CME

Using Modeling to Predict Medical Requirements for Special Operations Missions

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Objectives

1. Describe the use of modeling in determining medical supply requirements for military operations.
2. Describe how modeling provides an audit trail from the types of illness or injury to each inventory line item.
3. Explain the importance of current casualty data for modeling efforts.

ABSTRACT

Background: The objective of this study was to show the benefits of modeling clinical supply requirements for Special Operations missions by providing an analysis and validation of the Air Force Special Operations Command (AFSOC) Rapid Response Deployment Kit (RRDK) Allowance Standard. **Method:** The Naval Health Research Center (NHRC) method of modeling clinical requirements was used to analyze RRDK needs. Investigators studied the operational requirements for the RRDK, and met with RRDK subject matter experts (SMEs) to determine the type of patient conditions care providers routinely encounter while deployed, as well as the type of clinical tasks they perform to treat those conditions. A model was then built using the SME input. A patient stream was developed reflecting the types and quantities of injuries and illnesses usually experienced by Special Operations Forces, and applied to the AFSOC model. **Results:** This study identified several instances of multiple National Stock Numbers being used to order the same medication or supply, adding unnecessary cost and additional work for logisticians The resulting quantities determined by the NHRC model lowered the cost of the RRDK by more than $10,000, along with a minor drop in cube.

INTRODUCTION

Special Operations Forces (SOF) have become the "tip of the spear" in the Global War on Terrorism. From Iraq to Afghanistan and in many small, mostly unheard of conflicts in between, commandos from the joint U.S. Special Operations Command (USSOCOM) are engaged in unconventional operations to prevent extremists from gaining footholds in countries where they can build an operational base, as Al Qaeda did in Afghanistan in the 1990s.

Special Operations missions fall into nine categories. Direction action missions are short-duration, small-scale offensive actions in hostile or politically sensitive areas. Special reconnaissance missions involve covert reconnaissance or surveillance operations. Foreign internal defense missions involve training a friendly country's military or security forces. Unconventional warfare missions involve a broad spectrum of military and paramilitary operations, and are usually of long duration. Counterterrorism missions include offensive actions taken to prevent, deter, preempt, or respond to terrorism. Weapons of mass destruction (WMDs) counterproliferation missions are taken to locate, seize, destroy, render safe, capture, or recover WMDs. Civil affairs operations are aimed at winning "hearts and minds" in foreign territory. Psychological operations involve actions taken to manipulate the behavior of a population, government, or military force. Information operations involve adversely affecting the information systems of an adversary.[1]

Many of these missions are joint operations, using SOF from the Army, Navy, Marine Corps, and Air Force, working under the aegis of USSOCOM. In most cases, these missions are accomplished with little or no publicity, or acknowledgment of the U.S. government. The U.S. Air Force contribution to these joint operations includes specialized cargo, transport, and attack aircraft squadrons, highly trained forward air controllers, combat weathermen, and "parajumpers," or combat rescue specialists, who are assigned to the Air Force Special Operations Command (AFSOC), which operates as part of USSOCOM.[2]

Providing healthcare to AFSOC and USSOCOM Operators is a special cadre of Air Force physicians, physician assistants, nurses, and independent duty medical technicians that specializes in Special Operations medicine. Unlike their colleagues in the rest of the Air Force, who provide support in the continuum of healthcare normally seen in conventional warfare, these AFSOC providers must provide care in the most austere environments, often without the kind of support seen in conventional battlefields. Despite the need for such self-sufficiency, AFSOC medical capabilities must remain small and light, and capable of being deployed on short notice anywhere in the world.[3]

The Naval Health Research Center (NHRC) has used its method of medical modeling clinical requirements to create and update U.S. Marine Corps medical capabilities and Authorized Medical Allowance Lists (AMALs) since the mid-1990s. Like AFSOC, Marine Corps medical units must remain small, light, and flexible.[4] In 2004, the Air Force Medical Support Agency, Surgeon General Support Logistics Office requested that NHRC conduct a proof-of-concept study to assess the validity and feasibility of using its medical modeling tool in U.S. Air Force Allowance Standard (AS) development and management.[5] Following the success of this proof-of-concept study, NHRC was tasked by the Air Force to model elements of its Expeditionary Medical System. In 2007, the Air Force asked NHRC to conduct another proof-of-concept study to demonstrate the benefits of modeling medical supply requirements for Special Operations missions using the AFSOC Rapid Response Deployment Kit (RRDK) as the prototype.

Method

The NHRC method of modeling medical supply requirements was developed to establish and/or review AMALs for various levels of care in the Navy and the Marine Corps. Its aim is to give clinicians in the field or the fleet the materiel they need to provide the best care possible, while still maintaining as small a logistical footprint as possible, in concert with current Navy and Marine Corps doctrine.[4] It involves a four-step process that begins with the identification of likely patient types to be encountered by a particular type of medical treatment asset, including combat wounds, nonbattle injuries, and illnesses. Patient conditions (PCs) created for the Defense Medical Standardization Board (DMSB) Treatment Briefs are used for this purpose.

The PCs are then linked to clinical tasks developed by DMSB and NHRC. Those tasks are, in turn, linked to each supply item needed to complete the task. A patient stream drawn from historical combat data is created using any number of casualty estimation programs, including NHRC's FORECAS, SHIPCAS, and PKCAS software.[6] The required type and quantity of equipment and consumable supplies can then be calculated based on the probability of those PCs occurring in a patient stream. Figure 1 provides a basic representation of the NHRC modeling process.

In this model, PC 166, a multiple injury wound, is being treated by an AFSOC RRDK at the Forward Emergency Care level of clinical capability (formerly Level 1B). The task profile shows the likely clinical tasks to be performed on this type of patient in that functional area, and the percentage of those patients expected to receive them. The "Equipment/Supplies" column identifies the items needed to complete the blood type and cross-task at that level of capability. Not shown in this figure are additional data fields used to calculate supply quantities, including the amount of each supply needed to complete the task, how often the task will be repeated in the first 24 hours of treatment, how often the task will be repeated in each subsequent 24-hour period, and the average length of stay at that facility

PC 166, a multiple injury wound involving penetrating wounds to the chest and kidney

PC Code	Capability of Care	Functional Area	Task	% of Pts	Supplies
001		CCATT	Triage	100	Sponge Surgical Cellulose, Cotton, Gauze 4X4
002	**Emergency Forward Care**	FFCU	Assess Patient	100	Pad ABD 7 5X8 White 3 Layers Sterile 240S
003	Forward Resuscitative	SPEARR	O2 Set Up	100	Dressing Pressure Cotton 7 5X8 Sterile Latex-free
-	Theater Hospitalization	**RRDK**	O2 Admin	100	Dressing Pressure Cotton 11X11 Sterile latex-free
166	Definitive Care	FFPED	Needle Thoracostomy	25	Tape Adh Surgical 198X2 White Hypoallergenic
167		FFCCU	**Emergency Control of Hemorrhage**	**100**	

Figure 1: Example of NHRC clinical requirements model.

Once the model is created, it is then imported into NHRC's Estimating Supplies Program (ESP), a software program that provides logisticians and medical planners the ability to project their medical supply usages for a variety of expeditionary scenarios. This basic modeling method, often referred to simply as ESP, is also incorporated into two other NHRC software programs: the ReSupply Validation Program which helps create "push packages" for resupply; and the Tactical Medical Logistics Planning Tool, used by medical planners for course-of-action analysis.

RRDK Mission and Capabilities

RRDK capabilities are designed to reduce the impact of trauma, disease, and nonbattle injury (DNBI) on missions pursued by AFSOC and USSOCOM personnel. The RRDK deploys in support of AFSOC air squadrons and USSOCOM missions to austere locations to provide limited medical care and preventive medicine (PM). More specifically, RRDK capabilities include:

Clinical capability: Provides limited advanced trauma and sick call for a population at risk (PAR) of 200–400 personnel. Also provides limited PM practices such as environmental health site assessments. Modularized into four components (two advanced trauma modules, a medical module, and an environmental module) to allow flexibility in configuring the RRDK to individual mission requirements.

Endurance: Includes enough portable supplies to maintain its clinical capability for 30 days without resupply.

Limitations: Is not self-sufficient. Requires provision of base operating support from host unit and/or shelter of opportunity. Patient holding is limited to a maximum of 12 hours, with an average of 6 hours.

Manpower: Includes one flight surgeon and two independent duty medical technicians, known as the Special Operations Forces Medical Element.[7]

The RRDK usually deploys with a second AS designed for casualty evacuation (CASEVAC). Though separate from the RRDK AS, many clinical tasks performed by the RRDK require equipment contained in the CASEVAC AS. These items were included in this study's modeling efforts.

RRDK Clinical Tasks

RRDK subject matter experts (SMEs) were presented a list of clinical tasks usually performed at the emergency forward care level of care, and asked to identify which tasks they were required to accomplish in the performance of their duties. Eighty-four clinical tasks were identified (see Table 1).

Table 1. Rapid Response Deployment Kit Clinical Tasks

Task No.	Task Description	Task No.	Task Description
001	Triage	127	Patient Restraint (Gauze, Ties)
002	Assessment And Evaluation Of Patient Status	129	Perform Restrained Patient Control
005	Remove And Collect Belongings, Valuables And Equipment	142	Order And Document Appropriate Meds/Treatment
006	Establish Adequate Airway (Oro/Naso Pharyngeal Only)	145	Administer Appropriate Medication
007	Emergency Cricothyroidotomy	151	Gynecological Examination
010	Neurological Assessment	204	Provide Patient Safety Special Watch
011	Stabilize Spine (Collar/Spine Board)	221	Pericardiocentesis
017	Suction (Oral/Trach/Endo)	244	Hemacult Test- Feces/Emesis/Gastric Suction
019	Emergency Control Of Hemorrhage	245	Urine Testing
022	O2 Administration Setup	247	Place In Respiratory Isolation
023	O2 Administration Continuous (Nasal/Mask)	248	Force Fluids
024	Vital Signs	278	Arrange For Patient Evacuation
032	Set-Up Pulse Oximeter	279	Arrange And Document Return To Duty
038	Maintain On Ventilator	280	Patient Discharge Instructions
044	Setup Drainage Bottles/Pleurevac	359	Induce Local Anesthesia
046	Maintain Chest Tube Suction	453	Closed Reduction Of Dislocation
049	Start/Change IV Infusion Site	639	Pregnancy Determination - Hcg
050	Administer IV Fluid	740	Reduce Dislocation
063	Venous Cutdown[*]	748	Assemble Material/Clean Up
068	IV Infusion Terminate	802	Initial/Subsequent Non-Surge Debride Of Burn Or Open Wound
070	Bowel Sounds Assess	999	Morgue Care
071	Insert Ng/Og Tube	A6	Apply Tourniquet
073	Perform Ng/Og Suction	A12	Occlude Sucking Chest Wound
075	Irrigate Ng/Og Tube	A30	Wet/Cold Injury Therapy
076	Gastric Lavage	A6	Apply Tourniquet
079	Catheterization, Foley	D2940	Analgesic Filling[†]
082	Measure/Record Intake/Output	Z014	Intubation
085	Wound Irrigation	Z027	Cardio Arrest Resuscitation
086	Clean And Dress Wound	Z030	Electronic Monitoring Of Patient Vital Signs (Propaq)
092	Apply Ace Bandage	Z037	Bag Valve Mask Setup
093	Extremity Elevation	Z039	Perform Ventilation With Bag Valve Mask
096	Apply Sling	Z042	Insert Chest Tube
098	Apply Splint/Immobilize Injury	Z045	Change Drainage Bottles/Pleurevac
103	Circulation Check	Z083	Expose Patient For Exam
108	Minor Surgical Procedure (Debride/Suture/Incision)	Z094	Extremity Traction, Application/Adjust
110	Test Vision	Z103	Re-Establish IV Access (Intraosseous)
121	Eye Irrigation	Z277	Prepare For Evac Ground/Air
123	Eye Care (Dressings/Eye Patch)	ZZ02	Stain Eyes (Fluorescein Stain/Woods Uv Lamp)
124	Ear Care Irrigation	ZZ03	Needle Thoracostomy
125	Sponge/Hyperthermia Treatment	ZZ51	Clean And Prepare Instruments
126	Seizure Care/Precautions	ZZ58	Pressure Infuse Resuscitative Fluids (Equipment Task)

[*]Rarely performed in the field, but a required skill for RRDK flight surgeons. [†]Emergency dental care.

When modeling medications, the primary source for determining which drugs and dosages to use with which PCs was the Joint Special Operations Tactical Medical Emergency Protocol Drug List.[8] This was supplemented with USSOCOM's Tactical Medical Emergency Protocols,[8] and the Special Operations Forces Medical Handbook.[9] The drug reference database provided by WebMD's Medscape Today Web site was also consulted.[10]

RDDK Patient Stream

With its mission to provide healthcare support for trauma and DNBI at the "forward end of the spear" in every combatant command region, the RRDK is exposed to a large list of possible PCs. In teleconferences and a personal meeting, RRDK SMEs were asked to identify DMSB PCs representing patients they believed they were likely to encounter, and initiate stabilizing treatment for, while deployed. A total of 315 PCs were chosen. Table 2 shows the patient categories into which those 315 PCs fall.

Table 2. Rapid Response Deployment Kit Patient Conditions by Category

Patient Category	Patient Category
Abdomen & Pelvis	Infectious/Parasitic
Battle Fatigue	Lower Limbs
Burns	Miscellaneous
Cardiovascular	Multiple Injury Wounds
Dermatological	Neuropsychiatric
Directed Energy Weapon Eye Lesion	Respiratory
Environmental	Sexually Transmitted Disease
Eye/Ear Disease	Spine
Female Specific	Sprains & Strains
Gastrointestinal	Superficial/Soft Tissue
General	Surgical
Genitourinary	Thorax
Head	Upper Limbs

Developing a patient stream for this study was problematic because data on casualties among SOF are typically classified. Therefore, no actual RRDK patient data were available for this study. However, the little amount of data published on SOF casualties indicates Special Operations Forces suffer a disproportionately high rate of casualties. Many Special Operations missions, such as reconnaissance and direct raids, while cloaked in stealth and secrecy, can erupt into sharp periods of intense combat. A 1995 Naval Postgraduate School modeling study of SOF attrition rates during such missions found a sharp climb in SOF casualties the longer a Special Operations unit remains in contact with an enemy, particularly during daytime raids.[11]

According to the Special Operations Warrior Foundation, between 1980 and 2004 SOF warriors represented about 2% of all active-duty forces, yet accounted for 24% of all combat losses, a casualty rate 12 times higher than conventional forces (personal communication, S. McLeary, January 1, 2004). Table 3 breaks down the SOF casualties suffered during several major contingency operations.

Table 3. Special Operations Forces KIAs vs. Conventional Force KIA, 1984–2004

Contingency Operations	Country	Total U.S. KIA	SOF KIA	SOF % KIA
Eagle Claw (Desert One)	Iran	8	8	100%
Urgent Fury	Grenada	19	13	68%
Just Cause	Panama	23	13	57%
Restore Hope/Task Force Ranger	Somalia	29	18	62%
Desert Storm	Kuwait & Iraq	147	25	17%
Allied Force	Kosovo	2	0	0%
Enduring Freedom	Afghanistan & Philippines	51	49	96%
Iraqi Freedom	Iraq	314	15	5%
Total		593	141	24%

KIA, killed in action; SOF, Special Operations Forces.
Source: Special Operations Warrior Foundation.

A 2007 study of SOF casualties by COL John Holcomb et al., quantified the methods of injury leading to SOF deaths during Operations Enduring Freedom and Iraqi Freedom. Explosions (40%), gunshot wounds (27%), and aircraft accidents (27%) made up the bulk of the causes of death, resulting in a total of 67% wounded in action (WIA)[12] (see Figure 2).

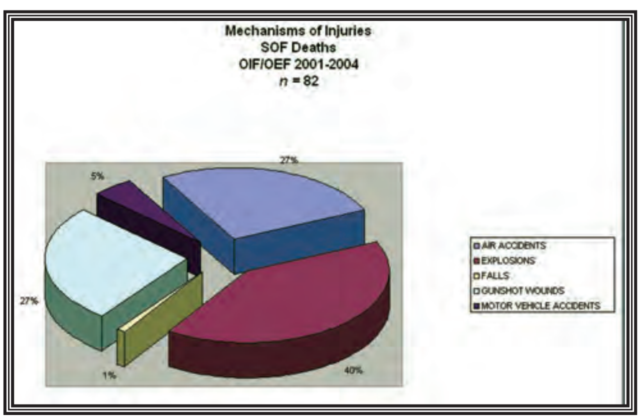


Figure 2: Causes of Special Operations Forces deaths. [12]

For this study, NHRC reviewed data from the Department of Defense Career History Archival Medical and Personnel System (CHAMPS) representing SOF casualties evacuated from Afghanistan and Iraq in March 2002 and December 2006. Ninety-seven casualties were identified. Of these, the largest cause of injury was explosives (53%), followed by penetrating ballistic wounds (26%; identified as "war wound, enemy cause"), with a total of 79% of injuries caused by combat action. Figure 3 provides a complete breakdown of these mechanisms of injury.

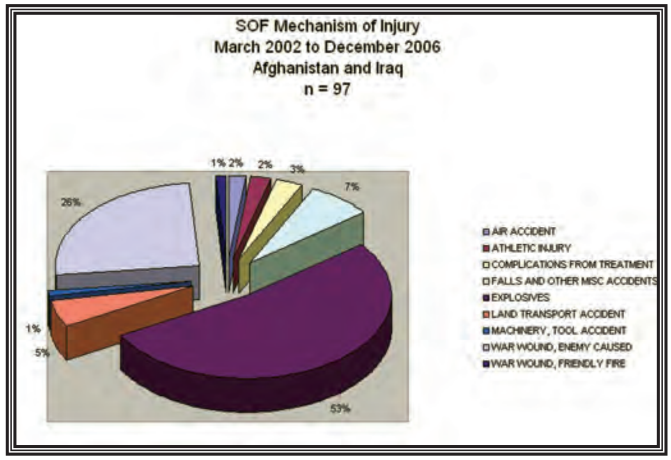


Figure 3: Special Operations Forces mechanisms of injury, from CHAMPS database.

While these statistics represent only the most severe casualties — those either killed or injured severely enough to require evacuation — they do indicate a higher ratio of combat-related injury to DNBI than experienced by conventional troops. Conventional forces, by comparison, suffer a nearly inverse proportion of DNBI to wounded in action (WIA) casualties. According to the Joint Patient Tracking Application (JPTA), a total of 77,240 casualties from all branches of the service were evacuated from Iraq and Afghanistan between 2004 and 2006. Of those, 80% were DNBIs, while only 20% were combat casualties.

These data showed that the present study required a patient stream weighted more heavily with combat injuries than most casualty projection programs are designed to produce. NHRC's warfare casualty forecasting software, FORECAS, was selected for use based on its ability to modify both combat intensity and environments.

Three patient streams were created: one each for desert, jungle, and urban terrains, and each with a PAR of 300 (the average RRDK mission requirement) engaging in moderate combat for 30 days. As stated previously, Special Operations missions are usually characterized by sharp, intense periods of combat lasting a short duration but resulting in a disproportionately high casualty rate. After several experimental FORECAS patient stream runs, it was determined that a moderate level of combat over a 30-day period best reflected this disproportionality.

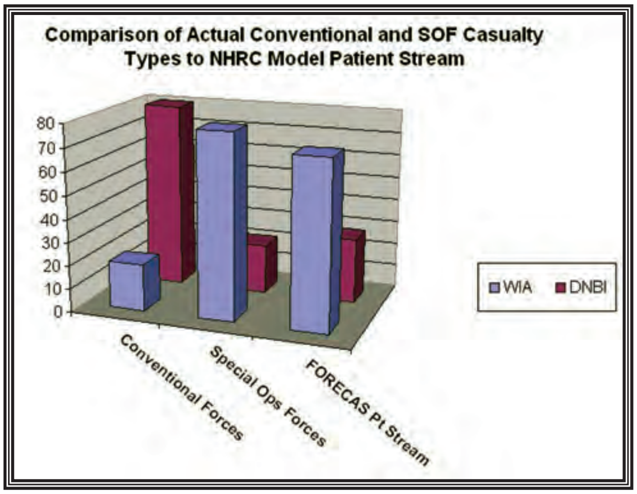


Figure 4: Comparison of actual conventional and Special Operations Forces casualty types and the NHRC patient stream.

The three patient streams were then aggregated. Averages were calculated for any PC appearing more than once, and then rounded to the nearest whole number. The resulting patient stream contained 97 patients, with 72% WIA and 28% DNBI. Figure 4 shows a comparison between the JPTA conventional forces casualties, the CHAMPS SOF casualties, and the NHRC patient stream. Figure 5 shows the patient category breakdown for the NHRC patient stream.

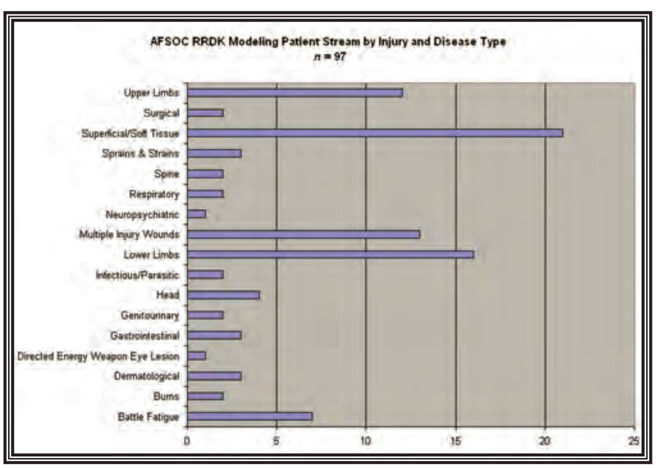
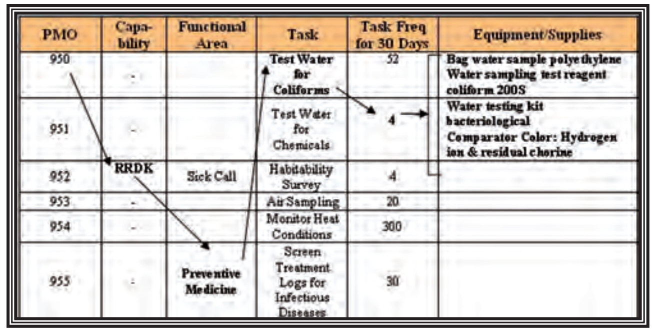


Figure 5: Rapid Response Deployment Kit model patient stream by injury and disease.



PMO	Capability	Functional Area	Task	Task Freq for 30 Days	Equipment/Supplies
950	-		Test Water for Coliforms	52	Bag water sample polyethylene Water sampling test reagent coliform 200S
951	-		Test Water for Chemicals	4	Water testing kit bacteriological Comparator Color: Hydrogen ion & residual chorine
952	RRDK	Sick Call	Habitability Survey	4	
953	-		Air Sampling	20	
954	-		Monitor Heat Conditions	300	
955	-	Preventive Medicine	Screen Treatment Logs for Infectious Diseases	30	

Figure 6: Preventive medicine objectives and tasks model.

Preventive Medicine Objectives and Tasks

Preventive medicine objectives (PMOs) are modeled with associated supplies and equipment, as depicted in Figure 6. Task frequencies are largely dependent on PAR size and the inherent disease risk for a given area of operations. Modeling assumptions for this study included deploying with a complement of 300 personnel for a 30-day period in an operational setting with minimal host-country infrastructure and preventive medicine.

Table 4. RRDK Preventive Medicine Objectives

PMO #	Objective Description
950	Water Sanitation
951	Pest Control
952	Heat/Cold Injury Prevention
953	Communicable Disease Control
954	Food Sanitation
955	Common Area Sanitation
956	Berthing Sanitation
957	Waste Management
958	Conduct Training
959	Industrial Hygiene

Nine PMOs were identified for the RRDK (Table 4), requiring a total of 31 PM tasks. However, at this far-forward level of care, many of these tasks are simply visual, requiring no equipment or consumables. PM supply quantities were calculated using a PM task frequency chart originally developed by NHRC for determining PM supply quantities for the Air Force's Global Reach Laydown (GRL) system, a similar forward emergency care medical and PM capability (see Table 5).[13]

Results

Of the 84 clinical tasks determined to be required by the RRDK mission, 15 did not occur in this patient stream (see Table 6). However, supplies sufficient to complete each of those 15 tasks at least one time were included in the final list. Because consumable supply quantities were rounded up to the nearest quarter package whenever possible, there should actually be enough supplies to complete each of these tasks more than once.

Table 5. Preventive Medicine Objective Frequencies

Task No.	PM Task	Daily	Weekly	Once	No. of Sites
Z504	Obtain Water Sample/Conduct pH Testing*	1			2
Z505	Obtain Water Sample/Conduct Chlorine Testing	1			2
Z506	Obtain Water/Ice Sample/Conduct Bacteriological Testing†		13		4
Z541	Conduct Vector Borne Disease Assessment*		1		1
Z548	Conduct Pest And Vector Identification*		1		1
Z580	Monitor Heat Stress Conditions	10			1
Z600	Screen Treatment Logs For Infectious Disease Cases*	1			1
Z607	Conduct Food Borne Illness Investigation‡			1	1
Z611	Dispense Std Prophylaxis/Contraceptive	1			1
Z640	Select Site Of Messing & Food Storage Areas*			1	
Z642	Conduct Inspections Of Messing & Food Storage Areas	1			1
Z644	Evaluate Food Sourcing And Transport*‡			1	1
Z660	Make Recommendations For Camp Setup*			1	2
Z661	Conduct Inspections Of Common Use Areas	1			1
Z662	Conduct Inspections Of Laundry/Shower Services	1			1
Z663	Conduct Inspections Of Latrines/Handwashing Site	1			1
Z680	Select Berthing Site*			1	1
Z681	Conduct Inspections Of Berthing Areas		1		1
Z700	Assist In Selection Of Waste Disposal Sites			1	2
Z701	Conduct Inspections Of Waste Disposal Sites		1		
Z790	Document/Report Inspection Results*		1		2
Z791	Make Recommendations/Troubleshoot Discrepancies*‡	1			1
Z910	Gather & Analyze Intel Data On Survey Area*			1	2
Z911	Conduct Visual Site Inspection And Record Results†			1	2
Z912	Develop Site Sampling Plan*			1	2
Z913	Map Out Site Inspection Grid*			1	2
Z914	Label & Record Sample Container			1	50
Z918	Collect & Interpret Ambient Air Sample*			10	2
Z924	Collect Soil Sample/Conduct Test 8*			8	2
Z926	Conduct Radiological Sampling/Monitoring*			18	2
Z930	Assessment Of Hazardous Waste*			1	10

*No supplies assigned this task.
†Includes bottled water sampling; with a shipment of 1000 bottles/week, 10 samples are taken. The four sites are two potable water sources (one sample each), the bottled water storage area (10 samples), and any ice shipments (one sample).
‡Tasks performed on an "as needed" basis.

Table 6. Clinical Tasks Not Included in Patient Stream

Task No.	Task Description
076	Gastric Lavage
084	Shave And Prep
124	Ear Care Irrigation
148	Obtain Specimen For Laboratory Analysis
151	Gynecological Examination
740	Reduce Dislocation
802	Initial/Subsequent Non-Surg Debride Of Burn/Wound
A10	Position For Postural Drainage/Place In Coma Position*
A30	Wet/Cold Injury Therapy
A2	Remove Casualty From Danger*
D2940	Analgesic Filling
Z108	Facility Site Set Up
ZZ01	Induce Vomiting

*No supplies required for this task.

During the modeling process, we discovered several medications that were identical in both formula and dosage, but were included under two or more different National Stock Numbers (NSNs) (see Table 7). Some of this may be due to logistical ordering errors. In other cases, multiple NSNs may have been chosen to allow distribution among RRDK modules. For this study, only one NSN was modeled for analysis, though all NSNs will be included in the final model unless otherwise instructed by AFSOC. However, should AFSOC decide to single up on these items, using the NSNs modeled for bisacodyl, erythromycin, and moxifoxacin is recommended because the packaging for these NSNs is best suited for distribution among RRDK modules.

When possible, in computing consumable supply quantities, all line items are rounded to the nearest quarter package. This not only provides logistics units an easier means of packing assemblages, it also ensures a more robust AS. Nevertheless, modeling the RRDK using NHRC's ESP model achieved a greater than $10,000 cost savings, mostly in medications (see Figure 7). A modest 4% savings was achieved in cube, while weight increased by less than 22.5 pounds (see Figure 8).

Table 7. Medication in RRDK Allowance Standard With Multiple NSNs

NSN	Nomenclature
6505008899034	Bisacodyl Tablets USP 5mg Film Enteric 1000S
6505001182759	Bisacodyl Tablets USP 5mg I.S. Tablet 100S*
6505010835988	Erythromycin Stearate Tablets USP 250mg 100S*
6505006041223	Erythromycin Tablets USP 250mg 100S
6505015034772	Moxifloxacin Hydrochloride Tablets 400mg (5/Strip) 30S*
6505015163194	Moxifloxacin Hydrochloride Tablets 400mg 50S
6505014622434	Sodium Chloride Injection USP 0.9% 500ml Bag 24S*
6505013306268	Sodium Chloride Injection USP 0.9% 500ml Bag 24S
6505013723425	Sodium Chloride Injection USP 0.9% 500ml Bag 24S

*Modeled for this study.

To increase confidence that the RRDK supply quantities estimated by ESP could handle varying patient loads, supplies for a second patient stream were calculated using the modeling program. This patient stream used patient condition distributions for con-

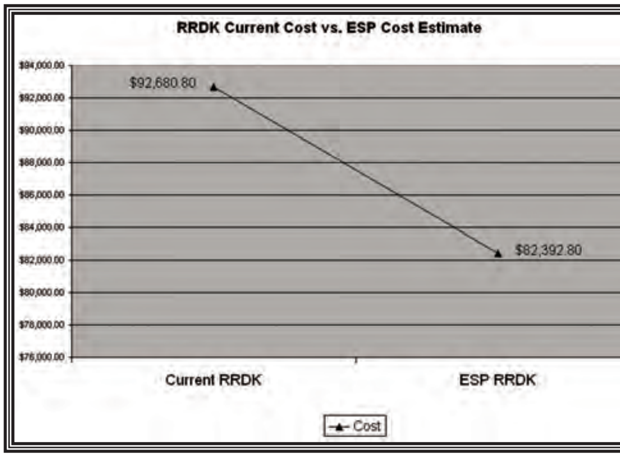


Figure 7: Current Rapid Response Deployment Kit cost vs. modeled estimated cost.

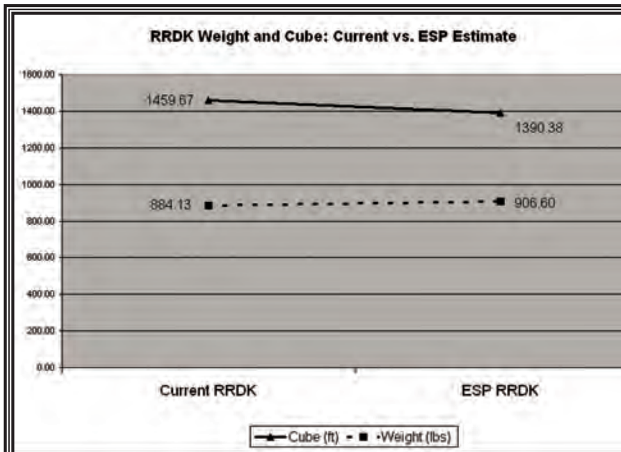


Figure 8: Rapid Response Deployment Kit weight and cube comparison.

ventional forces from the current conflicts, with a breakdown of 20% WIA, 26% NBI, and 54% disease, as compared to the combat heavy SOF patient stream of 72% WIA and 28% DNBI.

The supply requirements generated by this second patient stream were then compared to the RRDK allowance standard created by ESP and the quantities in the current RRDK AS. The RRDK supply quantities generated by ESP were adequate to handle more than 80% of the disease-heavy second patient stream requirements. This provided better coverage than the supply quantities currently stocked in the RRDK.

Discussion and Comment

NHRC's method of modeling clinical supply requirements has been used successfully to analyze conventional force medical supplies for the Navy, Marine Corps, and Air Force. Modeling medical requirements for an unconventional force posed particular difficulties. SOF missions, and casualties incurred on those missions, are typically classified information. Few data are available to develop statistical casualty forecasting software. Nevertheless, the information that is available on SOF casualties indicates that Special Operations units suffer a disproportionately higher ratio of combat casualties to DNBIs. This study was able to develop a patient stream simulating that disproportionality using the conventional warfare casualty project program, FORECAS. To increase confidence that the ESP-generated RRDK allowance standard could handle varying patient loads, a second disease- and NBI-heavy patient stream was run through the model. This showed the ESP-generated RRDK AS could provide a greater than 80% solution to widely divergent patient streams.

Exporting ESP capabilities to inventories other than those of the Navy and Marine Corps is a viable method of evaluating other preexisting medical systems' capabilities. In previous efforts, the inventories for the Air Force Mobile Field Surgical Team and the Critical Care Air Transport Team have been successfully incorporated in ESP. The Rapid Response Deployment Kit was included in the latest release of ESP (ESP 2.94), giving AFSOC planners a greater capability to configure the RRDK for a variety of patient streams. ESP and its family of logistics programs are also highly effective tools for configuring resupply packs, ensuring medical materiel sustainment across the spectrum of medical care facilities, while maintaining their clinical capability.

Finally, the ESP simulation creates an audit trail establishing clinical requirements for supply items in medical system inventories that enable logisticians and medical planners to validate current inventories and perform analyses of projected changes to future inventories. It also serves as a leading consumption indicator, making it easier to identify resupply requirements to ensure sustainment.

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Paula Konoske received her doctorate in social psychology from Wayne State University, Detroit, MI. Prior to coming to the Naval Health Research Center in 1994, she was a research psychologist at the Navy Personnel Research and Development Center, San Diego. Her research experience includes design of interactive technical training, survey design and development, program evaluation, Total Quality Leadership implementation, and the application of statistical process control. Dr. Konoske is currently the Program Manager for the Modeling and Simulation Group. Dr. Konoske has authored numerous technical reports and journal publications as well as presented research results at professional meetings and conferences.

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