

EDUCATION/HEALTHCARE

University of Kansas WellCar* Drives New Ways to Deliver Healthcare

With the Internet of Things (IoT) and Intel® inside, KU's WellCar* empowers nurse practitioners to bring mobile primary care to rural patients

Fifteen years ago, Gregory Thomas, a graphic designer by profession, was creating bottle labels for a winery. Then, a bout of cancer made him want to do something more meaningful with his life.

Today, Thomas is professor of design and director of the Center for Design Research (CDR) at the University of Kansas (KU). And he's on the forefront of some of healthcare's emerging megatrends, including the rise of the mobile health practitioner and the movement of healthcare services from the hospital or clinic to the community and home.

Working closely with healthcare visionaries and using Intel® technologies for mobile computing and the Internet of Things (IoT), Thomas and CDR students have created a smart vehicle for primary care delivery. Staffed by a health professional such as a nurse practitioner, this demonstration vehicle may hold a key to bringing affordable healthcare services to underserved populations across the United States and around the world.

Design as a Problem-Solving Tool

KU is a public research and teaching institution that offers more than 360 degree programs, attracting students from the 50 states and 105 countries. CDR¹ conducts advanced research that emphasizes the cross-disciplinary use of design as a problem-solving tool. Through these research-based learning projects, students conceptualize and develop new consumer products and services using advanced technologies in diverse subject areas.

After collaborative projects involving Bayer Healthcare and Ford, Thomas saw a convergence of trends—and an exciting opportunity. “Kansas has many counties with few or no healthcare providers, and it can be difficult to bring healthcare to people in rural environments,” he says. “Healthcare is moving toward greater use of nurse practitioners as primary care providers. But if you're living in rural America, and you're sick, you're struggling with a chronic health issue, or you've just been discharged from the hospital, your healthcare options can be very limited. And if you can't drive for several hours to a doctor's office or clinic, they're even worse.”



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Professor of Design,
Director, Center for
Design Research,
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At a Glance

Project

- Engage students in developing a demonstration vehicle to help address the shortage of healthcare providers in rural Kansas

Accomplishments

- Developed the WellCar*, a medically adapted vehicle that empowers nurse practitioners to deliver primary care through house calls to homebound and post-discharge patients

Lessons Learned

- **Recognize the power of research-based learning.** Use research projects to prepare students for real-world success, forge relationships with industry innovators, and enhance economic growth.
- **Solve real problems.** Develop user-centric designs that meet the needs of people who will use or benefit from the solution. Collaborate with systems thinkers, clinical practitioners, designers, and technology experts to develop creative solutions.
- **Implement a flexible technology framework.** "Technology is advancing so rapidly that even leading-edge technologies will be outdated in months," says Gregory Thomas. "We designed the WellCar to have an open, flexible architecture so we can keep upgrading them and incorporating new approaches."

Thomas believed advances in medical and information technologies, placed in the hands of nurse practitioners, might be able to expand those options. "We're seeing huge progress in the miniaturization of medical devices—diagnostics equipment that used to occupy half a room now fits into a shoebox," Thomas says. "At the same time, mobile computing and communications technologies are becoming more robust and prevalent."

Thomas was familiar with efforts to bring health-oriented products and applications into the car. "At some point, it all came together," recalls Thomas. "We started to think, 'Why can't we bundle all this equipment, use it to support the nurse practitioner, and take it out to rural areas?'"

The eventual answer was, "We can." The result is the WellCar*. And its impact may touch lives everywhere from the inner-city neighborhoods of America to villages in Botswana.

House Calls with a Modern Twist

From ambulances to bloodmobiles, medically adapted vehicles have been around for years. Thomas's vision was to bring back the house calls that the World War II generation remembers, but with a mobile medical office replacing the physician's iconic black bag. Under Thomas's leadership, the vision advanced to a working prototype vehicle aimed at enabling nurse practitioners to deliver primary care services to rural patients.

Nurses and other health professionals were quick to see the impact that mobile, primary-care nurse practitioners could have in rural communities. Debbie Gregory, a registered nurse and co-founder of the Nursing Institute for Healthcare Design, was one of the first to get involved with the CDR project. As a board member of NXT Health, Gregory is a leader in designing next-generation patient experiences, wherever they occur. She advised Thomas and his students throughout the project on both clinical care and design issues. She and Thomas also created a paper describing the need for a solution such as the WellCar and showing how it might enhance rural healthcare.²

Dr. Aenor Sawyer, medical director of WellCar and associate director of strategic relations at the University of California, San Francisco (UCSF) Center for Digital Health Innovation (CDHI), took a personal interest in the WellCar. As an orthopedist, Sawyer often transfers patients to home care, and at CDHI she's leading efforts to build out a next-generation model for highly distributed healthcare. Closer to the heart, she cared for her father at home for 10 years, and has a passion for developing innovative, home-based services.

“The Toughpad, with the Intel® Core™ vPro™ processor, is the brains of the WellCar*—the workhorse, very fast and durable....We looked at a ton of computers and narrowed our choice to the ones that could securely handle the heavy data and performance requirements, as well as take the hits of being on the road and being carried in and out of patients’ homes.”*

Gregory Thomas,
Professor of Design,
Director, Center for Design Research,
University of Kansas

Guided by the input they received as they worked with Sawyer, Gregory, and other healthcare leaders, Thomas and students from his Topics in Design class created a user-centered model of needed capabilities and likely workflows. Then, the student teams turned to medical equipment companies and IT leaders to explore ways technologies could support their functional requirements. Students designed the interior of the van, developed specifications for installing and integrating the equipment, solicited investors, and presented their results at conferences, among other tasks. The KU Medical Center, KU Transportation Research Institute, and other organizations also provided support or input.

Technology-Rich, But 'It's Not About Technology'

The WellCar aims to give nurse practitioners the equipment to handle before- and after-visit tasks, as well as to take into a patient's home for hands-on care. Working with their clinical consultants, the team envisioned helping the nurse with everything from finding the home to reviewing the patient's health history, performing diagnostic procedures, documenting care, securely transmitting results, and providing patient education. They pictured the nurse needing to consult with remote experts, coordinate with an extended care team, and interface with in-home health monitoring equipment that

patients might be using to manage chronic health conditions. Knowing Kansas's propensity for tornadoes, they wanted to keep the nurse informed of weather activity.

“Rural Kansans are an independent sort,” says Gordon Alloway, formerly the project director of Heartland Telehealth Resource Center (HTRC) and now a consultant specializing in rural health access. “How can we help them stay healthy and keep them living at home when their health starts to fail?”

The WellCar takes a new approach to an old concept.”

The WellCar team created a sophisticated, technology-rich environment to help flesh out that concept. But Thomas is a strong proponent of user-centric design. He and his students relied on clinician inputs throughout the project. “The WellCar isn't about technology,” Thomas says. “It's about compassion. Technology is essential, but it's there to empower the nurse and serve the patient.”



Industry Enthusiasm

Collaboration with private-sector innovators has been essential to creating the WellCar. Ford donated a new Ford Transit Connect Wagon*, a compact vehicle whose cargo capacity and maneuverability matched the team's objectives. A number of medical instrument companies offered compact medical devices for use in the WellCar or for patients to use at home to monitor and improve their health. Philips's hospital-to-home program donated telemonitoring equipment for home use. HealthSTATS International provided an in-home wearable device to help patients better manage their blood pressure. Noble International provided its AsthmaMD*, a tool to help asthma patients monitor their symptoms and for researchers to correlate symptoms with environmental and other events.

Vidyo has shared its telehealth and telemedicine remote conferencing capability. Voalte offered a smart phone system for secure collaboration among the care team. Sprint provided a mobile Wi-Fi hotspot for the WellCar and

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Kent DiasAbeygunawardena,
KU Graduate in Industrial Design

worked with students to optimize coverage in isolated areas of Kansas. Midland Radio has provided two-way weather-alert radios and wearable XTC* video cameras.

Thomas says many companies signed on because they saw the promise of the WellCar, but he was especially excited when he connected with the Intel Health and Life Sciences team. “From the beginning, we wanted to have Intel involved,” he remembers. “Intel is the company that enables most new technology to happen. Their validation meant a lot. They've given us practical assistance, shown us some of the

technologies we might be needing, and given us a broader understanding of where technology is headed. We've got a lot of Intel technologies inside the WellCar itself.”

Workhorse: Panasonic Toughpad* with the Intel® Core™ i5 Processor

Two solutions built around Intel technologies are key to empowering the nurse practitioner. One is a Panasonic Toughpad* tablet powered by the Intel® Core™ i5 vPro™ processor, which the nurse will use to securely access vital data both in the vehicle and in the patient's home. The Intel Core processor provides the performance to run the nurse's healthcare applications, and Intel® vPro™ technology contains features to enhance remote management and security.

“The Toughpad, with the Intel Core vPro processor, is the brains of the WellCar—the workhorse, very fast and durable,” says Thomas. “In addition to containing the patient health information, it will provide access to expert systems and databases, communicate with hospitals and clinics, send and receive diagnostics, and incorporate live, interactive videoconferencing technology. Its importance is huge. We looked at a ton of computers and narrowed our choice to the ones that could securely handle the heavy data and performance requirements, as well as take the hits of being on the road and being carried in and out of patients' homes.”



Communications Engine Based on Intel® IoT Gateway

The second solution is a custom communications platform being created by Cornerstone Integration. Built around the Intel® IoT Gateway with the Intel® Quark™ SoC X1020D, the Cornerstone platform aims to provide a secure, embedded IoT engine for the WellCar.

The Intel IoT Gateway combines technologies for networking, embedded control, enterprise-grade security, and device management. It also includes standards-based interfaces for I/O, cellular, and Wi-Fi to simplify communications down to sensors and controllers as well as up to data centers and private clouds.

“Cornerstone’s work will integrate the applications, communications, security, and remote management tools to minimize the WellCar’s operations costs and maximize security, performance, and availability,” Thomas says. “The Cornerstone platform will act as a conduit for all communications, data, and devices. The goal is for every bit of data generated—whether it’s a diagnostics sample to be analyzed or a prescription to be submitted from the Toughpad—to go through the Cornerstone platform. It will be the WellCar’s conduit between the patient’s home and the hospital, clinic, or lab.” With the Wi-Fi and Bluetooth* communications, nurses can carry a minimal amount of testing equipment into the home and connect through the Toughpad to the WellCar sitting in the driveway.

Putting Research on the Road

With the design phase wrapping up, CDR is collaborating with healthcare organizations such as UCSF to plan for proof-of-concept or pilot programs. UCSF has an active house calls program providing primary care to homebound elders, and its CDHI has provided input on clinical requirements throughout the WellCar project.

Now, CDHI and CDR are mapping a plan to collaborate on finalizing and testing the WellCar’s functionality, adding people and process to the technology solution and researching diverse use cases. While rural health will remain a focus, they see potential use in urban neighborhoods, global settings, and disaster areas.

A collaboration between the University of Pennsylvania and the Government of Botswana is exploring the use of the WellCar to increase access to healthcare services in the African nation.

Other interested organizations include the Midwest Cancer Alliance and the ALS Association Mid-America Chapter. These groups see the WellCar as a possible way to improve support for patients with cancer and ALS, respectively, as well as to extend clinical trials beyond the point when patients are discharged from the hospital.

Healthcare at the Point of Life

The common thread for many WellCar scenarios is what Dr. Sawyer calls healthcare at the point of life.

Key Technologies

- Ford Transit Connect Wagon*
- Panasonic Toughpad* MB5025 with the Intel® Core™ i5-3437U vPro™ processor and Windows* 10 Professional (prerelease software)
- Custom communications system developed by Cornerstone Integration and based on Intel® IoT Gateway and the Intel® Quark™ SoC X1020D
- Diverse medical and other equipment

“Healthcare is moving to a more highly distributed model of care, bringing care to where people are living their lives,” she explains. “The point of care is intersecting with where your life is actually happening. The WellCar can play an important role by enabling us to provide a higher level of clinical services in a nonclinical setting. Patients can be assessed and treated in their current locations and supported with point-of-life diagnostics, communication, and education. We’re empowering them to take better care of their own health in their current setting.”



Alloway says diverse organizations may find a strong business case for the WellCar. "Organizations that are innovators in healthcare, as well as those involved in mobile health or rural health, will be very interested in the WellCar," he says. "An organization that's reimbursed for the patient's overall health and wellness may find in the WellCar a platform to deliver and manage care to the home more effectively and cost-effectively than their current approaches. If they can use the WellCar to improve follow-up care after hospitalization, they may find the WellCar pays for itself very quickly by reducing readmissions."

Educational Impact

As for Thomas's students, their lives have already been affected by the WellCar. Emma Murano and Kent DiasAbeygunawardena, both May 2014 graduates in Industrial Design, say their work on the WellCar was among their most impactful educational experiences. Both are now employed as human factors verification and validation engineers with a leading global healthcare company.

"Working on the WellCar provided real-world experience around a life-changing product," reports Murano. "I gained networking connections, business knowledge, healthcare education, and a sense of true purpose behind getting my education. Even though I've moved on into the workforce, the WellCar is a project I hold close to my heart."

I have family members in rural areas of Kansas who could use this advancement in the healthcare industry today."

Along with practical skills, the students gained the satisfaction of doing important work. "This type of healthcare service will be a critical step in providing essential alternatives to the traditional brick-and-mortar model," says DiasAbeygunawardena. "With the Affordable Care Act, there are openings and demands for new solutions for providing mobile and effective healthcare to everyone—urban, rural, and otherwise. Personalized healthcare is the future and there isn't much that's more personalized than having your healthcare practitioner setting up shop in your living room."



¹ CDR operates under the auspices of the KU School of Architecture, Design, and Planning.

² See Delivering Healthcare in the Mobile Environment, 2013, at www.cdr.ku.edu.

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