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Medical Play in Kernel Blitz '97: Findings and Recommendations

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Center for Naval Analyses

Medical Play in Kernel Blitz '97: Findings and Recommendations

Neil Carey, Robert Levy, Federico Garcia,
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This CNA annotated briefing (CAB) summarizes findings and recommendations for medical play in Kernel Blitz '97, an amphibious exercise held in June-July 1997. The project was sponsored by the CINCPACFLT Surgeon.

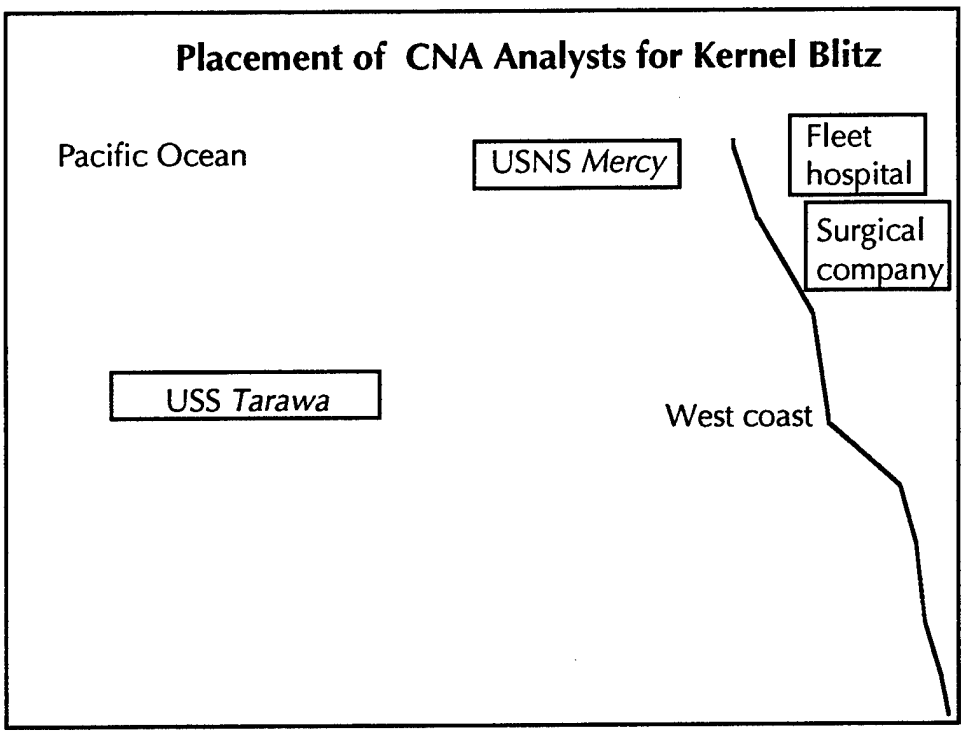
Tasking for Kernel Blitz '97 Medical

- **Original '97 tasking**
  - **CINCPACFLT**
    - ❒**Activation of hospital ship**
    - ❒**Telemedicine**
- **Additional tasking**
  - **I MEF**
    - ❒**MEF augmentation**
    - ❒**Blood program**

Our initial study proposal directed us to use Kernel Blitz play to analyze how well the hospital ship (USNS *Mercy*) was able to activate within its 5-day activation period. The CINCPACFLT Surgeon was particulaly interested in whether supplies through Prime Vendor could be delivered to *Mercy* within that time frame. We were also asked to look at personnel augmentation as part of our study of the hospital ship activation.

The original request also directed us to study telemedicine—the use of communications to facilitate the diagnosis, treatment, or tracking of casualties in theater. We were to focus on the value of telemedicine from the user's perspective.

After the original proposal was signed, we were tasked by first Marine Expeditionary Force (I MEF) to review how well the medical battalion and surgical company were augmented for Kernel Blitz. The general wanted us to determine whether those platforms received the right number of personnel and the right specialties, and whether those billets were filled by people who were slated to augment the MEF in the event of a real contingency. In addition, the general asked whether the system to supply blood, as a program, was working properly.



To answer the CINCPACFLT surgeon's and the general's questions, we placed analysts at four locations for Kernel Blitz. As the map shows, we had one analyst at the surgical company/medical battalion[1] and one on the LHA, USS *Tarawa*. Three analysts were aboard the hospital ship, Mercy, and one was at the fleet hospital.

Given this placement of analysts, we were well-positioned to look at the telemedicine demonstrations at several locations simultaneously.

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1. For purposes of this analysis, surgical company and the medical battalion are interchangeable. Both terms will be used in this briefing.

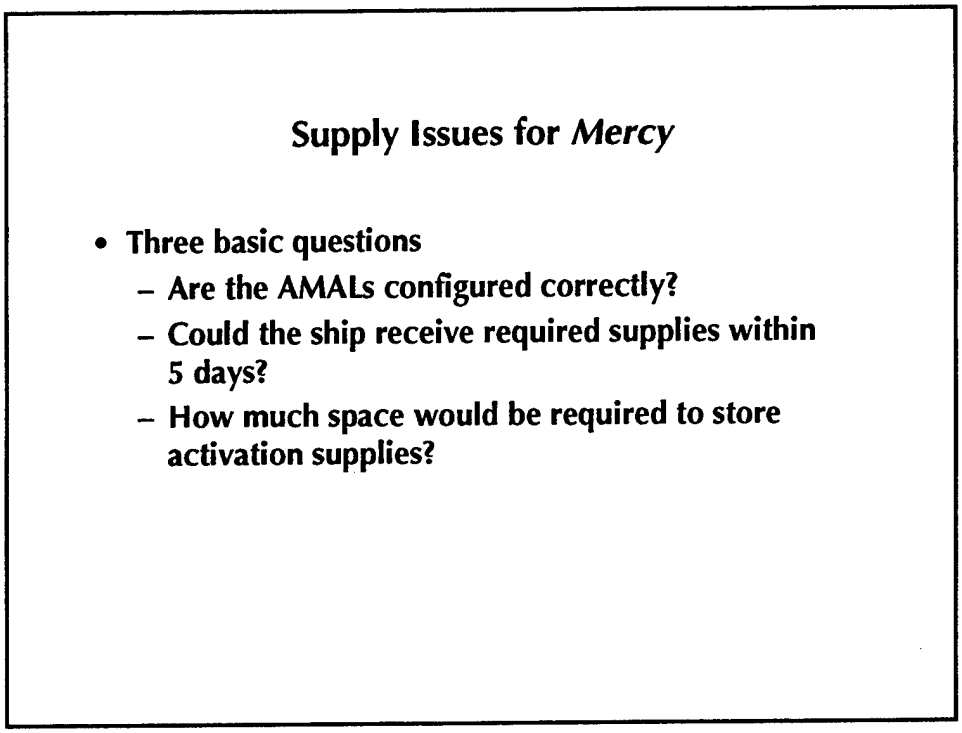
Outline

- **Supply augmentation on USNS *Mercy***
- **Personnel augmentation**
  - ***Mercy***
  - **L-class ships**
  - **Medical battalion**
- **Telemedicine**
- **Blood and oxygen**
- **Kernel Blitz '97 as a medical exercise**
- **Conclusions and recommendations**

This brief will present our findings in the following order. We will start with our analyses of supplies aboard *Mercy*, then move on to personnel augmentation for Kernel Blitz. Notice that we include analyses of the L-class ships—*Tarawa* and *Pelelieu*, as well as *Mercy* and the surgical company/medical battalion.

Next, we will consider telemedicine, the blood program, and oxygen. We include analyses of oxygen because in Kernel Blitz (KB) '95 it was discovered that the LHA ran out of oxygen very rapidly. Here in KB '97, we did calculations to determine what the "choke point," or limiter, was for theater oxygen supplies.

Finally, we will present our observations on KB '97 as a medical exercise, ending with overall conclusions and recommendations.



Analytically, there are three major issues for supply aboard *Mercy*.[1] First, do the Authorized Medical Allowance Lists (AMALs) contain the right numbers and mix of supplies? Next, could the ship receive those supplies within 5 days? And last, how much space would the ship need to store those supplies?

1. Appendix A has further information on the supply issue in Kernel Blitz (see the first backup slide, Comparing Medical Requirement to Space).

AMAL Configuration

- **Beyond the scope of CNA's KB analysis**
  - **But ongoing initiatives include**
    - **NHRC studies linking medical supplies to combat casualties**
    - **Recent data "scrubs" by program office, NAVMEDLOGCOM, or ship itself**
- **Clearly, much work needs to be done**
  - **Initiatives only touch on T-AH problems**

We did not address the question of whether the AMALs have the correct configuration, but we should mention several efforts to improve them. The Naval Health Research Center (NHRC) has been using patient flow data to help the Marine Corps determine the amount and type of supplies that should be in USMC AMALs. To do those studies, NHRC has used accepted estimates of casualty type and frequency and combined them with data on the tasks needed to treat those casualty conditions. We think that NHRC's data-driven approach has the advantage of being easily understood and well-documented.

The hospital ship program office, the Navy Medical Logistics Command (NAVMEDLOGCOM), and the two hospital ships—*Mercy* and *Comfort*—have all been scrubbing the hospital ship AMALs. For example, the hospital ship office recently requested a review of the most expensive AMAL items. The review produced a revised estimate of those items' requirements and saved money.

The size and expense of the AMALs indicate that AMAL review will be a continuous process. More work needs to be done.

Would Supplies Be Available to the T-AH?

- **Primary focus of CNA supply analysis**
- **Calculated expected wartime requirement**
  - **For medical consumables, move from 5-day to 30-day requirement for 1,000 beds**
- **Used preliminary surveys from Defense Personnel Support Center (DPSC) on industry preparedness**
  - **Indicates whether quantities would be available in first 5-day period**
  - **Matched NSNs–compare expected supply with requirement**

Most of our effort focused on whether supplies would be available to the hospital ship within 5 days. To do this, we first calculated the wartime requirement by multiplying the 5-day 1,000-bed requirement by 6 to get a 30-day requirement. The difference—a 25-day, 1,000-bed requirement—was the amount that needed to be received by the ship within the 5-day period.

To address this question, we used data from an Industrial Preparedness Planning (IPP) survey that is being conducted by the Defense Personnel Support Center (DPSC) in Philadelphia. DPSC is a part of the Defense Logistics Agency (DLA), primarily responsible for food, clothing, and medical supplies. The IPP survey goes out to industry suppliers, asking them to determine whether they could supply the military with medical supplies within 5 days. DPSC sent out about 20,000 surveys on about 8,700 "go to war" items, of which about 1,000 have been received so far. Clearly, our analyses at this point are preliminary.

Our analyses matched the Navy Stock Numbers (NSNs) of the services' requirements against the results of the survey so far.

Expected Availability (AMALs)

	Mission-essential	Total
Consumables		
Supplies adequate	97	260
Supplies inadequate	33	135
Total	130	395
Nonconsumables	20	243

NSNs match, but ship has sufficient quantities

This slide presents the expected availability of AMALs given the data from DPSC. Of the 130 mission-essential items, 97 (75 percent) would be available in sufficient quantities. Of the total items, 66 percent could be provided on time. Note that we excluded nonconsumables, such as equipment, from these calculations. Because there are more surveys yet to be collected, these numbers are preliminary. Nevertheless, they give us an idea of how many items may require further analyses. For example, once the entire survey results are in, it is necessary to look at whether there are substitutions possible for the 25 to 33 percent of items that appear to be insufficient. We did not address whether alternative supplies—for example, bandages slightly longer than those on the AMAL—would be sufficient to supply Navy and Marine Corps needs.

Is There Enough Space on Board?

- **ROS estimated 5-day AMAL takes up half of the current space available**
  - **Rough estimate, needs further look**
- **CNA designed a questionnaire for determining available space**
  - **Provide consistency, reproducibility**
  - **Obtain input from *Mercy's* supply officers and AMAL managers**

The third question is whether there is enough space aboard *Mercy* to hold all these supplies. The reduced operating status (full time, ROS) crew of *Mercy* did some first-cut estimates of their supply spaces, calculating that the 5-day AMAL takes up half of their current space. But the ROS crew felt that a more careful look at space needs should be undertaken. Furthermore, it was difficult to determine how each department made its estimates—the likely inconsistency across departments makes it hard to tell how much to rely on those estimates.

To help with this question, we developed a questionnaire[1] that could be used by each department of the hospital ships to measure their spaces. If each department used this methodology, there should be no ambiguity about how the estimates were made. Others could review the procedure they used to determine whether further effort is needed.

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1. A copy of the AMAL Storage Space Questionnaire is in appendix B.

Mercy AMAL Space Requirements

- **According to our calculations, 5-day AMAL**
  - **Contains 12,505 line items**
  - **Costs $22.9 million**
  - **Weighs 1.9 million pounds**
  - **Takes up 153,811 cubic feet of space**
- **If *Mercy* went to war**
  - **Cost would increase by 139 percent**
  - **Weight would increase by 186 percent**
  - **Space would increase by 197 percent**

We obtained data on the cost, weight, and volume of AMAL items from the NAVMEDLOGCOM home page. We worked with these numbers to determine that the 5-day AMAL costs almost $23 million and takes up about 154,000 cubic feet of space.

Because much of the 5-day AMAL consists of equipment, the 30-day AMAL would increase nonlinearly. We estimate that the cost would increase 139 percent, mass would increase by 186 percent, and volume requirements would increase by 197 percent.

Recommended Actions

- **More needs to be done on T-AH's AMAL configuration**
  - **Wartime requirement costly and takes up a lot of space**
  - **Potential for savings from AMAL reduction**
  - **Improvement to electronic inventory system**
- **Possible CNA follow-ons**
  - **Prime Vendor test for *Comfort* pharmacy supplies**
  - **Check with *Mercy* about space questionnaire**
  - **Update NSN match of AMALs with complete DPSC surveys**

In conclusion, more work needs to be done on the T-AH's AMAL configurations. The efforts to date by Military Sealift Command, NAVMEDLOGCOM, and the ships have been important steps in the right direction, but it is possible to save more money and space by doing a more complete scrub of the lists. Doing so will be a big effort.

The Military Sealift Command (where the T-AH program officer sits), NAVMEDLOGCOM, DPSC, and the hospital ships will have major roles in any followup efforts on supply. If the Navy wants us to participate further in this process, we suggest that CNA could:

(1) Work with *Comfort* on the pharmacy supplies—since *Comfort* and *Mercy* now have the same Prime Vendor.

(2) Follow up on more precise determination of space availability on the hospital ships—we envision an end product similar to a Ships Loading Characteristics Pamphlet that the Marines routinely develop for their LHAs.

(3) Contribute to analyses of the data that are obtained when DPSC completes its collection of IPP surveys, sometime this fall.

Outline

- Supply augmentation on USNS *Mercy*
- Personnel augmentation
  - *Mercy*
  - L-class ships
  - Medical battalion
- Telemedicine
- Blood and oxygen
- Kernel Blitz '97 as a medical exercise
- Conclusions and recommendations

We now present our findings on personnel augmentation.[1]

1. Further information about personnel augmentation can be found in appendix A.

Personnel Augmentation

- Questions for analysis
  - Were the billets filled by the appropriate personnel?
    - ❒Did the specialties match (i.e., NOBC/NEC)?
    - ❒Where did the personnel come from?
    - ❒Did they have the appropriate training?
  - What other specific problems arose in providing personnel?

We addressed two major questions: (1) Were billets filled by appropriate personnel, and (2) what other problems arose in providing personnel?

Background—*Mercy*

- For KB, *Mercy* staffed for 250-bed hospital
- Activity manning document (AMD) implies total staff of 731
  - Reduced operating staff (ROS) of 58
  - Augmented for full operating status by 673
- Data we received implies staff of 658
  - 617 personnel from NMC San Diego
  - 41 from other sites–all non-medical

Mercy was planned to be staffed at the 250-bed level. We used the AMD as a "standard" to determine how well the augmentation process performed. The AMD implies that total staff should be 731—a full-time staff of 58, which would then be augmented for deployment as a 250-bed hospital by an additional 673. The data we received from NMC, San Diego, imply that they didn't receive all 673, but came close, with 658.

Comparing *Mercy*'s AMD to Medical Officer Manning

Corps	AMD	Actual on *Mercy*
Medical	40	40
Dental	2	2
Medical services	17	14
Nurse	87	85
Total	146	141

Compared to the AMD, *Mercy*'s officer manning looks pretty good. *Mercy* lacked only three medical service corps officers and two nurse corps.

Mercy: KB '97 Mismatches (Specialty and Rank)

	Counts of mismatches		
	NOBC/NEC	Rank/grade	Total
Enlisted	1	25 (13 lower; 12 higher)	26
Officer	7	8 (5 lower; 3 higher)	15
Total	8	33	41

(30 medical)

If we look at specific specialty—Naval Officer Billet Code (NOBC) or Naval Enlisted Code (NEC)— the picture is only slightly less rosy. We counted a mismatch of rank if the enlisted or officer was higher or lower by two or more ranks. For example, a LT filling in for a CDR would be considered a mismatch. There were a total of 41 specialty or rank mismatches, 30 of which were medical. Personnel responsible for the *Mercy* believe that observed rank mismatches were not a quality-of-care problem because *Mercy's* personnel knew, and individually approved, each person for whom a rank substitution was made.

Other Personnel Augmentation Issues

- **System faltered a little for augmentees not from NMC, San Diego**
- **Total of 41 people from other commands**
  - **10 from other medical facilities on West Coast**
  - **No problem here**
- **Total of 23 from other platforms that would themselves deploy if war**
  - **19 from *Comfort***
  - **4 from fleet hospital assigned to Camp Pendleton**
- **Officer augment (3) came from reserves**

Mercy looked pretty good, but the system faltered a little for augmentees not from NMC, San Diego.[1] Twenty-three of the personnel who played on *Mercy* were assigned to platforms other than *Mercy*: 19 from *Comfort* and 4 from the fleet hospital. Three officers came from reserves, whereas, in theory, only active duty would augment *Mercy* in time of war.

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1. One augmentation issue we noticed was that reservists working at UC San Diego were working in a trauma-intensive (level-1) facility, whereas the Navy's Balboa Hospital is a level-4 trauma facility. We believe that the Department of Defense's recent efforts to obtain more trauma experience for its active duty surgeons might address this problem. The program, Sec. 744 of the National Defense Authorization Act for Fiscal Year 1996, is called "Demonstration program to train military medical personnel in civilian shock trauma units."

Personnel Augmentation—*Tarawa* and *Peleliu*

- *Tarawa*
  - **Requested 84, received 82**
  - **1 NEC mismatch, 6 rank/grade mismatches**
  - **Not all were amphib augmentees**
- *Peleliu*
  - **Requested 23, received 23**
  - **6 NOBC mismatches, 0 matches for critical care nurses**
  - **All were amphib augmentees**
- **Questions on chain of command for privileging on ships**

The story for the amphibious platforms—*Tarawa* and *Peleliu*—was overall good, but slightly more complicated. The match was fine for numbers—*Tarawa* got 82 of 84 (98 percent) of its augment, and *Peleliu* received 100 percent of its needs.

However, on *Tarawa* there were 6 rank mismatches and some augmentees were neither *Tarawa* augmentees nor augmentees for other amphib class ships. *Peleliu* had 6 NOBC mismatches. It received substitute NOBCs for all requested critical care nurses. While some of *Peleliu's* augmentees were not assigned to this particular ship, they were all assigned as amphibious ship augmentees in MPAS. Please see the backup slides for more details.

Augmentation of the *Tarawa, Peleliu,* and even the *Mercy* brought up a privileging issue. In *KB,* all military doctors had credentials and were privileged to practice at some military facility—but were not automatically privileged to practice aboard ships during the exercise. As regulations stand now, the senior medical officer aboard each of these vessels should have sought permission from the TYCOMs to grant privileges for physicians to practice aboard the amphibs and *Mercy.* On *Mercy,* it was not clear who had the right to grant such authority. The chain of command needs to be delineated and followed. But it seems reasonable to question whether the regulation that requires TYCOM permission is really necessary. Why should doctors who are already privileged at a CONUS facility need to be privileged again by the TYCOMs—shouldn't it be enough to privilege doctors once for all military facilities?

Personnel Augmentation—Surgical Company

- **For KB, 1st Medical Battalion staffed for 1 surgical company**
- **Requested 145 augmentees, received 141**
- **From 3 MTFs**
  - **136 from NMC, San Diego**
  - **4 from NH, Camp Pendleton**
  - **1 from NH, Oak Harbor**
- **HSO declared all participants assigned to FSSG platform**

The surgical company got 97 percent (141/145) of its augment, all of whom were assigned to augment a Fleet Service Support Group (FSSG), so they did quite well, too. (For these purposes, the FSSG and the surgical company are the same.)

We were told that the surgical company is planned to be augmented from NMC, San Diego, in the event of a real contingency. Almost all of the 141 augmentees came from San Diego; only 5 personnel came from other medical treatment facilities (MTFs). In fact, all of the 141 personnel who participated in KB '97 were assigned to an FSSG platform—excellent performance for the augmentation system.

Surgical Company: KB '97 Mismatches

	Count of mismatches		
	NOBC/NEC	Rank/grade	Total
MC	0	0	0
NC	5	4	9
MSC	1	1	2
Enlisted	5	5	10
Total	11	10	21

For the surgical company, there were 11 out of 141 (8 percent) specialty mismatches and 10 out of 141 (7 percent) grade mismatches. Because there was a shortfall of 4, the total shortfall plus mismatches was 18 percent ((4+11+10)/145). Most of the difficulties were for nurse corps, which suffered a 46-percent shortfall and mismatch rate. For example, none of the 6 nurses used to fill critical care billets had the appropriate NOBC. [1]

1. The surgical company asked for six critical care nurses (0904s), but received none from that exact specialty. Instead, the surgical company received five 0944s (staff nurses) and one 0932 (perioperative nurse). Staff nurses are considered acceptable substitutions for up to 50 percent of critical care nurses, so we counted only three mismatches among the critical care nurses. This was conservative because the staff nurses are supposed to have critical care nurses working with them. The 5 in the NOBC/NEC nurse corps mismatch column in the table includes two mismatches that were not critical care billets.

Outstanding Augmentation Issues for the FSSG

- **Prior to KB, two earlier training exercises**
  - **#1: Requested 52 augmentees, received only 34**
  - **#2: HSO SD found all but 1 of 55 augmentees, but not all for FSSG**
- **Receiving platforms have little information on augmentees**
- **Would like to know the true priorities for augmenting platforms**
- **Suggest NH, Camp Pendleton, and NH, Camp Lejeune, be primary source for MEF augmentation**

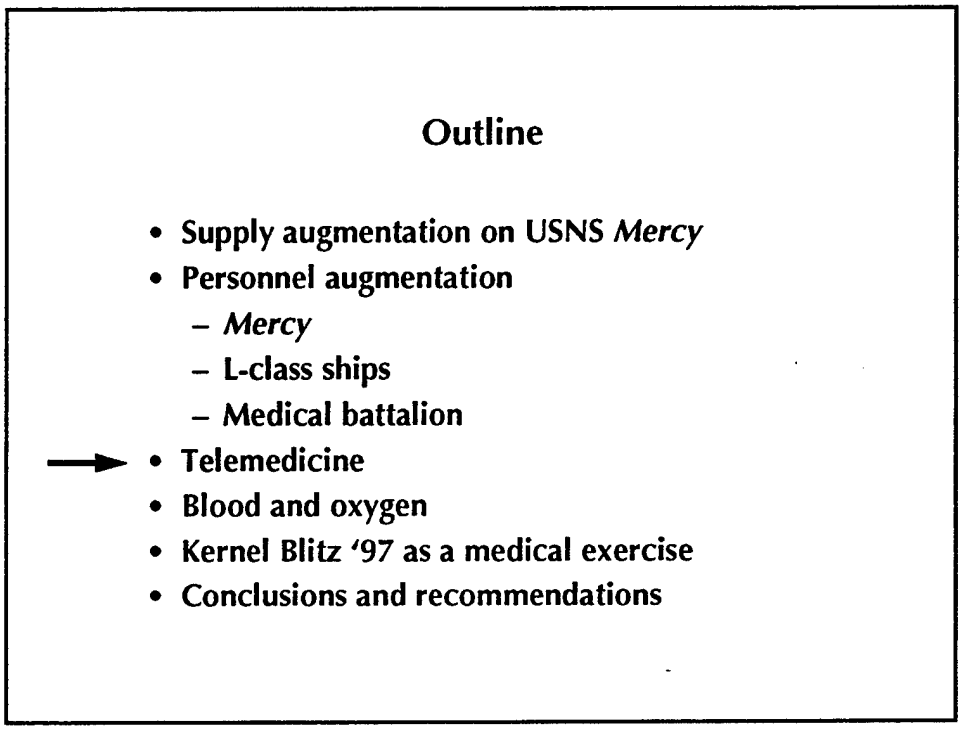
Performance for the FSSG shows a pattern of improvement. Two exercises ago, it received only 65 percent of its allotment of augmentees (34/52). In the most recent exercise before KB '97, the FSSG received almost all of its augmentees, but many were not assigned to the FSSG in the case of a real contingency.

Informally, we discussed augmentation with MEF personnel during Kernel Blitz. From the MEF's viewpoint, there seems to be a lack of information. They would like to know their priority for receiving augmentees. Lastly, they said they would like to have medical personnel from NH, Camp Pendleton, and NH, Camp Lejeune, be the primary source for MEF augmentation—the physical proximity of augmentees could prove advantageous for training purposes and in the event of a contingency. In fact, N-931 and BUMED, with CNA's help, is currently examining platform location by taking into account a number of factors, including physical proximity.

Personnel Augmentation—Summary

- Augmentation system seemed to work well
  - Boarding of augmentees on *Mercy* went very well
  - Tried to maximize appropriate platform training
- Nonetheless, there were some shortfalls and mismatches
  - *Mercy*: 8 percent shortfalls + mismatches
  - *Tarawa*: 11 percent shortfalls + mismatches
  - *Peleliu*: 26 percent (all mismatches)
  - Surgical company: 18 percent shortfalls + mismatches
- Nurse corps hit particularly hard

Overall, the personnel augmentation system worked well for Kernel Blitz. One test went very well—the boarding of augmentees on *Mercy* was accomplished in just a few hours on the evening the ship docked in San Diego. There was a fairly successful attempt to send augmentees to their particular platform or class of platforms as assigned by MPAS. There were some shortfalls and mismatches, as summarized here, ranging from a low of 8 percent for *Mercy* to 26 percent for *Peleliu*, with significant impact on the nurse corps.



We now move to the third portion of our brief, telemedicine.

Kernel Blitz Telemedicine Technology

- **Consultation with other facilities**
  - **Plain old telephone system (POTS)**
  - **E-mail**
- **Administrative automation**
  - **The Composite Health Care System (CHCS)**
  - **The Multi-Technology Automated Reader Card (MARC)**
  - **The Medical Information Engineering Prototype System (MIEPS)**
- **Digital peripheral instruments: dermascope, ophthalmoscope, and telepathology**

Telemedicine (TM) is an umbrella term that covers various technologies used to transmit and process information for health services. During Kernel Blitz 1997, TM included technologies for

- Consulting with other facilities
  - Plain old telephone system (POTS)
  - E-mail
- Automating medical administrative functions. These include the following:
  - The Composite Health Care System (CHCS)
  - The Multi-Technology Automated Reader Card (MARC)
  - The Medical Information Engineering Prototype System (MIEPS)
  - The Mass Casualty Medical Training and Evaluation System (MMT&E)
  - The Defense Blood Standard System (DBSS)
  - The Mobile Medical Monitor
- Digital diagnostic equipment. There was limited use of a digital dermascope, ophthalmoscope, and telepathology.

Telemedicine Questions for KB

- **What is the potential impact of telemedicine on medical outcomes?**
- **What impact does it have on patient administration?**
- **How did the telemedicine equipment perform?**

We focus on some of the issues about telemedicine in a heightened defense posture. What are the benefits of telemedicine? To what extent does it improve the efficiency of medical care delivery? What is its impact on patient administration? We seek to answer these questions based on a telemedicine survey as well interviews with medical and administrative staff at different platforms.

Telemedicine Survey

- **Self-administering survey on potential benefits of TM**
  - **Considered wide range of TM capabilities**
- **CEG completed a survey for individual casualties**
  - **Avoidance of death and permanent incapacitation**
  - **Avoidance or facilitation of MEDEVACs**
  - **Impact of TM on quality of care**
- **CEG asked to determine the impact if technology had been integrated**

To assess the potential demand for telemedicine in wartime, we prepared a self-administering survey. The Control Evaluation Groups (CEGs) on each platform incorporated the survey into their evaluation; they completed a survey for casualties received on their platforms during KB '97 (D-one through D+four). For some mild injuries (some cases of diarrhea and scabies), the CEGs at some platforms did not complete a survey. We obtained surveys from the surgical company, the fleet hospital, *Tarawa*, *Peleliu*, and *Mercy*.

The survey[1] listed telemedicine equipment planned for each platform on NMIMC's concept of operations for telemedicine. The survey collected a variety of information about telemedicine, including patient algorithm and the impact of TM on quality of care (as measured by its effect on diagnosis and treatment). The survey also collected information on other potential benefits of TM, such as the avoidance of death and permanent incapacitation. The survey also asked for information on the potential effect of TM in expediting and avoiding MEDEVACs.

For TM equipment not integrated into the medical play, we asked the CEGs to determine the impact of TM if it had been integrated. If the CEGs felt that a telemedicine modality not listed on the survey would have some impact, they were to write in the name of the technology.

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1. An example of the telemedicine survey is in appendix B.

Impact of Telemedicine Consults—KB '97

	Surgical company	*Peleliu*	*Tarawa*	FHOTC	*Mercy*
Surveys completed	87	20	66	145	86
Operational beds	48	48	60	100	250
Prevented death	–	–	–	4	–
Prevented permanent incapacitation	–	2	–	4	–
Established or changed diagnosis	–	1	–	7	–
Established or changed treatment	4	1	–	8	–

Surgical company. The surgical company integrated CHCS and MARC into the medical play. It had one phone line, Internet access, and the M3, but did not integrate these fully into play. The surgical company did not integrate the translator, dermascope, telepathology, or ophthalmoscope. According to the survey, POTS and telepathology would have established or changed treatment for three patients. The dermascope would have established or changed the treatment for one patient. Thus, consulting potential for telemedicine appears limited at the surgical company.

Tarawa. On *Tarawa,* CHCS and MARC were integrated into medical play. It had Internet access, dermascope, and ENT scope. According to the results of the survey, none of the clinical technologies would have made a concrete contribution to diagnosis, treatment, or prevention of death or incapacitation. On the other hand, the CEG team thought that CHCS, MARC, and MIEPS could speed administrative functions, which are not shown on this slide. On *Peleliu,* the survey reports that telemedicine could have prevented incapacitation, changed diagnosis or treatment in 4 of the 20 cases.

FHOTC. At FHOTC, considerably more cases would have benefited from telemedicine. This contradicts findings on *Mercy,* where the survey showed no concrete benefits from consultative telemedicine.

Results for Administrative TM

- CHCS
  - **Patient admissions module and e-mail capability were useful**
  - **Bandwidth constraints limited transmissions**
- MARC
  - **Improvement over handwriting method**
  - **Locating/removing MARC can be harmful to patients**
- MIEPS
  - **Time saving for platforms able to access web**
  - **Duplicates some data on MARC**

CHCS's patient admissions module was a valuable tool for patient admission and tracking. CHCS's e-mail capability was useful for internal communication.

On *Mercy*, the network connection plug on the back of the computer was very sensitive. Several times during the exercise, it was accidentally hit, resulting in a connection loss. Even more troublesome was that it took almost a half hour to reestablish a connection to CHCS.

Because of bandwidth constraints, CHCS files were not transmitted over the offboard server to remote sites. While there is a minimum requirement of 38.4 kbs, the maximum transmission rate was 2.4 kbs at times.

MARC was seen as an improvement over the forms used by corpsmen in the field because of MARC's greater legibility. However, some exercise participants pointed out that locating and removing MARC could be harmful to patients. One of the big advantages of MARC is that it does not rely on communications. Communications were problematic during Kernel Blitz.

MIEPS saved time for those platforms that were able to access the web. However, not all platforms had web access because of communication difficulties.

Other TM Conclusions

- **Administrative automation—glitches and all—is beneficial**
- **Low-end communication technologies beneficial**
  - **POTS and e-mail**
  - **In CNA peacetime TM study, cost-effective on all platforms**
- **High-end technologies (scopes, teleradiology, and VTC) have limited applicability**

In conclusion, administrative uses of telemedicine and low-end communications for consultation seemed quite useful in Kernel Blitz, but the high-end clinicial technologies like the scopes, were much less helpful. These findings agree with a study just completed by CNA on peacetime uses of telemedicine[1] and an earlier CNA study on wartime communications for Navy medicine in support of the Marines.[2]

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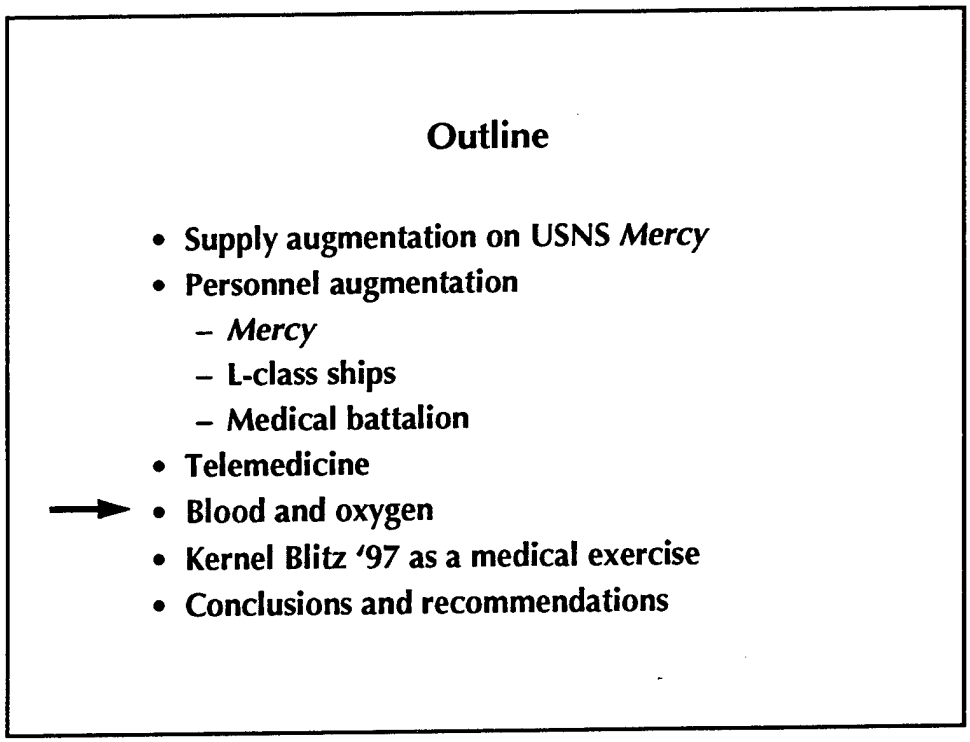
1. Federico Garcia and Peter Stoloff, *A Cost-Benefit Analysis of Shipboard Telemedicine,* Jun 1997 (CNA Research Memorandum 97-66).

2. Neil Carey, Cori Rattelman, and Hung Nguyen, *Information Requirements in Future Medical Operations,* Oct 1996 (CNA Research Memorandum 96-70).



We now turn to blood and oxygen, two important auxiliary classes of medical supply.[1]

1. Appendix A contains further information about blood and oxygen.

Blood and Oxygen Questions

- **Did the blood play stress capabilities?**
  - **Does the blood system work?**
- **Does the Defense Blood Standard System (DBSS) work?**
- **What limits the O_2 supply?**

In Kernel Blitz, we looked at three questions: Did blood play stress the system? How well does DBSS work? What limits the oxygen supply?

Findings for the Blood System

- **Blood system wasn't stressed**
  - **Patient flow smaller than system capacity**
- **Somewhat less blood used than expected**
  - **0.8 units per patient per platform vs. 2.7 on *Mercy*, vs 4.0 per patient planning factor**
  - **However, 4.0 is for all platforms combined**
- **Therefore, capacity was not an issue, but size of the discrepancy is difficult to assess**

The patient flow in Kernel Blitz was smaller than the system's capacity, so the blood system was not stressed. It seemed that fewer or smaller transfusions were needed in Kernel Blitz, but we couldn't assess how much different it was. We computed 0.8 unit per patient per platform in Kernel Blitz, and blood officers on *Mercy* estimated a need for 2.7 units per casualty on their platform. However, *Mercy* is probably more surgically intensive than are two other Kernel Blitz platforms, *Tarawa* and the surgical company.

DBSS and Oxygen

- **DBSS**
  - **In prototype stage**
  - **Had connectivity, reliability problems**
  - **To really use it requires earlier and better training**
- **Oxygen**
  - **Limiting factor is the containers aboard *Mercy***

The version of DBSS used in Kernel Blitz is the first to allow sharing of information across communication lines across sites, and it is still in the prototype stage. Unfortunately, communications were unreliable between ships, and there were problems within platforms as well. For example, on *Tarawa,* the blood label scanners didn't work, it was impossible to print from the DBSS system, and the report formats weren't working properly.

Our analyses of oxygen indicate that, if the hospital ship is in theater, there is sufficient oxygen available to the amphibious ships. *Mercy* can produce O_2 at a rate of 36 tanks per hour (either large "H" or small "D"), meaning they can produce up to 860 tanks per 24-hour period.[1]

The problem choke point is the number of tanks available for moving oxygen to other ships. *Mercy* has only 200 spare tanks, and only 70 of those are the large size "H" tanks that you would prefer to transfer to an LHA. *Mercy* has 800 backup tanks, but they keep those in case the ship's built-in oxygen system fails. Even if you used all 200 spare tanks within theater, it would take transportation assets to move them. One possible solution to the problem would be to carry O_2 as liquid. We do not know if that solution has been tested.

---

1. The 860 number optimistically assumes that no breakdowns occur during very intensive use. That assumption needs to be tested.

Blood Play Suggestions

- **Begin DBSS installation and training earlier**
- **Begin the play earlier**
- **Plan "paper patients" if insufficient cases available**

We have three suggestions for future blood play:

(1) Begin installation and training of DBSS earlier.

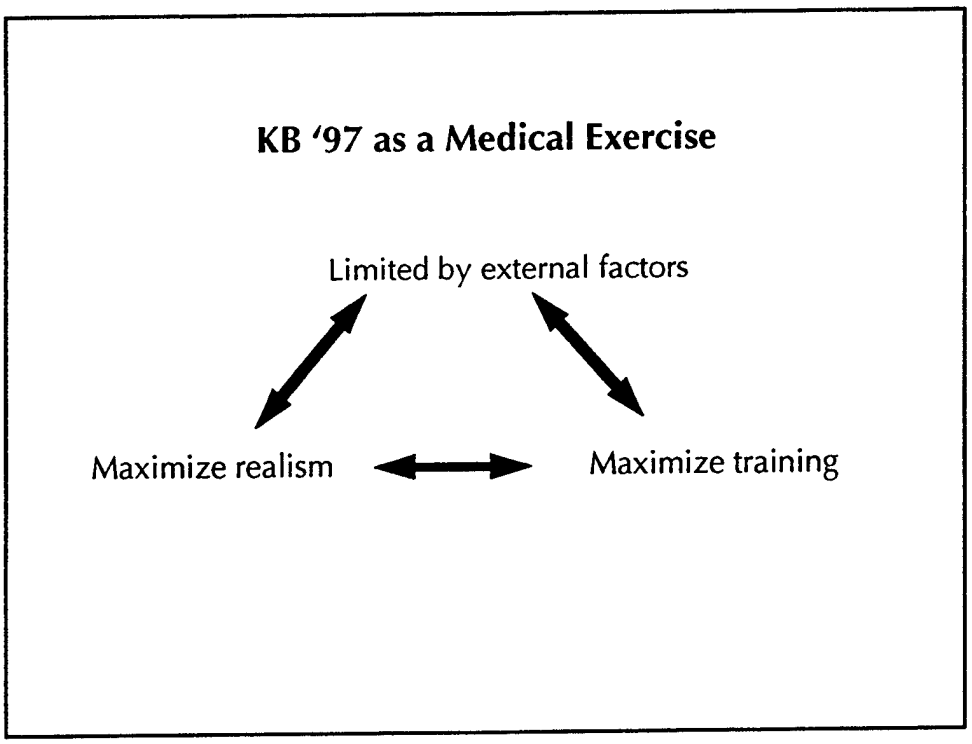
(2) Begin blood play earlier—the comparatively relaxed time before D-day can be used for a focused test of the blood system.

(3) Use "paper patients" to stress the blood system if not enough real patients are available.

Outline

- Supply augmentation on USNS *Mercy*
- Personnel augmentation
  - *Mercy*
  - L-class ships
  - Medical battalion
- Telemedicine
- Blood and oxygen
- → Kernel Blitz '97 as a medical exercise
- Conclusions and recommendations

In the next section of this brief, we analyze Kernel Blitz as a medical exercise.



There are three competing factors in a medical exercise: external constraints, realism, and training. Maximizing one factor may severely limit your ability to meet another.

KB '97 as a Medical Exercise

- **External factors**
  - **Line provided casualties**
  - **Safety dictated no night MEDEVACS**
- **Realism**
  - **Patients don't normally go through all facilities**
- **Training**
  - **Had to be delayed until patients arrived**
  - **Realistic, but fewer casualties than expected**

Several external limitations reduce play in any medical exercise. For example, the line's use of sea and air assets limits how many MEDEVACs can occur. As you maximize the realism of the exercise—say, by allowing for "down time" when there are few casualties to treat—the less training you are accomplishing. On the other hand, attempts to maximize training—by sending each casualty to all echelons of care, for example—decrease realism by having higher echelons treat patients who would usually have been only at earlier echelons of care. There is also a tradeoff between different types of training. "Recycling" casualty actors means less work for the wards, and longer training in decontamination means less time treating after decon.

Improvements in KB '97

- **Expanded scope of exercise**
  - ***Mercy* deployed as 250-bed hospital**
  - **More and better medevac assets**
- **Some tracking of supplies by Military Medical Training and Evaluation team (MMT&E)**
- **Tested M+1 manning for *Tarawa***
- **Further demonstrations of telemedicine**
  - **Patient tracking went well, more connectivity across platforms**
- **Tested nighttime care in wards**

Kernel Blitz '97 expanded and improved on KB '95 in a number of ways. This time, the exercise planners deployed *Mercy* as an expanded (250-bed) hospital. The Coast Guard supplied two MEDEVAC helicopters for the first time, and the Army provided Blackhawk MEDEVAC helicopters rather than the Hueys that were used last time.

The MMT&E team started tracking supplies this time, which was a more formal effort than there was in KB '95. In addition, the medical manning for *Tarawa* was considerably closer to mobilization levels than it was for the LHA that played in '95.

Exercise planners tested new and different telemedicine technology in KB '97. The patient tracking systems worked relatively well, and there was more communication connectivity across platforms.

Lastly, Control Evaluation Groups (CEGs) on *Tarawa* and *Mercy* earnestly tested the functioning of night crews in KB '97. They gave patients complications that tested the ability of ward nurses and corpsmen to respond to unexpected events.

Future Opportunities

- **Address warfighter battlefield clearing procedures**
  - **Still had problems with patient evacuation from the beach**
- **Increase stressors, concentrate on unique at-sea training opportunities**
  - **Play supply, blood, oxygen more fully**
- **Integrate telemedicine into casualty play even more**
- **Interview casualty actors for feedback on care**

Building on the many successes of KB '97, we think that a future KB medical play could address the problems that warfighters have in clearing the battlefield of casualties. In KB '95, casualties were sent via slow LCU back to a ship that had no surgical capability, when waiting a few minutes would have allowed them to be transferred much faster to a surgically capable ship. Similarly, in KB '97, there was some confusion about where to radio for help in clearing the beach, and some MEDEVAC helicopters had difficulty finding casualties and leaving sufficient room between their landing and the casualties.

KB '97 consciously increased stressors during medical play at night, and we think that practice should be continued and expanded. One way to further stress the system is to play supply, blood, and oxygen more fully in a future Kernel Blitz.

Telemedicine was more fully integrated into medical play in KB '97 than in KB '95, but we think that further integration would be worthwhile. Why not test using the MARCs or CHCS as the primary patient tracking systems, for example? Or have some patient algorithms call for a store-and-forward X-ray transmission and E-mail consultation on a complicated fracture case?

Lastly, we think there would be utility in interviewing casualties on the treatment they have received. The casualty actors notice things that are potentially overlooked, such as having been left in a hallway too long, or having been seen by multiple doctors who were not communicating. Their insights might promote learning.

Outline

- **Supply augmentation on USNS *Mercy***
- **Personnel augmentation**
  - ***Mercy***
  - **L-class ships**
  - **Medical battalion**
- **Telemedicine**
- **Blood and oxygen**
- **Kernel Blitz '97 as a medical exercise**
- **Conclusions and recommendations**

We're now to the final part of the brief—our summary and recommendations.

Study Conclusions

- **T-AH supply**
  - **There is a problem; coordinate with DPSC to solve**
- **Personnel augmentation**
  - **Overall, looked good**
  - **But, communication with field needs improvement**
- **Telemedicine in war**
  - **Administratively useful, clinically limited**
- **Blood**
  - **No major problems observed, but system not stressed**

Personnel at DPSC tell us that there is a problem in getting all supplies to the hospital ship within the 5-day period, although the size of the problem cannot be fully assessed until all IPP survey responses have been received. Coordinating with DPSC, NAVMEDLOGCOM, and the T-AH program office should allow Navy medicine to address items that are in critically short supply, and for which there are no substitutes.

Overall, the personnel augmentation system looked good. But there is considerable misunderstanding in the field about what they are supposed to be getting, and what the priorities are. Communication with the field needs improvement.

We found telemedicine for patient tracking and administrative functions to be useful, but the clinical usefulness is limited.

Lastly, we found no major problems with the blood program, but note that the system was not stressed in KB '97.

Exercise Recommendations

- **Kernel Blitz is unique opportunity to practice coordination with the line**
  - **MERCEX concentrates on clinical training**
- **Resources can be further exploited to maximize training**
  - **Use the time before D-day**
  - **Ensure that play challenges all personnel**
- **Medical should play again**
  - **Unique benefit of line visibility, coordination**

We believe that Kernel Blitz provides a unique opportunity for Navy medicine to coordinate with the line, giving nonclinical training. This separates Kernel Blitz from some other "in-house" training exercises, such as MERCEX, which concentrate on clinical training. For example, KB is an opportunity to determine what coordination with the line would be necessary to (1) get a helicopter from *Mercy* to bring oxygen tanks to *Tarawa,* or (2) move real blood from *Tarawa* to the surgical company, or (3) get a shipment of medical supplies loaded from a cargo vessel to Mercy, or (4) keep casualties overnight in a surgical company.

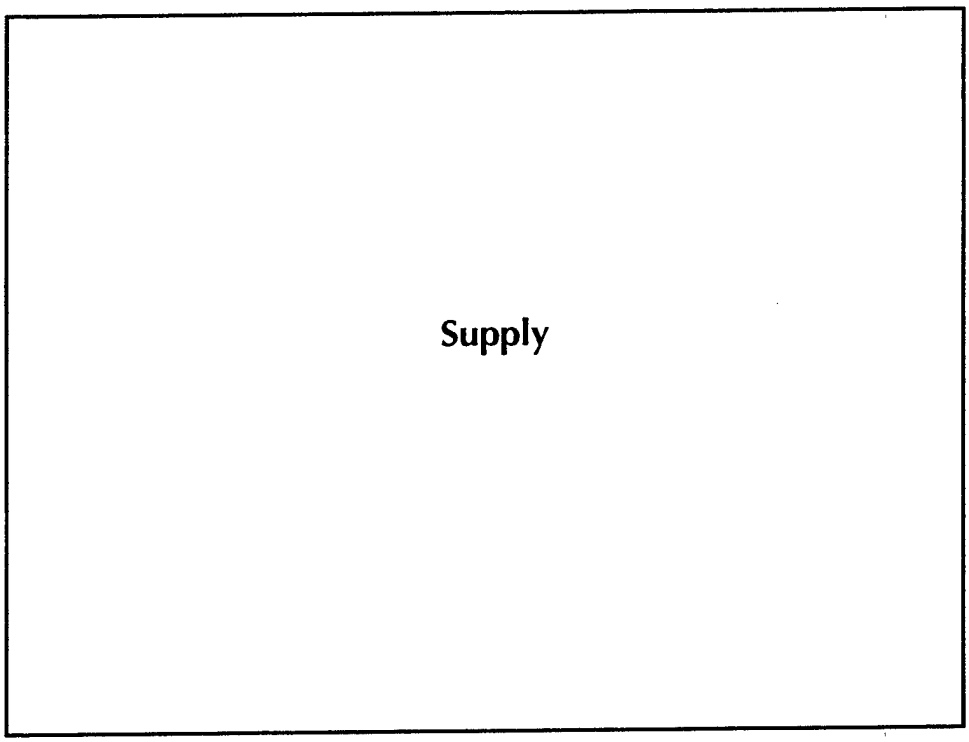
KB '97 was a success, and we believe that resources can be used even better by exploiting time before D-day, and by planning carefully to ensure that all personnel feel challenged throughout the exercise.

In summary, we believe that medical should play in Kernel Blitz again. The benefits to Navy medicine—in visibility and coordination—are worth the hard work that made KB '97 a success.

Appendix A:
Backup slides

Supply
Personnel
Blood
Oxygen

The following slides expand or provide background for some of the statements made in the main part of the briefing. They cover most of the issues we addressed in the main briefing: supply, personnel, blood, and oxygen.


Supply

Comparing Medical Requirement to Space

- *Jane's* provides measures of space and displacement
- *Mercy's* "usable" space is about 3.6 million cubic feet
  - Our estimate of wartime requirement is 364,000 cu. ft., or about 10% of usable space
- *Mercy* displaces 77,683 short tons
  - Our estimate of wartime requirement is 2,100 short tons, or about 3% of total displacement
- Admittedly, can't say whether supplies would fit
  - But, does put requirements in context

Personnel

Mercy: KB '97 Mismatches: Medical and Non-Medical

	Counts of mismatches		
	Medical	Non-medical	Total
Enlisted	14	11	25
Officer	17	1	18
Total	31	12	43

Personnel Augmentation—*Tarawa*

	Requested	Received
•	84	82
– MC	11	10
– NC	22	23
– DC	1	1
– MSC	1	1
– ENL	49	47

- 1 NEC mismatch / 6 rank/grade mismatches
- Most are not *Tarawa* augmentees/some not amphib augmentees.

Personnel Augmentation—*Peleliu*

- Requested 23, received 23
  - 3 MC, 1 mismatch—gen'l surg sent for ortho
  - 9 NC, 5 mismatches—0 matches for critical care nurses
  - 11 enl, 0 mismatches
- 15 augmentees were sent from NMC SD
  - 12 were not *Peleliu* augmentees, although all were amphib augmentees

Training Requirements

- Training plan outlines requirements for medical personnel
- Documentation resides primarily at MTF
- Checked T-1 status on *Mercy*
  - Depends on basic requirements for sea duty
    - ❒NBC (82% in compliance)
    - ❒Shipboard orientation (86%)
    - ❒Firefighting (96%)
- T-AHs have unique training reqts to meet Coast Guard certification prior to sailing

MMT&E

- **Hand-held computers were improvement over paper-and pencil evaluation**
- **Entry format of the comments section was slow and cumbersome**
- **Some software enhancements needed**
  - **Ambiguity about treatment at specific echelon of care**
- **On the *Mercy*, only 3 out of 20 CEG members were ATLS instructors**

Hand-held computers are a major improvement over paper-and pencil evaluation. Algorithms were in general good; however, MMT&E's comments section was slow and cumbersome. A more user-friendly entry format for comments is desirable.

MMT&E allows data entry for one or two algorithms at a time. In some cases, the CEG was able to improve on this—recorders were able to do five algorithms simultaneously by the end of the exercise. Nonetheless, some data went unrecorded at the initial stages of the exercise. The software should be revised to allow for late entry of start time, and subsequent events referenced to start time (such as Start, Start + two minutes, etc.).

On *Mercy*, only 3 out of 20 CEG members were ATLS instructors, which is considered necessary for conducting algorithms aboard a sophisticated echelon III platform. Inadequate training of CEG compromises MMT&E educational and evaluation mission. CEG on *Mercy* recommended the selection of more highly trained and experienced evaluators to run MMT&E algorithms at the echelon III level.

Number of Patients: KB '97 vs. KB '95

	1995	1997
LHA	63	66
Deploying platform	19	20
USNS *Mercy*	87	107
Surgical company	105	87
Fleet hospital	168	192

Blood Program

How did we get 0.8 unit of blood per patient, and how did Navy get 4.0 planning factor?

- Example of how CNA got 0.8 unit per patient: We had 20 patients one day, and they used 16 units to transfuse those patients.
- The planning factor of 4.0 per patient comes from NWP-02, Operational Health Service Support, p. K-3, also DOD Inst. 6480.4

Would you run out of blood?

D-Day	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	
554	323	216	270	241	213	210	208	204	(daily)
554	877	1093	1363	1604	1817	2027	2235	2439	(cum)

↑ run out of fresh blood

↑ still can treat 261 more patients

Therefore, you still have enough capability to supply blood, even with decreased frozen reserves

Calculations for when you would run out of blood, given smaller amount of frozen

	Liquid blood on board	Frozen blood on board, old(new)	Delta
LPH	None	None	
LHA	960	950(400)	550
LHD	960	1,330(400)	930
T-AH	2,000	2,850(400)	2,450

Plus, surgical company keeps 120 units fresh blood

Decreasing frozen blood, cont

- Used Culebra scenario, 1 T-AH, 3 LHAs, and 3 LHDs
  - D-day rate much larger in Culebra, other days similar
- Assumed planning factor of 4.0 units/patient
- Assume use all fresh blood before frozen

Therefore, decreased frozen blood means

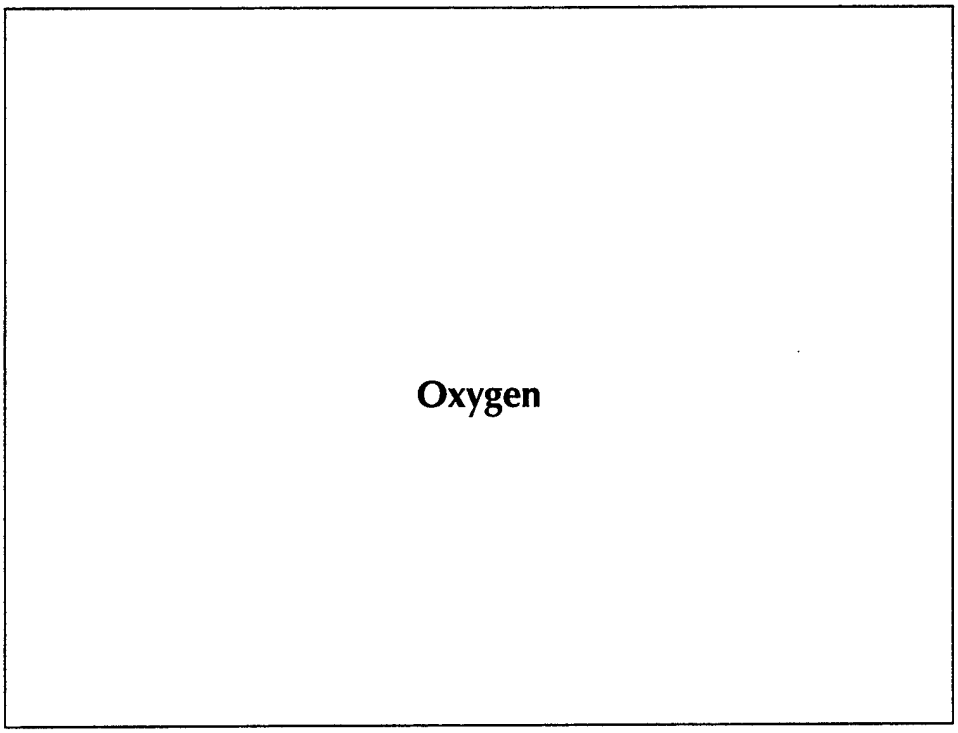
- 2 surgical companies, 3 LHAs, 3 LHDs, 1 T-AH lose a total of 6,890 frozen units, enough to treat 1,720 patients using 4.0 planning factor. Your capability to supply blood decreased from 4,420 patients to 2,700 patients, or 39%

Conclusion and further considerations

- Appears that frozen blood reserves are still sufficient, especially since:
  - PACOM frozen reserves will increase
  - Culebra casualty rates are higher than the official rates
  - Estimate of 4.0 units per patient is for all echelons, not for each platform
  - Walking blood bank is not utilized in this scenario, but it could serve as backup

Further consideration on blood

- One blood freezer on *Mercy* holds 550 units. So why limit it to 400 units? Why not 550 units?


Oxygen

How did we come to the conclusion that O_2 containers on *Mercy* are the limiting factor?

- On *Tarawa,* they said that a ventilator lasts about 4.5 hours on one tank of oxygen, so about 6 tanks per patient per day. They only have 60 tanks on LHA
  - With 5 ventilator patients, use 30 units. If 6 LHAs/LHDs, use 180 per day.
- *Mercy* can fill oxygen tanks at a rate of 36 per hour, or 860 per 24-hour period (at least several hundred).
- *Mercy* has only 70 large spare tanks available for shipments to other platforms
  - Therefore, number of tanks and speed of transporting tanks are the limiters.
  - 800 backup tanks on *Mercy* would not be used to transport oxygen--they are in case the ship's O_2 system fails.

Appendix B: Questionnaires

AMAL Storage Space Questionnaire
Telemedicine Survey

AMAL Storage Space Questionnaire

AMAL _____ Name_____

Phone _____

The purpose of this questionnaire is to determine the total available AMAL storage space aboard the Mercy. We are attempting to develop a standardized method for estimating the storage space for each AMAL. Please provide the following information:

1. How many storage areas are associated with this AMAL? Please provide room numbers and descriptions.

2. For each storage area please list the number of bins, shelves, drawers, etc.

3. List the cubic feet of storage space associated with each set of bins, shelves, drawers, etc. in all storage areas. How was this estimated?

4. List the percent of each set of bins, shelves, drawers, etc. in all storage areas that is currently being used for this AMAL.

5. List the cubic feet of storage space associated with each set of bins, shelves, drawers, etc. in any other storage areas that are empty but dedicated for this AMAL.

6. List any potential secondary storage spaces (hallways, etc.) that could be use for storage of this AMAL. Please provide room numbers and descriptions. Also list any limitations on using these spaces.

7. List the cubic feet of these secondary storage areas.

8. Approximately how many days of supply are currently on hand for this AMAL (the supplies from question 4). What percent of the AMAL does this represent?

Please list any additional information about storage space.
Please give the answers to this questionaire to _____ (phone).

Telemedicine Survey
FHOTC

Please complete this form for each simulated KB 97 casualty received on FHOTC.

Patient #:_____ Date (mm/dd): _____/_____

Algorithm #:_____ Time: _____:_____

Patient condition (code):_____

Status upon admission: ☐ Mildly injured/ill ☐ Moderately injured/ill ☐ Severely injured/ill ☐ Dead

Disposition: ☐ Limited duty ☐ Light duty ☐ Return to full duty ☐ Evacuation ☐ Death

Did your duty station use a TM capability in this case? If yes, complete the next section: ☐ No ☐ Yes

Which capabilties? Check all that apply:
☐ Phone ☐ CHCS ☐ E-mail ☐ MARC ☐ M3 Monitor ☐ Video S/F ☐ Dermascope ☐ TelePathol. ☐ Ophthalm.

Consulting facility:_____

How was the quality of text, image, sound, or information produced?
☐ Excellent ☐ Good ☐ Poor ☐ Failed to connect

How was the timeliness of the connection? ☐ Excellent ☐ Good ☐ Poor

How many interruptions to the transmission (lost text, image, or sound) occurred?_____

Did TM establish or change the diagnosis? ☐ No ☐ Yes
If yes, check one (the capability that applies the most):
☐ Phone ☐ CHCS ☐ E-mail ☐ MARC ☐ M3 Monitor ☐ Video S/F ☐ Dermascope ☐ TelePathol. ☐ Ophthalm.

Did TM establish or change the treatment? ☐ No ☐ Yes
If yes, check one of the following:
☐ Phone ☐ CHCS ☐ E-mail ☐ MARC ☐ M3 Monitor ☐ Video S/F ☐ Dermascope ☐ TelePathol. ☐ Ophthalm.

Did TM save man-days in this case? ☐ No ☐ Yes If yes, no-duty days saved:_____ Light-duty days saved:_____
Check one of the following:
☐ Phone ☐ CHCS ☐ E-mail ☐ MARC ☐ M3 Monitor ☐ Video S/F ☐ Dermascope ☐ TelePathol. ☐ Ophthalm.

If permanent incapacitation was a likely outcome, but was prevented in your duty station, did TM prevent it? ☐ No ☐ Yes
If yes, check one of the following:
☐ Phone ☐ CHCS ☐ E-mail ☐ MARC ☐ M3 Monitor ☐ Video S/F ☐ Dermascope ☐ TelePathol. ☐ Ophthalm.

If death was a likely outcome, but was prevented in your duty station, did TM prevent it? ☐ No ☐ Yes
If yes, check one of the following:
☐ Phone ☐ CHCS ☐ E-mail ☐ MARC ☐ M3 Monitor ☐ Video S/F ☐ Dermascope ☐ TelePathol. ☐ Ophthalm.

If MEDEVAC, immediate destination:_____
Transport mode:_____

Did TM expedite the MEDEVAC? ☐ No ☐ Yes
If yes, check one of the following:
☐ Phone ☐ CHCS ☐ E-mail ☐ MARC ☐ M3 Monitor ☐ Video S/F ☐ Dermascope ☐ TelePathol. ☐ Ophthalm.
Hours saved:

If no MEDEVAC, did TM prevent it? ☐ No ☐ Yes
If yes, check one of the following:
☐ Phone ☐ CHCS ☐ E-mail ☐ MARC ☐ M3 Monitor ☐ Video S/F ☐ Dermascope ☐ TelePathol. ☐ Ophthalm.

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Attn: RADM SANFORD, MEDICAL INSPECTOR GENERAL 00IG
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Attn: MICHAEL L. STEWART, HMCM (SS) FORC
Attn: CAPT BOB BRANDT, MED-03
Attn: MED-03B
Attn: CAPT DUNDON, MED-32
Attn: CAPT GILEVICH, MED-36
Attn: CAPT ST ANDRE, MED-38
Attn: CAPT MCQUINN, MED-04
Attn: CAPT CARSTEN, MED-42
Attn: MED-05
Attn: MED-05B
Attn: MED-51
Attn: MED-52
Attn: MED-53
Attn: MED-06
Attn: CAPT GRAF, MED-06B
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