

Designing Shipboard Medical and Dental Facilities for the Owners with the Owners

Ms. Tracy Ballagh
CAPT Kendall King, USN (Ret.)



Computer model, PMS 317, LPD-17 Program Office

The LPD-17 Class will support the Expeditionary Warfare Mobility Triad of LCACs (Landing Craft Air Cushion), Marine Corps Advanced Amphibious Assault Vehicles (AAAVs), and the V-22 Osprey, vertical take off and landing aircraft to fully support expeditionary maneuver warfare.

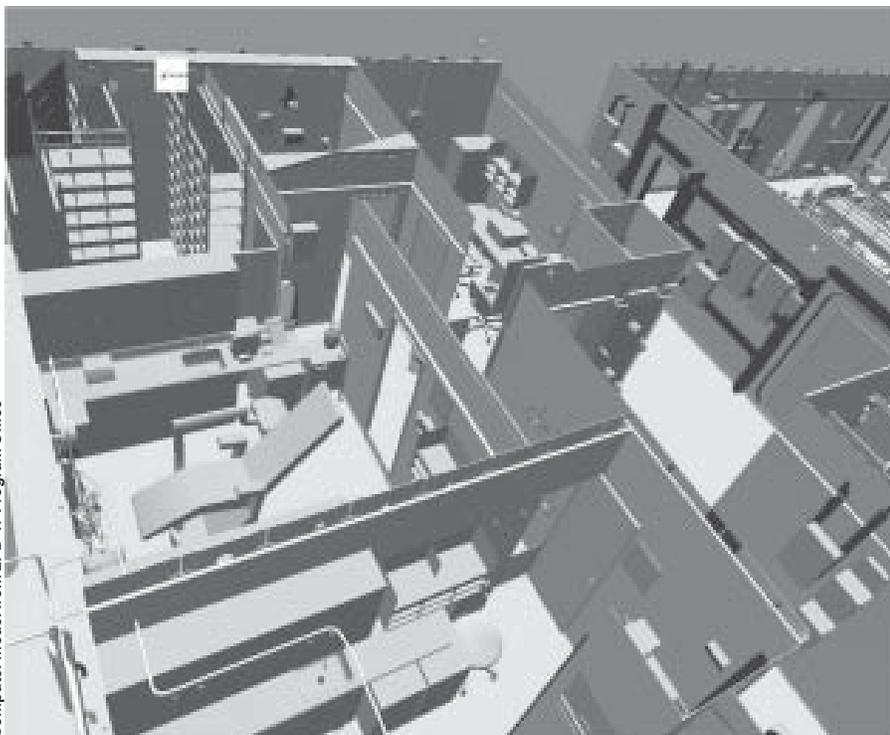
An MV-22 *Osprey* lands on the flight deck of LPD-17 and begins to offload its cargo of wounded flown from the forward base, 300 miles inland. The first litter patient is carried gingerly from the flight deck toward triage, bypassing the unneeded Casualty Decontamination Station. Once in triage, they carry the wounded patient to a waiting bed, easily negotiating the turn, entry, and passage among other patients. Gently positioning their patient, the stretcher team heads back to the flight deck for another patient while the triage team begins to check the new arrival's vital signs.

These patients are far more likely to survive their wounds than were their

comrades of previous conflicts. The enhanced chances of survival and full recovery are not by luck, however. The medical capabilities of the USS *San Antonio* (LPD-17) Class of amphibious transport dock ships reflect the influence of fleet and Marine Corps healthcare professionals more than any warship built to date. Healthcare personnel were intimately involved in validating the design of the USS *San Antonio's* triage well before commencement of the ship's construction.

The enhanced survivability rate of casualties is the result of advanced planning by medical personnel using state-of-the-art tools to provide input to the design, layout, and equipping of

spaces throughout the ship. Using a computer design simulation to demonstrate the effective form, fit, and function of moving a patient into a triage, fleet medical personnel and the ship's design team labored tirelessly to ensure mistakes of the past were not repeated. Medical subject matter experts from coast-to-coast, the eventual "owners" of LPD-17's medical facilities, concurrently viewed and reviewed the evolution to ensure adequate clearance measurements and routes for stretcher-bearers to move the litter to the ship's main battle dressing station. They laboriously reviewed three-dimensional space layouts to ensure efficient use and equipping of the medical and dental spaces. The



San Antonio Dental spaces include two operating rooms, two dental storerooms, a dental sterilization room, dental apparatus room, and a dental records office. Fleet dental personnel contributed recommendations that led to over 25 design and outfitting changes in these spaces.

result is a ship with medical and dental facilities that meet 21st century afloat medical requirements.

LPD-17 Capabilities

USS *San Antonio*, the first 21st century expeditionary warship, is well under construction with a scheduled delivery in 2004. LPD-17 and its sister ships will form an integral part of future Amphibious Ready Groups (ARGs) and expeditionary forces throughout the first half of the century. Each will have the capability to support or perform the full gamut of amphibious and Special Operations Capable (SOC) missions throughout the world's littorals. Moreover, this ship class will have the capability to accomplish independent missions separate from the ARG or other forces, such as conducting non-combatant evacuations (NEO) or advanced force operations. The design of LPD-17's medical and dental spaces is critical to the success of

these types of missions. For this reason, the LPD-17 design team collaborated through all stages of the ship design with the fleet medical and dental experts who will staff, operate, and maintain these spaces.

Just as in the LPD-4 Class of amphibious transport dock ships that it replaces, the mission of the *San Antonio* Class is to embark, transport, and land elements of a landing force. It is the first class of amphibious ship designed to support the Marine Corps' "Mobility Triad" of Advanced Amphibious Assault Vehicles (AAAVs), Landing Craft Air Cushioned (LCAC), and aircraft to include the vertical take-off and landing MV-22. Collectively, the LPD-17s crew of 361 and up to 800 embarked troops of a Marine Expeditionary Unit (MEU) can support a variety of operational scenarios. Moreover, the Mobility Triad provides ARG and MEU commanders a much greater degree of flexibility to plan and support missions.

First, the design of LPD-17's flight deck accommodates the launch and recovery of a variety of helicopters plus the MV-22. Four of these aircraft can fit on the LPD-17 flight deck (plus one in the hangar) and, when launched, can transport landing forces and equipment hundreds of miles. The AAAVs are true amphibians, able to splash from the ship's well deck, swim ashore from over-the-horizon, and carry their embarked troops ashore. Moreover, LPD-17 will be able to carry 14 AAAVs and 2 LCAC simultaneously.

The LPD-17 Class brings other attributes to the fleet. Quality of life improvements include more efficient food service spaces that employ a flexible, consolidated galley to serve officers and enlisted alike. Berthing areas incorporate the sit-up berth that increases storage space by 40 percent while providing ample room for sleeping or sitting up to read or write. Moreover, berthing spaces are identical for ship's crew or embarked troops and each berthing area has an adjacent sanitary facility and lounge.

While not flagship configured, the LPD-17 has ample command and control facilities to support temporarily embarked commanders and a full communications suite to interact with the ARG flagship or higher authority. This

also provides the capability for ship's medical personnel to interact and consult with counterparts on board larger ships and at shore-based medical facilities further enhancing on board medical care.

Self-defense and survivability in the littoral, where the ship will operate, are crucial elements that drove ship design. The LPD-17's profile is especially distinctive because of the streamlined look of its two enclosed masts, the Advanced Enclosed Mast Sensor, which surround its communications and radar antennas. This distinctive design reduces radar signature, which in turn enhances survivability in a hostile environment. Survivability enhancements also include improved weaponry, the MK 2 Ship Self Defense System, and improved damage control and overall ship design features.

Considerable advanced planning ensured incorporation of the capabilities to provide forward resuscitative healthcare in a myriad of potential operational scenarios. The ship's design encompasses an overall capability heretofore only found on large-deck amphibious ships. For example, the ship will have a morgue, an Operating Room, and convertible Main Battle Dressing Station. Other features include a scrub room, a gowning room, a pharmacy, a lab, Navy and Marine medical records rooms, a sterilization room, and two consulting rooms. The 6-bed Intensive Care Unit (ICU) and 18-bed ward includes a nursing station with an adjacent quiet room. The LPD-17 will utilize computed radiography to process x-rays in lieu of the traditional wet processing.

Fleet planners did not overlook manning requirements in this planning process either. Current manning requirements call for a medical staff of a medical officer and 12 corpsmen.

When dictated by operational requirements, Fleet Surgical Teams from the ARG flagship (an LHA/LHD) or ashore medical facilities augment ship's company medical personnel. In addition, two dental operating rooms, with associated records room and lab and manned by the ship's dental officer and three dental technicians, round out the ship's extensive healthcare facilities.

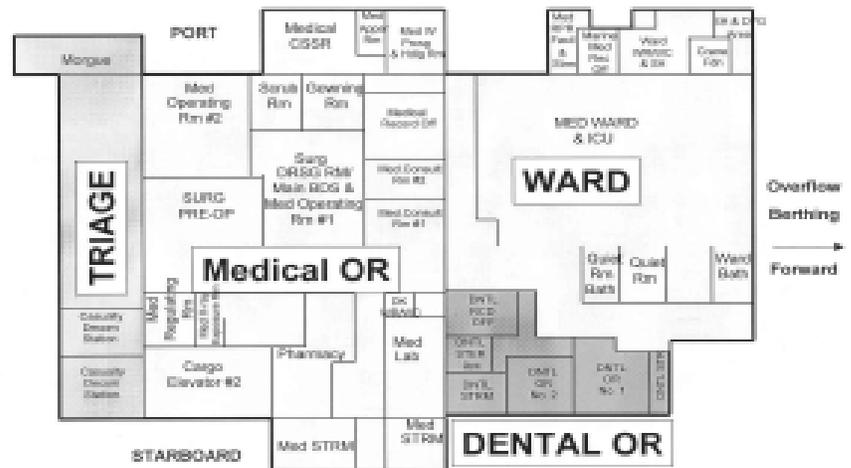
LPD-17 Design Process

The LPD-17 design process was as revolutionary as the ship itself. During the 1990s, Naval expeditionary warfare commanders reported growing requirements experienced during forward presence operations. Increasingly, real world events often caused an ARG/MEU to split, as circumstances required presence in varying locations. For instance, an LPD might cover a non-combatant evacuation operation off the West African Coast while the remainder of the ARG supports missions inside the Mediterranean Sea. Incorporating this feedback, the 1995 LPD-17 Class' Operations Requirements Document emphasized a need for the ship to be

able to perform its mission independently or as part of a group or force.

The LPD-17 program used a number of initiatives to ensure that their design met naval medical and dental requirements. Since 1997, a Medical Service Corps officer has been co-located with the design team in Avondale, LA. This individual maintained a dialog with medical and dental subject matter experts, seeking to resolve design questions and serving as a conduit for new technologies or policy initiatives. One of these officers even proposed a rearrangement of the consulting room – an arrangement later validated by the fleet and implemented into LPD-17's design.

During a series of conferences, the LPD-17 Team directly solicited suggestions and recommendations from the owners. As early as 1996, the fleet recommended increasing the enlisted corpsman manning from 10 to 12. At a follow-up conference in 1998, attendees ensured that the Preliminary Ship's Manning Document reflected this change. A 1998 LPD-17 Medical/Dental Workshop brought together the owners with the designers to review two-dimensional space drawings



LPD-17 Class Medical and Dental Complex. These spaces will enable *San Antonio* to support first response health care by ship's personnel and when augmented, casualty receiving and treatment to include forward resuscitative surgery.

Computer model from LPD-17 Program Office

of each medical compartment and to provide recommendations to OPNAV's Required Operational Capabilities document. Participants ranged from hospital corpsmen and dental technicians to anesthesiologists and the force dental officer. As noted by CAPT Edward Wyatt of OP 931 and the Surgeon General's office, "the teaming of PMS 317 and the key medical and dental activities bring exactly the right expertise together to positively impact LPD-17." The workshop's recommendations led to the incorporation of dozens of proposals into the design.

In 1999 and 2000, design team coordination with the owners moved into a new phase known as the virtual crew. The design team projected three-dimensional models of specific medical and dental spaces from their Avondale design facility to fleet representatives located in the LPD-17 War Room at Little Creek, VA, and at COMPHIBGRU Three in San Diego, CA. These electronic "walk throughs" enabled the "virtual crew members," up to 25 fleet subject matter experts at a time, to verify accessibility of ICU beds, visibility from the nursing station, and the placement of the dental chairs. In the ward and ICU alone, the owners recommended modifying a ward cabinet, replacing a flaked ice machine with a cubed ice machine, and changing the type of portable ventilator. They also recommended the deletion of the surgical scrub sink and addition of two-hand washing sinks for ward personnel in addition to changing the model of adjustable hospital beds. Also validated were the locations of oxygen bottle brackets, emergency lighting, electrical outlets, and other services in the Ward.

During virtual crew sessions, designers demonstrated distances in or-

der to validate clearance around equipment. The use of computer-generated Sailors and Marines, anthropomorphically sized between the 5th and 95th percentile, ensured that humans could fit in the designed spaces. After the space review and validation, these 3-D space models became the final detailed design to drive the steel cutting machines and actual construction.

Examples of LPD-17 Design Accomplishments

In addition to the triage example mentioned at the beginning of this article, two other examples highlight the value of the "ownership" and design team interaction. While reviewing the two-dimensional drawings of the Central Sterilization Supply Room (CSSR) in 1998, medical experts traced the process flow for sterilizing instruments based upon equipment position. They discovered that clean and dirty instruments crossed through the same areas and recommended physical separation into "dirty" and "clean" sides. The design team asked for assistance in rearranging the CSSR, and Fleet Surgical Team Six responded. The Surgical Team's recommendations to relocate equipment led to a revised traffic pattern that facilitated infection control practices. This is reflected in the current, revised design.

The dental operating room also received scrutiny. In addition to validating equipment and instrument selection, the owners helped improve space arrangement. Through their interaction, the design team moved or reoriented a dental dresser, an eye wash station, two wall cabinets, two heaters, and an x-ray machine. The resultant operating rooms will have better access and accessible storage space.

Conclusion

The overall results of this effort not only ensured LPD-17's medical capabilities meet fleet requirements of the 21st century, but also reduced costs. By incorporating recommendations more than two years before construction started, the LPD-17 Program avoided costly engineering changes. Overall, the LPD-17 medical and dental space design reflects over 130 adopted change recommendations, total validation of equipment selection, and even modernization of allowance lists and consumables. This team effort ensured that the USS *San Antonio* Class will meet the needs of expeditionary warfare healthcare professionals throughout the first half of the 21st century.

From triage to operating room to central sterilization and supply room, USS *San Antonio*'s medical and dental spaces exemplify a design for the owners with the owners. Perhaps the best description of the overall effort is by SURFLANT's Force Master Chief Corpsman Raymond Bailey, a participant in LPD-17 design events beginning in 1996 when assigned to COMPHIBGRU Two. He noted, "Never before have designers so involved the healthcare communities in warship design. At every step of the process we were asked for our input and then had an opportunity to validate the results. When medical and dental personnel step aboard USS *San Antonio* in 2004, they will benefit from a design that has been refined from the efforts of dozens of owners and designers." □

Ms. Ballagh is the Deputy Program Manager Representative, LPD-17 Program, Supervisor of Shipbuilding, New Orleans, LA.

CAPT King is the LPD-17 Program Design for Ownership Team Lead, American Systems Corporation, Chesapeake, VA.