Introduction

Think of mobile health clinic and what comes to mind? Depending on where you live, it might mean Tommy the Tooth van dispensing free brushes and toothpaste to the community. Maybe a loved one received a mammogram in their small town or received diabetes education. The Lions Club may have sponsored a mobile vision clinic where senior citizens were screened for glaucoma. Perhaps migrant farm workers lined up for hours to get free medical care while working in the fields. Whether you live in the city or the country, chances are some type of mobile health clinic has visited your community sporting colorful graphics on the outside and various medical/dental services on the inside.

Such nostalgic views do not reflect the evolving field of mobile healthcare being observed today. At the recent annual American Telemedicine Association (ATA) meeting in Seattle, the Mobile Health Clinics Network (MHCN) sponsored their own 3-day forum, replete with top-of-the-line vehicles competing for space with other telemedicine vendors in the exhibition hall. The partnership between ATA and MHCN in holding their meetings together reveals how telemedicine is impacting the way mobile health clinics are delivering services to the communities they serve. As medical groups and hospitals consider launching a new initiative or replacing worn-out vehicles, they must evaluate the benefits and costs of incorporating telehealth capabilities into their project. “At MHCN, we see mobile health and related e-health technology as agents of change that impact access to quality medical and dental care,” says Darien DeLorenzo, who serves as its CEO and Executive Director. She sees the advancement of telemedicine and tele-dentistry as bridging the gap between the mobile health clinic and a fixed site. “It has made timely patient–professional consultation more attainable.”

Indeed, telemedicine is exerting its influence on mobile health solutions in unique and unexpected ways. Everything, from vehicle selection, design, and construction to satellite needs, power demands, and disaster possibilities, are all up for change when these technologies are put into the equation. In this issue of Medical Connectivity, we’ll look at how mobile health is evolving thanks to telemedicine, identify some challenges that must be overcome, and highlight two notable programs that effectively marry both disciplines.

Thinking Long Term

Talk with Larry LaGuardia, Sales/Business Development Manager for LDV, Inc., an industry leader in integrated mobile solutions, and you’ll soon understand how the mobile healthcare market is rapidly evolving. “There have been significant changes,” LaGuardia points out. “Overall, it is shifting from a direction far different from just a few years ago.”

For years, a lot of mobile healthcare programs were fairly basic, necessitated by funding issues. Instead of having long-term funding, these initiatives were funded by short-term grants. While hospitals, medical groups, and organizations would undertake these projects, they were not usually integrated into the sponsoring institution as a long-term, budgeted line item. LaGuardia recalls how a lot of vehicle purchases were really based on delivering basic, short-term funded services. As a result, recreational vehicles (RVs) were the popular choices when it came to buying a mobile health clinic. “This was one of the reasons why LDV was not all that active in the mobile medical solutions industry,” he explains. “It was contrary to our corporate culture.” His company’s vehicles were extensive, designed for heavy use, and expected to be used for long periods of time. “You just didn’t see our customers plying their trade out of a Winebego. They were in a very different category all together.”

Today, higher demands are being placed on vehicles used for mobile medical needs. Medical associations and hospitals are now looking at their outreach vehicles as a permanent part of their culture. In doing so, they have become permanent, budgeted items. This requires that the vehicles last longer, making structural integrity and high-quality electrical systems imperative. They also must be more reliable to maintain the rigorous schedules of delivering program services. “These programs do not want to have to buy a new one in a couple of years,” says LaGuardia. “They also don’t want to get
caught not being able to update it because of outdated structure or design.” As he sees it, the trend is toward vehicles that will service programs for a long time. Today’s vehicles can be updated, changed, and modified without having to buy a new one. Ultimately, vehicle performance must justify its cost.

New Digital Imaging Requirements
One of the more active markets in mobile health solutions is digital mammography, which demands a higher quality product (Fig. 1). Today’s digital imaging systems have a heavy footprint for a relatively small location. Such structural issues may simply be too much for an off-the-shelf recreational vehicle to handle properly. Mammography systems can now be custom built around a commercial body and chassis, where heavier and more durable modifications can be made. “You are working with aluminum and steel as opposed to Styrofoam and plywood,” says LaGuardia.

Horror stories abound in the mobile health clinic community about vehicles running into trouble out in the field. It is an intimate industry, where word gets around fast. As soon as someone makes a mistake, the whole world knows about it. LaGuardia knows instances where a digital mammography unit was installed only to have the rear axle break from weight overload. High power demand can also create problems. “People were using smaller standard RV generators to power these units,” he explains. “Every time they used the imaging equipment, they had to shut off the air conditioning in order to maintain enough power!”

Telemedicine Drives Specification Needs
Although the marriage between mobile health and telemedicine is still in the honeymoon phase, it is clear which one is wearing the pants. Telemedicine is forcing the mobile health field to evolve in a hurry. It is doing this by demanding that equipment be perfected so that it is reliable and secure enough for the healthcare market.

A good example of telemedicine exerting its influence on the market is the type of satellite dish installed on vehicle roof tops. The need to send massive amounts of information (i.e., medical records, x-rays) to a fixed location for downloading requires large-size dishes. Videoconferencing also needs satellites that are larger and heavier. As a result, vehicle design needs to take into account these important size, weight, and environmental considerations. This necessitates the purchase of a commercial-grade bus, truck, or trailer. Most RVs are not designed for these larger satellite dishes. Instead, they can only accommodate small dishes used by vacationers to get television reception. Dishes used for medical-related transmissions are two-to-three-times larger. “When you get a 200-pound dish on a one-piece, rubber-stretched roof, you need a pretty substantial structure up there to hold it,” warns La Guardia. “If there is a 40 MPH wind or gust, it will start to damage the roof and generate water leaks.”

Given these new, evolving demands, mobile health programs are getting away from RVs. Issues such as the generator, electrical wiring, structural design, capacity concerns, equipment durability, and roof integrity simply do not make these vehicles suitable for today’s initiatives. Industry insiders are now talking about making improvements as a result of telemedicine and digital mammography demands, and the long-term outreach commitments being made by these medical
groups. There is a move away from RVs made out of fiberglass and rubber roofs. Now, mobile health solutions consist of buses (with aluminum or steel bodies) and step or walk-in vans (all-aluminum commercial trucks). These vehicles have heavier roofs structures with welded tread plates.

Lessons from Homeland Security

Lately, LDV is doing a lot of vehicle design projects in the homeland security market for federal, state, and local law enforcement agencies. Premier medical organizations are also interested in creating sophisticated mobile command centers for complex data transmission and videoconferencing. LaGuardia just delivered a large mobile communications center to WakeMed Healthcare and Hospital System in North Carolina (Fig. 2). Considered a cutting-edge medical group, WakeMed wants to be ready for another Hurricane Katrina situation or any kind of emergency disaster requiring evacuation. Other major hospitals and medical centers are also concerned about what they will do with their facilities during a disaster.

WakeMed’s massive command center has cutting-edge technical capabilities that are as sophisticated as any found in mobile centers used by law enforcement agencies. It can be used as a backup for communication and data exchange in lieu of a fixed site. With sever-

### VEHICLE MANUFACTURERS

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al hospitals as part of their group, WakeMed will be able to send and receive massive amounts of information from these hospitals to this command center, then relay the data somewhere else where needed. The vehicle includes a large satellite dish for live videoconferencing, considered critical during a major incident. Its high-performance, closed-circuit video camera system can feed real-time information to a fixed site, allowing the recording and documentation of patients evacuated from hospitals into schools or other places. “This was one of the big problems with Katrina,” recalls LaGuardia. “They could get people out but didn’t know what to do with them at the receiving end because there were no records available.”

WakeMed’s new mobile command center is a prime example of how mobile healthcare is really turning a corner. Vehicles are being designed to coordinate patient care in the event of a disaster. There is confidence that these mobile facilities can send and receive medical information quickly and accurately. It is a real application of telemedicine even though people are not receiving medical care directly from the vehicle.

**Disaster as Selling Point**

Mobile health clinic programs are finding that disaster preparedness can make or break them when it comes time to obtain grant funding for their initiatives. “The need to show disaster capability is beneficial when applying for grants,” insists LaGuardia. “The more useful you can make the vehicle, the more likely you are to receive a grant.” When he works with Homeland Security customers, LaGuardia wants them to put specific equipment and specifications into their blueprints right from the start. As part of their proposal, they can now say they have the equipment ready and available in the event of a disaster or emergency.

LaGuardia wants mobile health programs to take the same page from his Homeland Security clients’ playbooks. “If a mobile healthcare unit has satellite or cellular communications capabilities, they will be able to communicate with other agencies around them,” he points out. “The vehicle would have use far beyond basic outreach or healthcare. It could be used to help coordinate medical activity in the event of an emergency.” This is an incentive for administrators to consider putting in telemedicine capabilities when purchasing a new vehicle.

Having witnessed wildfires break out in the San Diego area, George Hayes knows the value mobile health units can have in an emergency situation. As manager of the Whittier Institute for Diabetes Mobile Medical Unit, Hayes has his vehicles primed and ready to go as critical components of disaster teams in the community. “When defining your mobile health program, you must identify its role in business recovery,” he insists. “How can your unit help out in case of an emergency?”

Such applications are becoming more need to have than nice to have. When something is a need to have, then the overall quality of the vehicle is better. Compare this to just a few years ago when people were buying something basic and pretty because they were trying an outreach program. As LaGuardia sees it, the market’s evolution demands an evolution of the product. Take electrical wiring, for example. “In other markets where we are the recognized leader, we have always planned all of our wiring to meet military specification standards,” he says. “We always run our 110 and 220 in conduit or accessible raceways.”

Bringing this type of technology to the medical market ultimately benefits the end user. As technology changes, wiring or electrical requirements will need to be updated. Take the case of mammography units going from analog to digital. This evolution created a bunch of new environmental and overall power draw requirements. For years, the mobile health industry used metal clad conduit, which is not repairable or upgradable. Mobile health organizations that couldn’t rewire easily had to tear out walls and floors to run new wiring. It is now easier to change a wire or replace a switch than trying to redo everything with current designs.

**The Colonias Program**

Juan Hinojosa, Texas State Senator, is a big proponent of mobile health clinics, particularly when they incorporate telemedicine capabilities. His constituents along the Texas and Mexico border benefit directly from the Colonias Telehealth program operated by the University of Texas Health Science Center at Houston (UTHSC-H). “Health outreach programs are extremely important to the border,” says Hinojosa. “Promotoras and the mobile health units are valuable tools in reaching communities that normally don’t receive much-needed healthcare services.”

Just what are the Texas *colonias*, Spanish for “communities”? *Colonias* are the unincorporated, isolated subdivisions along the Texas–Mexico border. All suffer from substandard housing, inadequate plumbing and sewage disposal systems, and poor access to clean water. Adequate solid waste disposal facilities are also lacking. As a result, sanitation and health parameters in the *colonias* are comparable to those seen in underdeveloped countries.

Along the border, health conditions are among the worst in the United States. For example, the diabetes-related death rate in this area is at least 25% greater than the state rate. Hepatitis A and parasitic infections are endemic in the region, acquired mostly from contaminated water. Tuberculosis, dengue fever, and leprosy are just...
three of the third-world diseases plaguing this region. Economically, there is a higher prevalence of border counties having the lowest per-capita income when compared to nonborder counties in the state. Residents of the colonias often have no means of transportation to reach medical care facilities and providers, both of which are in short supply. They also have no insurance. Visiting the doctor means losing time at work and wages, something they cannot afford to do.

The Texas–Mexico Border Health Services Projects were initiated in 1989 to assist with desperately needed medical and dental services, health care professional education, health promotion, and disease prevention. “Already our project has worn out two mobile health clinics,” says Margaret McNeese, M.D., who serves as its medical director as well as the associate dean for the UT Houston Medical School. “Those two vehicles provided services to more than 50,000 Hidalgo and Cameron border residents.” The Texas–Mexico Border Health Services Projects is now on their third mobile health clinic. The vehicle serves the large, rural indigent population in Cameron County. Telemedicine equipment inside the vehicle delivers a total spectrum of healthcare services beyond just basic primary care. The van is self-contained with an examination room, laboratory area, blood collection station, health education room, and patient intake area. Telecommunications link the residents to specialty care at UTHSC-H.

The physician assistant and two medical assistants who staff the mobile health clinic place special importance on glucose and cholesterol screenings. “A major project goal is to prevent diabetes by identifying and educating at-risk clients,” says Paul Toscano, PA. “Our glucose screenings have helped us to diagnose prediabetic conditions in a number of patients.” He and the medical assistants provide health education to these individuals while referring them for follow-up treatment at diabetes clinics.

The team has also been successful in introducing older women to the importance of preventive care. Encouraging them to undergo Pap smear screenings and to perform breast self-examinations is at the forefront of this outreach effort. Toscano and the rest of the crew keep busy providing other services, such as hypertension screenings, pregnancy testing, and treating upper respiratory infections and urinary tract infections.

Another major goal for the mobile health clinic program is medical education of healthcare students and medical residents. This consists of various clinical rotations aboard the vehicle. For example, fourth-year medical students participate in 1-month rotations where they learn how to hone their multicultural communication skills. Other students also take advantage of this unique learning experience. These include third-year medical, nursing, and medical assistant students, as well as nursing faculty.

“Learning the culture of the population being served by mobile health units is critical,” says Brian Quinn, M.A., who is the director of grants and communications for the Friends of the Congressional Glaucoma Caucus Foundation. “Can you be culturally adaptable? Do you understand the primary language and community vernacular?” With multiculturalism becoming so important in healthcare, Quinn believes demonstrating such competencies will increase the chances for funding opportunities. Other important parameters to understand include the daily schedules of the people being served,
community norms, important health behaviors, and assessing their willingness to access mobile care.

**Floating Mobile Clinics in Ecuador**

Taking mobile health solutions to the next level is Ecuador, where boats travel along rivers in South America to provide medical services to local communities. In the Amazonian region, these mobile floating clinics cruise on the Rio Aquarico, Rio Napo, and Rio Morona—major tributaries that connect to the Amazon. The boats have telemedicine links connecting medical experts in Ecuador and around the world through wireless telecommunication connections. “These river boats provide exciting opportunities for cultural exchange and knowledge sharing,” says Dale C. Alverson, M.D., medical director at the Center for Telehealth and Cybermedicine Research in Albuquerque, New Mexico, who spearheads the initiative. “This gives us opportunities for international faculty and student interaction in many disciplines.” Alverson has created formal agreements with the Universidad Tecnologica Equinoccial in Quito, the Ministry of Public Health Ecuador, the University of New Mexico (UNM) School of Medicine, and the Iberoamerican Science, Technology, and Education Consortium (ISTEC). In addition, the Ecuadorian Air Force donates broadband satellite connectivity throughout the country, as well as links to international networks. The telehealth network establishes links between universities in Ecuador and remote communities located in the Ecuadorian jungle, Andes, and the Galapagos.

Medical students from UNM travel to Ecuador to conduct preliminary surveys regarding the health knowledge, attitudes, beliefs, and behaviors of the local people and providers. “One of their efforts resulted in a recent survey related to Chagas disease in the Amazonian region of Ecuador,” says Alverson. He sees telehealth as providing the tools for continued collaborative knowledge sharing, education, and research within Ecuador and other countries. The remote sites serve as “base camps” for ongoing field research, including further investigation related to tropical diseases. Among those under investigation are malaria, dengue fever, leishmaniasis, and others.

The telehealth river boat initiative is catching on with other countries in Latin America. Those expressing keen interest in the project include Mexico, Venezuela, Colombia, Peru, Bolivia, Argentina, and Brazil. Members of the Latin American, Caribbean Chapter of the ATA are helping to get these efforts off the ground. As health problems become more global, Alverson sees such telehealth efforts bridging the distance gap between all countries to address critical health issues. “Using Ecuador as an international model, a platform for student and faculty exchange integrated with telehealth technologies creates a means of maintaining virtual continuity to address important global health issues, education, and research,” he says. Future plans include applying telehealth technologies to create a collaborative knowledge network and address these issues more efficiently. One such program is currently under development with Nepal, Katmandu University, the UNM’s Department of Economics, and the Center for Telehealth and Cybermedicine Research.

—Kevin D. Blanchet