹

SCOMR remarked that the standard LSVW wheeled ambulance, while capable in many deployed tactical scenarios,¹²² was not sufficiently durable for extremes of tactical field operations, and recommended that the armoured Bison ambulance variant be considered as the standard field ambulance for forward GME operations.¹²³ Clinical staffing would comprise one Advanced Care Paramedic and one Primary Care Paramedic,¹²⁴ similar to their AME staffing recommendation discussed previously. Armoured ambulances are currently part of CF HSS doctrine¹²⁵ for use in forward areas, and are currently deployed on OP PALLADIUM (Balkans) and OP APOLLO (Southwest Asia) integral to Role 1 HSS elements.¹²⁶ There are 74 Bison Wheeled Light Armoured Vehicles that have been re-roled as ambulances;¹²⁷ 23 are currently so-configured, with the remainder scheduled to be fielded in 2003/2004.¹²⁸ In total, 66 are scheduled to be distributed to the restructured Role 1+2 Field Ambulances.¹²⁸ The doctrinal HSS staffing comprises one Medical Assistant Primary Care Paramedic (Enhanced Skills certified) and one Medical Assistant Primary Care Paramedic certified.¹²⁹ It should be noted for reference that while a great number of nations have chosen ambulance variants of their main wheeled armoured fighting vehicles to satisfy the requirements of speed, mobility and protection,¹³⁰ others have chosen purpose-built soft-skinned vehicles because they offer more space and are more readily identifiable as ambulances by enemy forces.¹³¹

CONTINUITY OF CARE

If appropriate priority is not given to forward medical care, evacuation, and a sophisticated casualty regulation network, a commander runs the risk of a huge logistical burden and an adverse impact on

morale as the dead and injured accumulate. Inattention to these issues will mean the loss of trained troops who could have been treated, stabilized, and even returned to duty.³⁴

2001, CAPT Arthur M. Smith, MC, USNR(ret), Professor of Surgery and Military and Emergency Medicine at the Uniformed Services University School of Medicine.

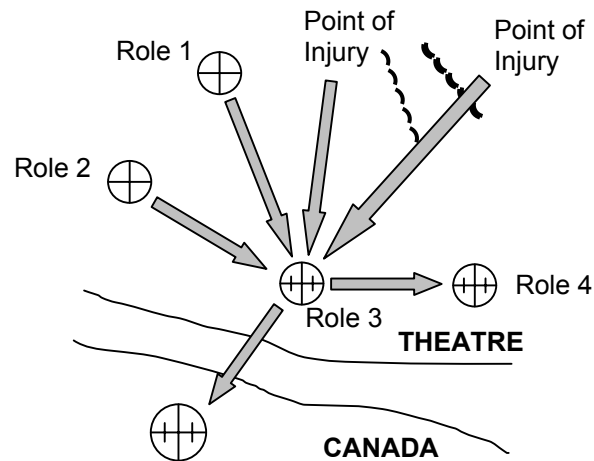
Beyond its treatment, evacuation and mobility capabilities described previously, the Field Ambulance has the essential HSS capability of patient sorting, staging, and holding. It is to be noted that the holding function of a Role 2(+) Field Ambulance is significantly more limited, in both volume and duration, than that of a Role 3 facility. It is, however, a valuable forward “capacitance” capability during periods of interrupted evacuation.¹³² Although these are not necessarily concepts that would commonly be incorporated to a great extent in Canadian civilian trauma management, Canada’s deployed HSS requirements for warfighting should better reflect the caveat of Smith and Bellamy in *Navy Medicine*, “war surgery is not synonymous with civilian trauma management.”¹³³

CF doctrine on continuity of care mirrors that of NATO¹³⁴ and requires that “treatment must be continuous and progressive to the level necessary for definitive treatment of patients’ conditions to minimize mortality and morbidity.” It states that patients should be evacuated through a series of HSS facilities, each with an increasing capability for treatment (i.e. Role 1 to Role 2 to Role 3 etc.), and that “sorting of patients to reflect priorities for treatment and evacuation or return to duty shall be conducted at every HSS treatment facility.”¹³⁵ U.S. Army doctrine states, “routinely bypassing an echelon of care will not be practiced.”¹³⁶ British joint doctrine recognizes that even for Operations Other Than War (OOTW), initial insertion of a force may not be into a benign environment, and that “conventional echeloning of medical assets may therefore be required for force protection reasons and to avoid obstructing military activity” until an area has been “stabilized and dominated by force.”¹³⁷

Evacuation doctrine allows for patient-care flexibility at the tactical level, which is able to respond to rapidly evolving tactical and/or operational scenarios. It ensures that while the minor sick and injured are treated and returned to duty as far forward as reasonable, the seriously ill or wounded are evacuated to appropriate treatment as rapidly as possible.¹³⁸ Basic USMC/USN doctrine requires that no patient be evacuated further to the rear than their medical condition requires or the military situation demands.¹³⁹ From the Second World War through Vietnam, 30-40% of wounded Marines were treated at Role 2, about 25% were treated at Role 3, and 37% were

transferred out of theatre.¹⁴⁰ Smith and Llewellyn summarize the importance of this principle in the *U.S. Naval Institute Proceedings*: “when the field medical system is functioning efficiently, it should be able to ‘fix forward’ to prevent itself from becoming a giant evacuation conduit through which trained, experienced soldiers and marines pour out of the theater to rear-echelon health care facilities.”⁴⁰

Figure 3
CF schematic of the hub-and-spoke concept.



CF doctrine holds that Forward AME should be used whenever possible to transport seriously injured/ill patients from as close as practical to their point of injury/illness to a Role 3 facility (as per the Vietnam experience⁸¹). NATO¹⁶, U.S. Joint¹⁴¹, British Joint¹³⁷, and CF¹⁴² (Figure 3) doctrine espouse, if not in name then conceptually, the “hub and spoke” paradigm for OOTW on a mission-dependant basis. This is described in NATO terms as “the Role 3 (HSS facility) placed centrally, with the sending units (undefined, but presumably Roles 1 and 2) arranged around it.” British doctrine goes on to describe the utilization of Role 2 assets in this paradigm “to reinforce the primary care matrix.”¹³⁷ In his recent paper *Aeromedical Evacuation: How Will We Clear the Next Battlefield*, Powell has raised concerns about patient evacuation on the more extended and dispersed future battlefield, stating that the concomitantly extended patient transit times will necessitate stabilization of injuries nearer to the point of injury prior to transport.⁸⁷ Further, as in CF doctrine previously discussed, the benefit for the patient of immediate transfer to a Role 3 facility must be weighed against the patient’s condition and consequent ability or inability to withstand the environmental rigours of the transit.¹⁴³ This practice also, of course, assumes a tactically permissive environment. Hooton has predicted in the *Marine Corps Gazette* that “uninhibited aeromedical evacuation of casualties from the front to the rear area hospital may not be

able to occur in the future.”¹¹⁴ Mullen reminds us that “operational constraints may dictate that evacuation cannot be accomplished at all.”¹⁰¹

There is the further recognition in CF doctrine that the direct Role 1 to Role 3 AME capability may be subject to interruption for a variety of reasons,¹⁴⁴ necessitating evacuation of these seriously injured patients via a Role 2 facility to a surgical capability (i.e. Role 2+ or higher) as an acceptable alternative.¹⁴⁵ Beyond the patient holding requirement that this would precipitate, it is to be remembered that the concomitant sustaining care may be provided at the unaugmented Role 2 facility, with the additional capability of resuscitative and stabilizing initial surgical intervention at the Role 2+ augmented Field Ambulance.⁴⁴ Liston has warned in *Jane’s International Defence Review* that although Bosnia has been a success in bringing a North American civilian standard of deployed care, few would dispute the impracticality of attempting to apply the HSS experience of Bosnia to a future major conventional conflict.¹³¹

CONCLUSION

The CF must have a deployable HSS capability for treatment and evacuation that is valid across the 11 *Force Planning Scenarios*. Further, it must meet the expectation of the Canadian populace that it can provide a Canadian standard of care to our deployed personnel, while conforming to Allied doctrine to the greatest extent possible in the interest of interoperability.

The continuing relevance of the traditional CF Role 2 Field Ambulance has been questioned in recent years, as the majority of CF deployments during that time have been on operations other than war which have permitted the use of the hub-and-spoke model of medical evacuation and treatment, which is the military HSS posture that most closely resembles the civilian paradigm of care available to the majority of people in Canada. This military HSS model involves the direct aeromedical evacuation of patients to a Role 3 HSS facility, and bypasses the traditional echeloning of patient evacuation and care. While this approach has enjoyed successes in certain conflicts including the Vietnam War, and many periods during the last decade of peace support operations, history and doctrine recognize that it requires a tactically permissive environment, and may not be sufficiently resilient to either significant increases in volume or to diminution of elements of its significant resource requirements.

The echeloned system of deployed military care has its roots in the Napoleonic and U.S. Civil Wars, and is based on the requirement to provide the necessary clinical intervention as close as possible to the point of injury, in both time and space, within the constraints of the tactical

situation. It embodies the concept of rapid initial lifesaving clinical care and onward evacuation of more-seriously injured patients, and the forward treatment and return to duty of less-seriously injured patients. The intent of Canadian HSS to provide a deployed standard of care benchmarked to that generally available in the national civilian health care system, superimposed on the requirement for the preservation in-theatre of scarce and highly-trained military human resources for the commander, oblige the CF to possess a robust system of forward clinical intervention and evacuation capabilities.

Detailed reports and recommendations from experiences in recent conflicts, as well as the analyses and predictions of military scholars, have given a strong indication of the elements of HSS capability that will be necessary in order to provide effective HSS in the predicted environment of increased lethality of future conflicts. The benefits of dedicated rotary-wing aeromedical evacuation assets, staffed with appropriately-qualified personnel, have been recognized, as have the intrinsic shortfalls of systems relying on unstaffed “lifts of opportunity”. While dedicated aeromedical evacuation is an essential capability, the hazards of over-reliance on this mode of evacuation have been identified in the context of its dependence on weather, tactical availability of airspace, positional security compromise, and resource intensiveness. Hence, there remains a requirement for an in-depth ground medical evacuation capability, the historic purview of Role 2 HSS organizations, comprising purpose-modified armoured and soft-skinned vehicles.

Military HSS experience in previous conflicts, combined with current civilian clinical literature and protocols, has indicated the importance of rapid initial surgical intervention in the clinical management of severe trauma in order to reduce patient morbidity and mortality. The Allied doctrinal HSS embodiment of this clinical reality is the forward surgical capability, whereby HSS Role 2 organizations have either an organic or augmented capability to provide initial lifesaving surgery. Along with this surgical capability, there is a requirement for the systemic capacitance of a limited forward patient holding and sustaining care capabilities, organic to Role 2 HSS organizations, when clinical, tactical or logistic factors prevent the further evacuation of patients to Role 3 or higher facilities.

Ongoing phased studies of the CF HSS capabilities necessary to meet CF requirements have been undertaken and have identified capability elements that been incorporated into current CF HSS doctrine. This doctrine now includes an evolved Field Ambulance with organic Role 1 and 2 assets, modularly-augmentable to Role 2+ with a surgical capability. Armoured ambulances and enhanced soft-skinned ambulances are integral to this organization, as is staffing for a true aeromedical

capability. The only HSS capability shortfall remaining is that of a *dedicated* aeromedical evacuation platform, and this is a requirement common to all Roles of CF HSS that the CF must still address.

In the context of the CF *Force Planning Scenarios*, the evolved CF Field Ambulance, seamlessly augmentable on a task-tailored basis and highly mobile, is indeed well-situated to provide deployed HSS in scenarios from Operations-Other-Than-War to Warfighting. It will be a key capability for land casualty management in the patient care continuum across the spectrum of conflict in the 21st century battlespace.

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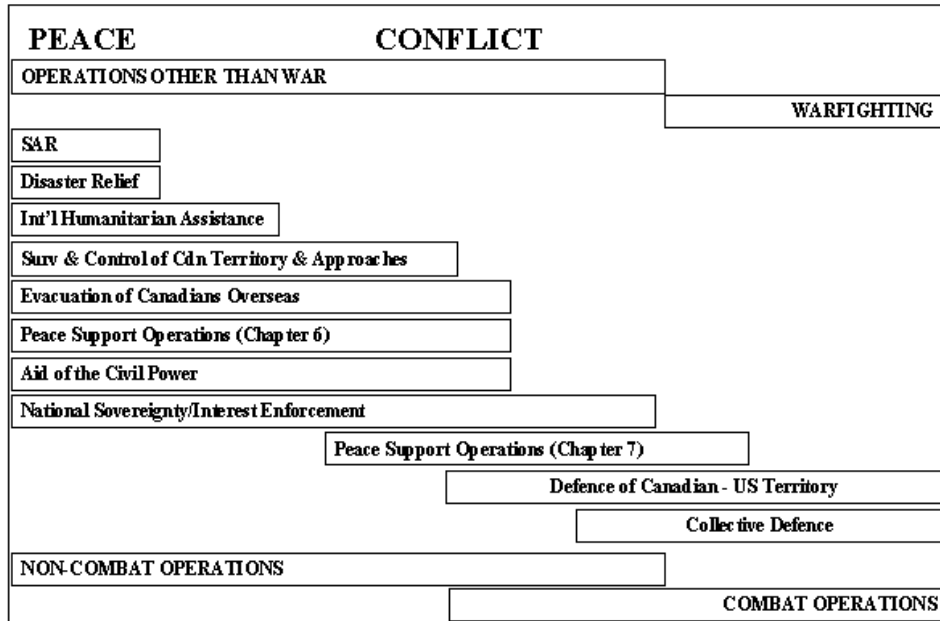
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ANNEX A – CF Force Planning Scenarios³



No.	Scenario	Summary
1	Search and Rescue in Canada	Sub-scenarios include rescue from a ship at sea, search and rescue of an overdue hunting party in the North, and the rescue of survivors from a major airliner downed in a remote area in the North.
2	Disaster Relief in Canada	Assist in the relief of human suffering and assist authorities to re-establish the local infrastructure after a major earthquake on the west coast of Canada.
3	International Humanitarian Assistance	As part of a UN operation, assist with the delivery of relief supplies to refugees amassed in a central African nation.
4	Surveillance \ Control of Canadian Territory and Approaches	Assist Other Government Departments and law enforcement agencies in identifying, tracking and, if required, intercepting platforms suspected of carrying contraband goods or illegal immigrants before or after entering Canadian territory.
5	Protection and Evacuation of Canadians Overseas	Assist DFAIT, as part of a combined force, in the protection and evacuation of Canadian nationals in a foreign nation threatened by imminent conflict.
6	Peace Support Operations (Chapter 6)	Participate as part of a UN peacekeeping force maintaining a cease-fire and assisting in the creation of a stable and secure environment where peace building can take place.
7	Aid of the Civil Power	Assist civil authorities in the establishment of law and order in an area where lawlessness has occurred as the result of disputes over the control of water rights in a time of severe drought.
8	National Sovereignty/ Interests Enforcement	Claiming extended jurisdiction under UNCLOS III, Canada has requested the cessation of seabed exploitation operations by a foreign nation. The CF will assist OGDs in the enforcement of Canadian claims.
9	Peace Support Operations (Chapter 7)	At the request of a foreign nation, as part of a UN coalition, the CF will participate in operations to restore pre-conflict boundaries and return control of an occupied area to the control of the rightful country.
10	Defence of Canada/US Territory	In cooperation with US forces, the CF will defend Canada/US territory against potential threats initiated by an emerging world power as a result of Canadian and American support for a foreign military operation.
11	Collective Defence	As part of a NATO force, the CF will attempt to deter and, if necessary, contain an attack on NATO territory and conduct restoration operations.

ANNEX B - Levels of Health Services Support¹⁰

General

HSS shall be organized into levels of support corresponding to the command and control relationship at each level of organization. Each successive level becomes more sophisticated from front to rear (see following section for descriptions of Roles of Health Care).

Tactical Support at the Unit Level

Medical and/or dental elements attached or integral to units (normally Role 1 HSS, but may be augmented), e.g. ship's sick bay, unit medical station or squadron medical element.

Tactical Support at the Environment Component Level

HSS elements attached or integral to lower level environmental formations (normally Role 2 HSS, but may be augmented), e.g. fleet auxiliary logistic support ship, field ambulance or airfield medical station.

Operational Level Support

HSS elements operationally responsible to the Canadian TFC of CNC (through TF Support Group/ National Support Element [NSE] Commander) (normally Role 3 HSS, but may be augmented), e.g. Composite Health Services Unit.

Strategic Level Support

Normally, Canada-based health services formations and units, e.g. CFHSG, HSGs, maritime HS units, CFEME and CMED (normally Role 4 HSS), but may be augmented). In exceptional circumstances, strategic level support could be derived from allied military and foreign nation capabilities provided health care delivery meets Canadian levels of accessibility and quality of health care.

ANNEX C - Roles of Health Care¹³

General

In addition to levels of support, HSS shall also be based on clinical capabilities designed to meet the characteristics of the operational environment and to play a specific part in force health protection and the progressive examination, treatment, evacuation and hospitalization of sick and injured personnel. These capabilities are referred to as “Roles” and are relative to medical and dental care. A capability may be enhanced to meet the specific requirements of a mission by the selection of selected capability modules, the presence of which is indicated by the “+” sign (e.g. Role 2+).

As a general rule, as HSS capabilities are increased, it is at the price of increased requirements for complex equipment, personnel and supplies, which in turn increases lift and other support. Highly sophisticated treatment facilities in combat areas sound encumber the commander and restrict his freedom of movement. However, if the nature of the operation allows it, sophisticated treatment facilities can be positioned near to the most likely point(s) of injury/onset of illness.

The number and types of HSS treatment facilities and their location will be determined by the casualty and patient/workload estimates and the time required for transportation from point of injury/onset of illness to the required treatment capability, keeping in mind the time-related constraint of medical care. The availability and type of transport assets to be utilized, the length and difficulty of the evacuation route, the operational environment and its limitations and the operational level evacuation policy will have an impact on the size and capabilities of treatment facilities.

Roles of Medical Care

ROLE 1. The minimum capabilities of this role include locating casualties, providing them with first aid and emergency medical care, evacuating them from the site of injury to a safer location, sorting them according to treatment precedence, and stabilizing and preparing them for evacuation to the next Role of care, if required.

ROLE 2. The minimum capabilities of this role emphasize efficient and rapid evacuation of stabilized patients from supported elements, and en route sustaining care. Emergency lifesaving resuscitative procedures may be performed. Patients requiring minor care may be held for short periods and returned to duty. Medical resupply may be provided to supported Role 1 facilities. Role 2 capabilities may be augmented to include capacities for emergency surgery, intensive care, essential post-operative care, blood replacement, diagnostic services, and stress reaction and mental health management.

ROLE 2+. This consists of the Role 2 minimum capability augmented by any or all of the following: life/limb-saving surgery, intensive care, essential postoperative care, blood replacement, laboratory services, basic diagnostic imaging capability.

ROLE 3. The minimum capabilities of this role emphasize resuscitation, initial wound surgery, post-operative care, and short-term surgical and medical in-patient care. Diagnostic services such as x-ray and laboratory, and limited scope internal medicine and psychiatric services, are available. In-theatre reception and storage of medical supplies and blood, and distribution to supported units, is provided, as well as repair of medical equipment within the area of operations. Other ancillary capabilities include liaison teams for tracking Canadian patients in allied or host-nation facilities, teams providing assistance with stress reaction and mental health management, and coordination of force health protection activities in the area of operations. Role 3 capabilities may be augmented with specialist surgical (neurosurgical, maxillofacial surgical, burns etc.) capabilities,

advanced and specialist diagnostic capabilities (CT scan, arthroscopy, sophisticated laboratory tests, etc.), major medical, dental and nursing specialties, and environmental health and industrial hygiene capabilities.

ROLE 4. This Role includes reconstructive surgery, definitive care hospitalization, rehabilitation, storage and distribution of national medical stocks inclusive of blood, blood products and intravenous fluids, and major repair or replacement of medical equipment.

Roles of Dental Care

ROLE 1 (Emergency Care). This capability is the most basic type of dental care. It consists of services rendered to treat acute conditions (pain, infection and trauma), to control life-threatening oral circumstances (haemorrhage and respiratory distress) and to initially stabilize, for evacuation, injuries to the teeth, jaws and associated orofacial structures. Common examples of Role 1 dental care include extractions, placement of sedative/temporary restorations, therapeutic medication by injection or prescription, and application of pressure dressings.

ROLE 2 (Sustaining Care). This Role includes the treatments required to address emergency casualty situations, as well as therapies to deal with additional urgent oral conditions and those measures required to intercept potential dental casualties. This support aims to minimize time lost to personnel engaged in operations. Common examples of diagnoses which require Role 2 care include decayed teeth, defective restorations, tooth fractures, acute periodontal (gum) conditions, traumatic and inflammatory oral lesions, pericoronitis (infected wisdom teeth), temporomandibular joint (TMJ) disorders (acute or chronic non-surgical management), post-operative surgical complications and endodontic (root canal) conditions. Role 2 care includes diagnostic services (examinations, radiographs, laboratory tests), temporary and basic restorations, tooth extractions, pulpectomies (the initial stage of root canal therapy), routine denture adjustments (e.g. repairs or additions), debridement of oral lesions, gingival curettage, written referrals/consults and counseling as well as the initial stabilization of oral and maxillofacial fractures and injuries in preparation for evacuation.

ROLE 3 (Maintaining Care). Role 3 intervention seeks to maintain the overall fitness of personnel at functional fitness status (NATO Level 2). This allows for the operational deployment of personnel without the need of routine care. While Role 3 care includes the same types of procedures provided in role 2 care, time and space permit more time-consuming and complex treatments and the active role of specialists where required. Role 3 care includes more definitive management of maxillofacial injuries, as well as restorative (fillings), oral surgical (extractions), periodontal (gum disease), endodontic (root canals), prosthodontic (dentures) and preventative (cleaning/oral health education) services.

ROLE 4 (Rehabilitative Care). Role 4 functions provide a full range of dental services, including comprehensive rehabilitative care. It aspires to repair and restore deficits in full oral function (including aesthetics) incurred because of wounds or disease. Examples of Role 4 care include complex endodontics, extensive restorative dentistry, prosthodontics (complex bridges and dentures, and osseointegrated implants), periodontal surgery, complex surgical procedures (jaw repair/realignment), complex TMJ therapy, speech-aid appliances, and maxillofacial prosthodontics.