

# A technology and nursing collaboration to help older adults age in place

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**This is an account of an active collaboration between Computer Engineering, Health Informatics, and Nursing within an academic health science center to improve the quality of life of older adults as they “age in place.” The Sinclair School of Nursing at the University of Missouri-Columbia has developed a licensed home health agency, Senior Care, to provide the care needed by residents of TigerPlace, a specially designed independent living center near the University. Technology has the potential to help address common problems encountered by older adults related to functional decline. Collaboration between Nursing, Computer Engineering, and Health Informatics is likely on a path to improve the quality of life of seniors.**

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Helping older adults remain independent in the setting of their choice is a complex, multifactor endeavor. Although nurses are uniquely well-prepared to help, the chronic health problems and needs of older adults are better addressed from multiple perspectives. Technology offers creative options that mainstream healthcare often fails to consider. This is an account of an active collaboration between Computer Engineering, Health Informatics, and Nursing within an academic health science center to improve the quality of life of older adults as they “age in place.” Suggestions for replicating such collaboration in other health sciences center are outlined.

## “AGING IN PLACE” PROJECT

At the 1996 Academy of Nursing meeting, several faculty and the dean of the University of Missouri-Columbia (MU) Sinclair School of Nursing (SSON) began to imagine a new model of long-term care for older adults. Several faculty at the SSON had worked in long-term care, had active research programs focused on improving care to older adults, and many had a desire to see things done differently.<sup>1</sup> Elders participating in faculty research projects about aging services consistently related how they wanted to stay at home as long as possible and feared moving to a nursing home.<sup>2,3</sup> Based on the lessons learned from several community-based service models of nursing case management,<sup>4,5,6,7</sup> and from early demonstrations for nursing home diversion programs,<sup>8,9</sup> faculty believed that with the right supportive and restorative services it would be possible to help older adults improve their health and well-being, with most avoiding the need for traditional nursing home care. With that vision, the “Aging in Place” Project began, where seniors would be able to “age in place, in the home environment of their choice, with supportive health care services as needed.” The Aging in Place project has 2 major complementary parts: Senior Care and TigerPlace.

## SENIOR CARE AND TIGERPLACE

In 1999, Senior Care was created as a department within the SSON. Senior Care is a licensed, Medicare-certified home health agency and an in-home provider of supportive services that is funded through a state community-based long-term care program and private-pay services. From the outset, Senior Care was designed to provide community-based care to the residents of TigerPlace (a state-of-the-art senior independent living and care option) and residents of other private congregate senior housing, public senior housing, and private homes of community-dwelling seniors in Boone County, Missouri. The SSON obtained a \$2 million grant from the federal Centers for Medicare and Medicaid (CMS) to build the infrastructure for Senior Care and to evaluate the effectiveness of the Aging in Place model of care.<sup>10</sup>

To promote independence for frail older adults, the Aging in Place model includes an environmental component as well as health and supportive services.<sup>11</sup> TigerPlace was designed to provide that environmental component. The Americare Corporation of Sikeston, Missouri, in collaboration with the SSON, designed TigerPlace, a senior-living community that was opened in mid 2004 just a few miles from the MU campus. TigerPlace is designed to promote the independence of older adults. Nurses, physical therapists, occupational therapists, and specialists in environmental design participated in the building plan. TigerPlace is located on about 6 acres of land adjacent to other Americare facilities. Construction began in spring 2003 for Phase 1 of TigerPlace, a 34,000 square foot development of 33 apartment units. Additional apartment units will be constructed in Phases 2 and 3, as demand and service use is demonstrated for the project.

A central feature of TigerPlace is a wellness center that is operated by Senior Care where there is ongoing assessment of resident needs and health-promotion activities, including exercise and health classes, to help residents remain active and vital. Senior Care provides an array of home care services such as medication management, assistance with activities of daily living, and care-coordination of health conditions with residents' physicians and other health care providers. Senior Care also provides Medicare home health care when residents need and qualify for that service.

Pets are welcome at TigerPlace. Plans are for residents to bring their family pets and the building is designed to be "pet friendly." For example, each apartment has an exterior door (for easy outdoor access), screened porches, and wide windowsills for cats to enjoy. Furthermore, the building has a veterinary exam room where pets may have regular health care and treatment by students and faculty of the MU College of Veterinary Medicine. Services also are available for

individuals who require additional help in caring for their pets.

Other MU activities are accommodated in spaces that include a large community room, exercise room, wellness center, clinic space for resident use with health care providers, and office space for Senior Care. Space is multipurpose and MU faculty and students share education, research, and practice activities with the residents of TigerPlace.

## GOALS AND ADVANTAGES OF AGING IN PLACE PROJECT

The primary goals are to design and implement exciting research, education, and practice opportunities at Senior Care and TigerPlace while integrating TigerPlace into the MU campus and the Columbia community. There are many advantages for the Aging in Place Project. Advantages for residents include ongoing assessment, early illness recognition, and health promotion activities, all within a well-designed housing environment that will help older people stay healthier and active longer, avoid expensive and debilitating hospitalizations, and for most residents, avoid relocation to a nursing home.

Advantages for MU include a venue for interdisciplinary research to improve the lives of older people that combines an exciting wellness-focused nursing practice (Senior Care) with a creatively designed environment (TigerPlace), innovative educational opportunities for students across all colleges and schools, and an ideal practice environment for health care providers of the future to create and implement better ways of caring for older people. Additionally, there are advantages for public policy makers as Senior Care and TigerPlace bring together the research, education, and practice skills of MU faculty so that complex cost-effectiveness and elder outcome questions can be answered to guide public policy decisions about services for older people such as those funded by Medicare or Medicaid.

## TECHNOLOGY AND SENIOR CARE

The initial collaboration with Computer Engineering focused on the challenge of helping clients of Senior Care services consistently take their medications. Senior Care has now served more than 1500 older adults in the community, public, and private housing developments. A major problem encountered in the services is medication management by the clients. With comprehensive assessment by the nurses and close communication with physicians, prescribing an optimal medication regimen for clients is attainable. What Senior Care staff found to be missing was a cost-effective way to measure that clients have actually taken prescribed medications consistently at the correct times.

The Director of Senior Care approached the Computer Engineering faculty with the problem. Several

faculty enthusiastically responded and designed a capstone project for undergraduate engineering students to create a sensing mechanism that is incorporated into a medication planner to assess medication compliance. Both Electrical and Computer Engineering students chose this project for their capstone course, a final course in their plan of study that culminates the baccalaureate degree. The students designed and constructed a microprocessor system that will identify the times at which medicines are taken from a standard 28-bin medication box. The students used a microprocessor to read and store the time data. The microprocessor records the time and date at which each medicine compartment is opened. Although pilot testing is not complete at this time, the plan is for Senior Care nurses, on their weekly visit to clients, to download the data into their laptops, refill the medications and reset the medication assessment system. By interpreting the times the medication compartments are opened, the nurse can assess how closely the client is adhering to the plan for medication administration. The nurse can detect clients who are having difficulty taking medications according to the plan; more advanced (and expensive) computerized medication dispensing machines can then be installed.

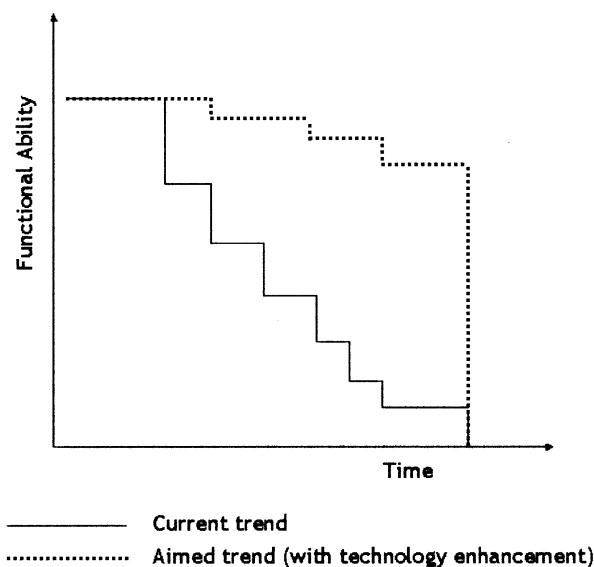
Both students and staff have benefited from this successful capstone project, with students gaining real world experience in solving problems for older people, and staff gaining experience with the unique approaches of engineering students, so that persistent clinical problems can benefit from new perspectives. Clients are better served with an inexpensive assessment of medication plan-adherence and those needing more expensive medication-dispensing systems can get them when needed, but not unnecessarily.

## TECHNOLOGY TO SUPPORT AGING IN PLACE

Key to the concept of Aging in Place is creating an environment that supports independence in older adults. A group of faculty from nursing, computer engineering, and health informatics was initiated to brainstorm and plan how computer-supported technology could be incorporated into the TigerPlace environment to promote aging in place and improve or maintain functional ability. One result of a brainstorming session is illustrated in Figure 1. The solid line illustrates the typical trajectory of functional decline based on research and practice with older adults. The typical trajectory includes plateaus where no measurable decline occurs and precipitous step-downs illustrating functional decline. The aimed trend with technology enhancement envisioned by the group (illustrated by the dotted line) should extend the length of the plateaus and reduce the depth of the steps.

With consensus on a goal of using technology to minimize functional decline and maintain the same

Trajectory of functional decline and goal for the use of technology



**Figure 1.** Trajectory of functional decline and goal for the use of technology.

degree of function for a longer period of time, the engineering faculty challenged the nurses, “What are the major problems of older adults and the nurses who help them?” The nursing faculty on the team, experienced in Senior Care and long-term care facilities, listed the most common things encountered in care of elders: falls (or fear of falling), urinary incontinence, sight and hearing loss, reduced mobility and strength, social isolation, cognitive impairment, and difficulty managing medications. The engineering faculty began generating ideas and asking more questions about the problems listed. Within a few months, the group generated many ideas that resulted in submitting grant applications to the National Institutes for Health, National Science Foundation, and MU Research Board about the development and use of technology to address functional decline and the resulting problems faced by elders as they age. What began as a planning group to consider how technology could promote aging in place, resulted in an active collaborative research team generating grant applications and conducting pilot work about the feasibility of research ideas.

It is important to consider that technology is available almost everywhere. This country and many others in the world have an immense capability to develop a large amount of technology. The question is not how to design technology, but what technology to use, how to use the technology, and how appropriate technology is in particular situations. Most importantly, will it work? That is, will it satisfy the goal of helping older adults to safely stay in the home of their choice? This identifies a fundamental need for assessment, evaluation, and

measurement of the technology. The response of the technology itself must be measured to determine that it operates properly. Furthermore, the effect on the resident must be measured to determine whether the resident receiving or using the technology benefits from the technology.

## TECHNOLOGY AT TIGERPLACE

For TigerPlace, a flexible technology infrastructure is being implemented to identify individual risk factors for functional decline and deal with those most relevant to each individual resident. Our basic plan is that sensors be connected to small computers with wireless links to produce a sensor network. The sensors allow us to sense weight on a mat, measure motion and proximity, hear calls and perform a variety of physiological measurements. Each element in the sensor network communicates wirelessly to a personal computer in each resident's living area. The sensors measure the outcomes of the risk factors and, hence, by changing sensors, different risk factors can be assessed. The flexibility of the sensors will allow us to adapt individualized combinations of risk factors as well as changing risk factors for individual residents, such as falls or problems with gait and mobility. The sensor data are transmitted into a personal computer in each resident's living area; that computer is, in turn, wired to a larger server in which all residents' personal computers are connected. The server provides a means to store the data and compare incoming data to preprogrammed parameters of urgency. Input that is outside of each resident's individually programmed parameter will immediately alert care-giving staff of potential problems.

Due to its clinical focus, the TigerPlace project encompasses a broader approach to individualized technology than that of the "smart home" concept which is an emerging trend in health informatics. Smart home features usually include motion-sensing devices for automatic lighting control, motorized locks, door and window openers, motorized blinds and curtains,<sup>12</sup> smoke and gas detectors, and temperature control devices. Such an infrastructure is designed to address some of the neurological and cognitive problems in the elderly, and enhance their ability to function independently within their residence. Smart home initiatives include the SmartBo project,<sup>12</sup> a demonstration apartment operated by the Swedish Handicap Institute; the PROSAFE project<sup>13</sup> that utilizes a set of infrared motion sensors connected to either a wireless or wired network to support automatic recognition of resident activity to accommodate patients with Alzheimer's disease; and the Aware Home Research Initiative (AHRI) at Georgia Institute of Technology that aims to enhance the quality of life of senior citizens and help them maintain independence while staying at home.<sup>14</sup> The TigerPlace initiative will build on the smart home technology and move beyond it with individualized

clinical nursing assessment for risks of functional decline and alerting mechanisms of the need for intervention.

## PILOT WORK IN PROGRESS

As the first grant application was being written, questions arose in the research team about the willingness of older adults to accept and use technology. To address these issues and better inform the proposed research in the application, the research team planned and conducted 3 focus groups with 15 seniors in a continuing care retirement community near MU.<sup>15</sup> The seniors were articulate and helpful. Several were enthusiastic about the current role of technology in their lives. Surprisingly, 66% of the participants in the groups used email to keep in touch with friends and family and "surfing the Internet."

In addition, a substantial minority (26%) made use of advanced software applications, such as image processing software and financial organizers. One visually impaired resident used a computerized optical device to magnify printed materials and to read text aloud.

Participants expressed concerns about several of the risk factors the research team identified as important clinical issues such as falls, mobility, isolation, and sensory impairments. The participants raised a number of additional issues, such as security of their residence and reminder systems that they would find helpful. The pilot study revealed that participants were not only willing to accept technology interventions, but were willing to have the technology installed in their homes if it is reliable, can detect a range of emergencies, requires minimum action by the user, is affordable, and is not intrusive. The insights from the pilot study were used in the design of technology for TigerPlace and for the proposed research applications written by the team.

The team is conducting other work in 2 areas that will benefit TigerPlace and the Aging in Place Project while awaiting review of the research applications. First, the Computer Engineering faculty is developing a communication microprocessor that will read sensor data and transmit it to the personal computer. In this project, the microprocessor-to-microprocessor communication protocol is being developed and inter-processor communication is being demonstrated. This sensor network will be expected to access several microprocessors, each with its own set of sensors, and eventually transmit that data into the resident's personal computer. Work is also underway to determine the range of transmission and possible bit error rate in transmissions.

The second area of work is in the field of robotics and automation. It is becoming increasingly clear that people are comforted by artificially intelligent entities, as evidenced by the computerized medication dispensing machines that Senior Care is using successfully in private and public housing. The dispensing machines have a voice recording to remind people to take their

medication. Often, users talk to the machine and some have even named their machine. These devices and other automated devices appear to be providing useful interventions to help those with disabling conditions.<sup>16,17,18</sup> Automated devices are not a substitute for social interaction with real people; however, they can be used to augment real social interaction and provide useful services. For example, a person may speak to a robotic device and give it commands with some emotional attachment, and benefit from the interaction. One SSON study currently underway is investigating the effect of robotic pets on the elderly (eg, studying the physiological effects of a pet as a companion and comparing the effects of these artificial pets with effects received from real animals).<sup>19</sup>

The research team is examining robotic devices as a way of providing information to elders in a warm, positive way. There are plans to include a robotic “buddy” in TigerPlace that will introduce residents to a database of activities and services, as well as the use of technology in general. Tiger Buddy is envisioned as a friendly, information kiosk that is available on demand, without the residents feeling like they are a bother to a staff worker. The Tiger Buddy is always there and will continuously answer even repetitive queries in a cheerful and helpful manner. It is anticipated that the Tiger Buddy will help draw the residents together and thus, to a degree, address social isolation by helping to facilitate group activities and even giving the residents something to talk about.

## REPLICATION OF COLLABORATIONS WITH SCHOOLS OF NURSING

What has been experienced in the TigerPlace and Aging in Place Project is replicable in other universities. The ingredients needed are faculty willing to reach out and ask for help from non-traditional health-related schools. Nurses frequently collaborate with faculty from other health professions schools such as medicine, physical therapy, psychology, or social work. Faculty need to take a step beyond the traditional and look for those who are willing and eager to experience the “real world” of health care, but who are not traditionally included in the schools of health professions. If developing interdisciplinary research about aging is of interest, talk to colleagues in other schools about their experiences with older adults; almost every person has had some experiences with older people and most have ideas about how their expertise could be of help to address the problems of aging. Using this personal connection to begin the collaboration and move to building on each discipline’s expertise is very effective.

Interdisciplinary research teams take time and nurturing. Faculty need time to learn about each other’s unique language and perspectives about research. It is helpful to start with a common problem of wide interest (for the SSON that was research about aging). Encour-

age creative research ideas and the development of grant applications, persistence with the grant application process, and provide positive recognition for interdisciplinary efforts. Members of the research team from Computer Engineering and Health Informatics have recently received faculty appointments in the SSON. Such appointments across schools and colleges encourage and recognize interdisciplinary team efforts.

## A BRIGHT FUTURE

Active collaboration between MU and the corporate partner for TigerPlace is providing an exciting present and very promising future. As TigerPlace becomes a reality, the work of interdisciplinary teams will be very important to the quality of life for the residents. Addressing the complex issues of aging requires many researchers from multiple perspectives. Active collaboration is also enriching the lives of researchers who are learning and challenging each other to stretch beyond their usual circle of discipline-similar colleagues to develop new and creative solutions to complex problems of aging.

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