

# Cook County Health and Hospitals System Computer Assisted Quality of Life and Symptom Assessment of Complex Patients

INTERVIEWEE: William Trick, MD; Francisco Angulo, IT Director for the Department of Medicine

## Summary

Cook County Health and Hospitals System in Illinois developed software for the Computer Assisted Quality of Life and Symptom Assessment of Complex Patients Program, which works to streamline and automate the patient intake process in the clinical setting. To build the software, physicians were surveyed on what information would be most useful to ask their patients before their health care visits.

The survey asks about quality of life, symptom burden, tobacco use, and patient satisfaction. Once patients complete the survey, program staff can use these responses to guide their care management decisions and administrators can evaluate their patients' needs. The program's goal is to identify patients who are doing poorly or whose clinical condition is deteriorating and to provide these patients the opportunity to be seen in the Advanced Illness Management Clinic.

In one and a half years, Cook County has used this software with more than 3,000 patients.

## Patient Identification

### Inclusion Criteria

All adult Spanish- or English-speaking clinic patients are eligible to use the audio computer-assisted self-interview (ACASI) software system. Those who have moderate to severe cognitive impairment can have a family member assist them.

### Data Sources and Tools Used

Patients must first complete their usual clinic registration process, which creates patient- and visit-specific bar-code labels. One bar-code label is placed on an index card, which the patient scans with a scanner attached to a touch-screen kiosk. The visit number prompts the software to pull demographic information from the electronic health record (EHR) system that was collected using a real-time HL7 interface. The patient confirms their identity to begin the survey.



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## Ongoing Data Collection Methods

The ACASI software system standardizes the intake process. The information captured by the program is joined to a data warehouse that contains patient visit history, ADT information, laboratory data, pharmacy information, and radiology results.

## Assessment

### Tools Used

The ACASI clinic software was developed internally by a team based in the Cook County Health and Hospitals System.

### Assessment Elements

The patient survey covers questions about quality of life, symptom burden (using the Memorial Symptom Assessment Scale), tobacco use, partner violence, patient satisfaction, and depression assessment (PHQ-9 or PHQ-2).

### Timing and Location

The survey is taken prior to being seen by the physician in the hospital outpatient or general medicine clinic.

## Care Management Team

### Team Composition

The primary point of contact for the patient is the clinic nurse, who works closely with other clinic staff members.

### Team Roles and Education

The following roles are proposed, as the process to date has required assistance from research staff:

- Clerk — Prints visit label and affixes the label to an index card, and directs the patient to a kiosk
- Triage nurse — Receives printout of responses and places the paper copy in patient's chart
- Smoking cessation specialist — Receives list of current smokers interested in smoking cessation and begins phone intervention
- Registered nurse — Provides guidance on symptom relief

- Physician — Uses symptom burden to guide care management

## PCP Involvement

Once the survey has been completed, a paper copy of the results is printed at the nurse's station. The nurse places a copy into the primary care physician's (PCP) folder for review prior to visiting with the patient.

## Shared Management

The program offers comanagement with smoking cessation specialists who counsel patients on smoking cessation. The clinic is not staffed for comanagement of patients whose assessment suggests depression.

## Ongoing Care

### Caseload

The program has four kiosks installed. Each interview takes approximately 10 minutes. Up to 16 patients can be processed each hour.

### Frequency

Patients are directed to a kiosk each time they visit the clinic. The software does not repeat certain questions if the visit takes place within a specified time range from the previous visit.

### Services

The PCP reviews and discusses survey results with the patient. In addition, triggers in the software alert health professionals other than the patient's PCP. For example, if patients indicate that they are a smoker and are willing to quit, the survey is sent to a smoking cessation specialist, who will guide them through the smoking cessation process.

## Care Transitions Support

The program piloted an assessment of hospital patients using portable devices for the ACASI system. Patients who had a high symptom burden at the time of discharge were referred to the Advanced Illness Management Clinic.

## Outcomes

### Results

In one and a half years, Cook County has used this software with more than 3,000 patients.

Patients who had a high comorbidity burden were not the same patients who had a poor quality of life. A patient's symptom burden was found to be more closely correlated with quality of life.

### Ongoing Measures for QI

The program can track patients' symptom burden and quality of life over time, both in aggregate and at the level of the patient. The program also can track patients who report symptoms commonly associated with specific medications.

### Evolution of Program

The program has tested a variety of scanners for patient usability. To minimize disruption of workflow in the clinic, the program prioritized patients to participate in the survey. Patients who were about to be seen by their provider were not given the interview because providers did not want to delay the visit.

### Lessons Learned

One of the challenges of the program has been that the survey process slows patient intake at clinics. Clinic nurses have expressed frustration in their ability to get patients quickly triaged and into the physician's office.

Another challenge is providing an option for patients to complete the survey prior to their clinic appointment via telephone or online; many patients do not have access to the Internet and many do not provide accurate contact information to clinic staff.

## Costs

The major cost for the program was in ACASI software development. Additional costs included the purchase of the touch-screen kiosks, printer installation, and kiosk cabinetry. While the program used an existing data warehouse, personnel time to create tables for efficient data transfer had to be paid for by the program.

## Technology/Innovation

### Technology Enablers

A large data warehouse collects data from EHRs for the program. Data are streamed through HL7 messages and daily batch uploads, and then processed and maintained in the program's research and QI data warehouse.

### Future Direction

Program leaders plan to add the ASSIST for Substance Dependence, a screening test, to the survey software. The software is amenable to use outside of the hospital, but this would require the appropriate bandwidth to operate efficiently.

The ultimate goal of this program is to develop the survey software into a tool that can be used to identify high-risk patients. Another goal is to incorporate response-driven patient education into the screening system.

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**Author:** Medimetrix

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## University of Missouri TigerPlace

INTERVIEWEE: Marilyn Rantz, PhD, RN, FAAN

### Summary

Sinclair Home Care was created as a department within the University of Missouri's Sinclair School of Nursing (MUSSON). It is a licensed home care agency that provides community-based care to residents of TigerPlace and Lenoir Woods, apartment-style senior residences, to support the aging-in-place (AIP) program. The Centers for Medicare and Medicaid (CMS) provided a \$2 million grant to start the agency and to evaluate clinical outcomes of AIP. From its creation in 1999, the agency was designed to serve older adults and to provide services to TigerPlace. Profits earned from Sinclair Home Care support the ongoing development of AIP services and student educational and research experiences at TigerPlace.

The MU team has successfully developed and tested sensor networks, which were installed in the TigerPlace apartments in the fall of 2005. The suite of sensors includes motion sensors, chair pads, a stove sensor, and a bed sensor that capture residents' restlessness, pulse rates, and respiration rates. The MU team developed an integrated intelligent monitoring system that reliably captures data about the residents and their environments in a noninvasive manner and balances residents' needs of health and safety and privacy.

### Patient Identification

#### Inclusion Criteria

Residents of TigerPlace must be 55 or older and function independently when they move into the facility. All residents of TigerPlace receive basic care from the Sinclair Home Care AIP program, including routine assessments. Residents may pay privately for additional services, such as personal care or medication management.

#### Data Sources and Tools Used

Potential residents of TigerPlace self-select to move into the independent apartment-style living facility that has special state designation for residents to age in place through the end of life in their apartments. The housing administrator typically interviews most people first when they make initial and follow-up contacts during decisionmaking. A registered nurse (RN) care



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coordinator interviews potential residents before they move in to begin the assessment process for care and service needs. Potential residents are interviewed to assess desire for independence and openness for health promotion.

## Assessment

### Tools Used

TigerPlace residents receive a comprehensive health assessment by an RN upon admission.

### Assessment Elements

The health assessment includes:

- Physical assessment
- Minimum data set
- Geriatric depression scale
- Mini-mental state exam
- Fall risk assessment
- SF-12 health survey
- Review of current medications
- Activities of daily living
- Independent activities of daily living
- Social history
- Evaluation of elopement risk

These assessments are completed every six months for all residents and more frequently if using long term care insurance or hospice, or with changes in health status.

## Care Management Team

### Team Composition

The RN care coordinator is the primary point of contact for patients. Personal care attendants and nursing staff also are available to assist patients with daily care needs. The RN care coordinator works collaboratively with each resident's primary care provider for medical management, as needed. The care management is led by the RN care coordinator working

collaboratively with social work, rehabilitation, and other specialists.

The project involves the diverse talents of many different academic disciplines, including:

- Nursing
- Electrical and computer engineering
- Social work
- Physical therapy
- Occupational therapy
- Medicine
- Environmental design
- Landscape architecture
- Health informatics
- Business

An interdisciplinary group of nurses, physical therapists, occupational therapists, environmental design specialists, and other experts in gerontology were involved in the design of TigerPlace to ensure a supportive environment for residents. In addition, faculty from computer engineering participated in the building planning to ensure that the infrastructure would support technological advances.

### Team Roles and Education

Americare Corporation of Sikeston, Missouri, made the investment to build TigerPlace in 2004, with additions in 2008 and 2011. Americare staff are responsible for maintenance, housekeeping, transportation, social activities, and dining services.

MUSSON made the investment to develop Sinclair Home Care, a home health agency that first delivered AIP services in the community (1999 to 2006) and then in TigerPlace (2004 to present).

Sinclair Home Care staff are employees of MUSSON and are responsible for health care services, health promotion

activities, and an exercise program. Sinclair Home Care staff also link residents with MU faculty and students as well as to the numerous recreational and educational activities at MU. The contribution of these multiple partners is marketed to prospective residents and is an important factor for residents and their families when choosing TigerPlace.

MU business and engineering students have collaborated to develop new products for older adults. For example, students designed a walker with automatic breaks. Horticultural students have designed individual gardens for residents and a courtyard feature. Nursing students interview older adults, participate in designing social activities, and do weekly foot care and massage to learn assessment and communication skills with older people. Occupational therapy students apply their massage techniques, a service the residents truly enjoy. Students from social work, medicine, health informatics, and many other departments interact with the residents of TigerPlace.

### PCP Involvement

The program RN care coordinator works with the residents' physicians and other health care providers to ensure that the residents receive the needed care.

### Ongoing Care

#### Caseload

One full-time RN care coordinator, one full-time social worker, one full-time licensed practical nurse, and one part-time RN (0.25 FTE) serve the 62 to 65 residents of TigerPlace. There are 5.31 FTE personal care aides for the 33 residents who pay privately for services.

#### Frequency of Outreach

Sinclair Home Care has staff at TigerPlace from 6:00 AM to 10:00 PM to assist residents with care needs. In addition, TigerPlace has two staff members on the night shift to assist residents, as needed.

### Services

TigerPlace residents receive a comprehensive health assessment by an RN upon admission and at least every six months.

Ongoing care coordination takes place at the Wellness Center at TigerPlace, which operates five days a week. Residents may have their vital signs checked, get assistance with medications, or consult with an RN on any health care issues or other problems. The RN care coordinator and social worker also assess residents on a routine basis and when notified by other staff of changes in behavior or health status.

Staff also is on call 24 hours a day by phone for questions or assistance with problems. If a problem is identified, the RN care coordinator works with the resident's physicians and other health care providers to ensure that the resident receives the needed care and that the various health care providers involved have the information necessary to provide the best care possible. The RN care coordinator and social worker meet with residents and their family members to discuss issues and potential solutions. The care plan and any services are documented in the electronic health record (EHR).

Every resident has access to four private home visits to assess problems as they arise. Residents can opt to pay for services, such as medication management and assistance with activities of daily living, such as bathing, dressing or grooming. Exercise classes are offered five times per week. Medicare services also are offered on a short-term basis as residents need and qualify for them, such as post-hospitalization recovery assistance.

Many residents and their family members have found RN care coordination appealing, as many have had serious health consequences with uncoordinated care in the past. In addition, this case management approach allows couples to stay together who might otherwise have to be separated to receive the care they needed (e.g., when a spouse moves to a nursing home). Care coordination has allowed couples to stay together throughout the hospice and end-of-life process of a spouse at TigerPlace.

## Care Transitions Support

The social worker meets with new residents to familiarize them with the services offered and to ensure a smooth transition. Sinclair Home Care coordinates medical care for residents and makes sure the necessary services are in place to allow people to stay through end of life. When a resident chooses to move to another facility, the RN care coordinator ensures that the appropriate medical records are transferred with the resident to facilitate the transition.

## Tools

TigerPlace uses advanced sensor technology to capture patients' activities and patterns. Changes in activity patterns can indicate a potential change in patient health. Therefore, algorithms are set to alert clinicians of any changes detected that could be of concern. These early warning indicators are what guide clinicians in creating appropriate interventions for patients.

The EHR, supplemented with sensor data when available, is used to support clinical decisions. Data analysis of sensor data is automated so real-time health alerts are emailed to the RN care coordinator, social worker, and research team members. The alerts are derived from changes in sensor patterns from each resident's baseline. Almost half of the residents living at TigerPlace participate in the sensor research and live with the environmentally embedded technology that provides the continuous data for the decision-support system. The system is currently in the commercialization phase of development at MU.

## Outcomes

### Results

As a result of the sensor technology, clinicians identified cases 10 to 14 days before patients raised a concern or had an event occur (e.g., a fall, emergency department [ED] visit).

To assess the program's effectiveness, a group of patients living with sensors was compared with a group of patients living without sensors. Both of these groups of patients had identical care coordination and care services. Results showed that patients' functioning was statistically better in the group of patients with sensors.

## Ongoing Measures for QI

Ongoing measures for QI purposes included:

- Number of ED visits
- Number of hospitalizations
- Number of falls
- Six-month assessments, including:
  - Nursing home minimum data set
  - Geriatric depression scale
  - Mini-mental state exam
  - Fall risk assessment
  - SF-12 health survey
  - Activities of daily living
  - Independent activities of daily living

Comparisons of costs of care, living costs, and clinical outcomes are conducted with national data of nursing home or assisted living as compared to residents of TigerPlace grouped according to acuity.

## Evolution of Program

The addition of the sensor work has provided decision-support for augmenting RN care coordination. Sinclair Home Care used an EHR from the outset in 1999, but adding the sensor data has enabled them to make advances in proactive care coordination. They now have an EHR that integrates the sensor data so clinical staff can use the information in their everyday workflows.

Family members have supported MU student and faculty research by participating in interviews and focus groups, and by sharing informal feedback as the sensor research has evolved over the years. Their active participation and honest feedback have been important to keeping project research on track, and for developing technologies to enhance AIP. Family member feedback also has led to valuable program policies such as not requiring residents to wear sensors, and prioritizing privacy and dignity while addressing the health concerns of older adults.

Families have shared that a key reason they were interested in TigerPlace is the technology research in progress. They want to see these technologies developed and want to participate if they can see technology used to help people remain at home and live as independently as possible.

### Lessons Learned

The sensor technology and early warning program work best with a team who knows how to interpret the information accurately. It is important to have a care coordination component along with the early warning indication system.

It was challenging to move this project out of the laboratory setting and into people's homes. Unlike demonstration-smart homes that can be specially configured with numerous sensors and computers, project leaders wanted a system that could be installed in any home with minimal time and effort and especially with minimal wires and cables. In addition, they observed that people do not want extraneous sensors, wires, and computers cluttering up their living space. Thus, using small, wireless sensors was an important consideration for the project. Project designers had to balance the engineering tendency to put sensors everywhere with more practical considerations of installing and maintaining them (e.g., replacing batteries).

The commercial PIR (passive infrared) motion sensors have proven to be practical for this application. These sensors are small, wireless, and lightweight enough to be mounted on a wall or ceiling with double-sided foam adhesive. Because the apartments at TigerPlace are not all the same size, a custom configuration is necessary for each apartment. Larger apartments have more sensors than smaller apartments.

Some sensors have been discontinued, including:

- Binary floor mats, which provided specific location information of the resident  
**Reason for discontinuation:** Tripping hazard
- Binary chair pads, which signaled when or how long the resident was sitting on a chair  
**Reason for discontinuation:** Discomfort and constant readjustment

- Floor vibration sensor to identify falls from floor vibration signals, as well as qualitative gait patterns, e.g., walking with a limp or a shuffle.  
**Reason for discontinuation:** Generated false alarms due to concrete floor construction

Project designers also had to consider where to place the computer that provides the data monitor functions. At first, computers were simply placed on the floor, typically behind a large piece of furniture. Sometimes, residents would unplug the computer because they wanted to use the power outlet. To remedy this problem, a dedicated cabinet was installed above the refrigerator in each apartment with holes in the cabinet for ventilation. A power outlet and network port to a dedicated local area network were installed inside the cabinet so that all wires and cables were concealed.

Another challenge has been keeping all of the sensors and computers operating continuously. This concern was addressed by first doing a weeklong validation test in the lab with a computer and sensors configured for a specific apartment. This test identified some problems and eliminated unnecessary trips to TigerPlace. After the system was installed, instances in which sensors stopped transmitting and computers stopped logging still occurred, resulting in data gaps. For example, sensors occasionally fell down. A stove sensor failed due to excessive heat. Power spikes from thunderstorms caused computers to reboot and sometimes required manual intervention to bring them back online. Eventually, project designers implemented an automated monitoring system that emails the system administrator daily on the status on each network, so that problems can be addressed in a timely manner.

### Costs

The MUSSON received \$2 million from CMS to start the Sinclair Home Care home care agency and evaluate AIP. In 1999, the agency opened as a department of MUSSON. From the beginning, the agency was designed to serve older adults and provide services to TigerPlace. Profits from Sinclair Home Care support the ongoing development of AIP services and student educational and research experiences at TigerPlace.



Costs for any TigerPlace nursing home-eligible participant have never approached or exceeded nursing home care (average annual care cost for 2008 was \$7,331 plus the housing cost). For those not nursing home eligible, the annual average care cost was \$2,591.

## Successes

Student research and educational experiences at TigerPlace or with TigerPlace residents enhance their educational programs at MU. Hundreds of MU students have participated at TigerPlace at some point in their education. The Interdisciplinary Eldertech Research Team has been very successful at securing grant funding for the research in progress at TigerPlace. Now, commercialization of the technology is an ultimate outcome for the work, so elderly people or those in need of chronic disease management living in private homes or other facilities throughout the country can benefit from the work at TigerPlace.

## Technology/Innovation

### Technology Enablers

The MU team has successfully developed and tested sensor networks that have been installed in TigerPlace apartments since the fall of 2005. The team has developed an integrated, intelligent monitoring system that reliably captures data about the residents and their environment in a noninvasive manner and that balances the needs of health and safety and privacy. The team developed algorithms to extract patterns of activity from the collected sensor data and to generate alerts that indicate a potential health change in residents. They evaluated the usability of the interfaces and investigated the acceptability of the technology by seniors.

The MU Eldertech research team developed a new hydraulic bed sensor that captures quantitative pulse and respiration rates as well as bed restlessness. Algorithms automatically separate the ballistocardiogram heart signal from the respiration signal to compute pulse and respiration rates. This system is a part of the early illness alert system. The hydraulic bed sensor provides more finely grained information for detecting changes in sleep patterns and physiological signals that may indicate changing health conditions.

The biggest challenge the team faced was trying to connect sensor data to medically relevant events. Although the project has access to EHRs, these records do not easily accommodate data mining. Thus, current studies have necessitated manual extraction of health data and comparison to logged sensor data. In addition, the project team found that the sporadic collection of vital signs was not frequent enough to match the continuous collection of sensor data. To address this, the project made telemedicine equipment available to residents and asked that they collect their vital signs daily for some months. Residents, however, were resistant to such frequent data collection, so the project team integrated all vital signs into the EHR. The EHR data are collected in an internal database, which also includes other pertinent data on sentinel health events, such as hospitalizations and falls.

In research funded by the Agency for Healthcare Research and Quality and the National Science Foundation (NSF), the MU team has installed sensors — webcams for construction of privacy protecting voxel images, Microsoft Kinect to obtain ghost-like depth-images, and radar for signals — for development of a nonwearable technological approach to fall risk assessment and fall detection. Ten apartments, housing 15 residents, are involved in this two-year data collection project. The team has developed a robust automated fall risk assessment system using the Kinect motion sensing input device and is still working on reducing false alarms for an environmentally embedded fall detection system so people will not have to wear any sensors, yet will still be able to alert others when falls occur.

### Future Direction

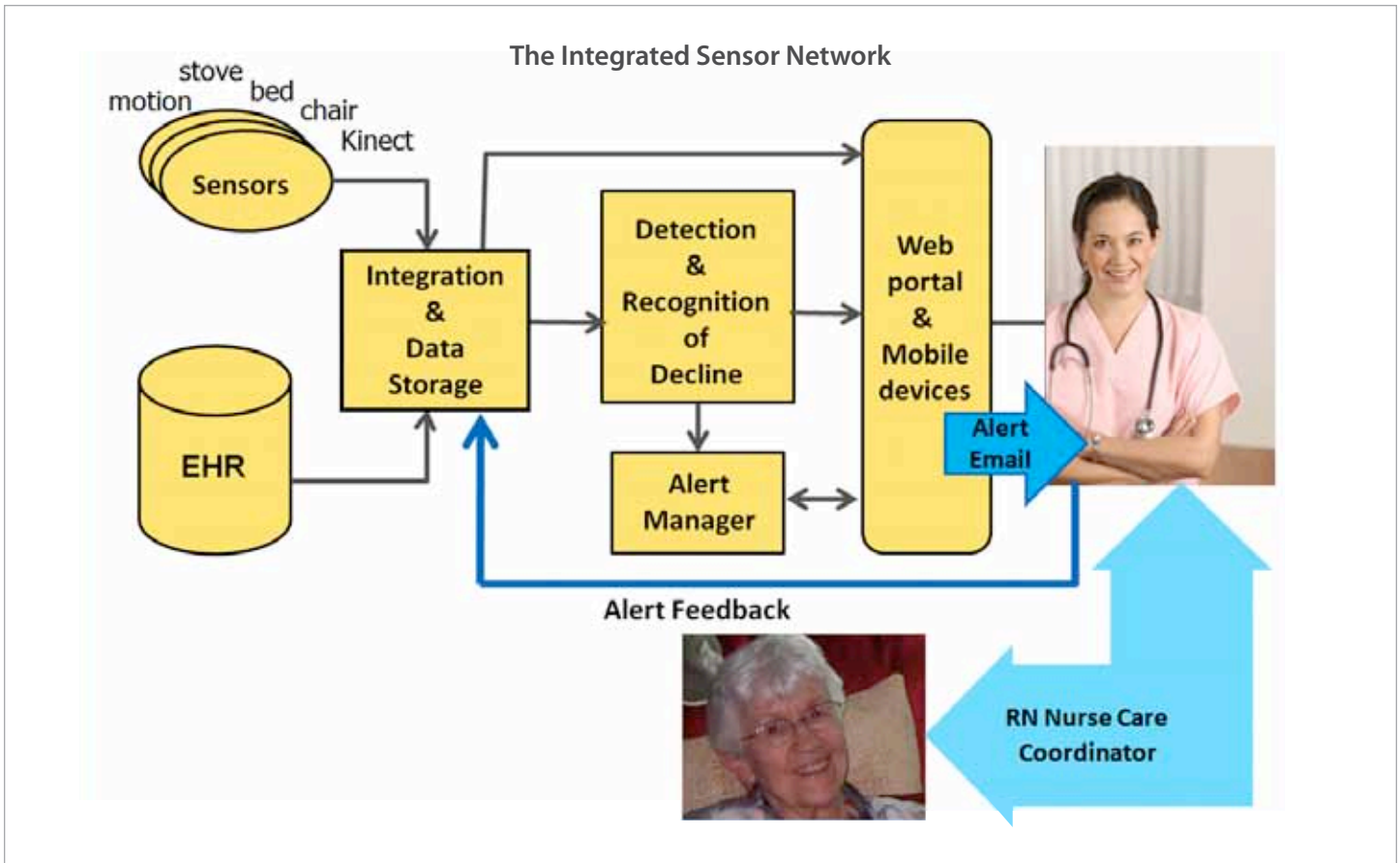
In a recent National Institutes of Health study, statistically significant differences in health outcomes were demonstrated between a control group and an intervention group in which early illness alerts (based on sensor data) were automatically sent to nurses. Nurses rated the clinical relevance of the alerts and their potential in aiding early interventions; this information has been captured in a database for future development of early illness alert algorithms.

The collaboration between TigerPlace residents, researchers, and students from a variety of disciplines is a model for

others interested in doing research in eldercare technology. While TigerPlace is a unique facility enabled by legislation to demonstrate a new model of long term care, these kinds of partnerships easily could be formed in other venues with the goal of providing a real-world setting for education and research in gerontology and eldercare technology.

MU recently received funding from an NSF grant under US Ignite and deployed sensor networks for 15 apartments at Western Home communities in Cedar Falls, Iowa, as a pilot, which will then expand to their entire retirement community for remote care coordination.

Author: Medimetrix



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## Wenatchee Valley Medical Center Health Buddy — Patient Telemonitoring Program

INTERVIEWEE: Lori Smet, RN, Case Manager Coordinator

### Summary

The Health Buddy Program combines telehealth with care management and nursing intervention components to provide care to patients with chronic conditions. Through the Health Buddy device, developed by Bosch, the patient answers condition-specific questions by pushing buttons, which enables self-reporting of their vital signs and symptoms. The device transmits the responses to a web-based application that organizes the information, stratifies it according to risk, and highlights out-of-range values, allowing case managers to quickly pinpoint health issues and respond accordingly, usually by calling the patient or physician.

The program focuses on frail, Medicare-aged patients suffering from diabetes, chronic obstructive pulmonary disease (COPD), depression, or heart failure as well as comorbidities with a Medicare HCC (Hierarchical Condition Categories) score of >2.0. Program participants were all identified through billing from Medicare and HCC-risk adjustment scores.

The original 2006 program served 763 beneficiaries at the Wenatchee Valley Medical Center (WVMC) and the 2007 refresher program served 1,056. While the three-year demonstration program is officially over, the program continues to care for 50 patients who are still using the Health Buddy system.

### Patient Identification

#### Inclusion Criteria

The program focuses on frail, Medicare-aged patients suffering from diabetes, COPD, depression, or heart failure as well as comorbidities with a Medicare HCC score of >2.0.

Exclusion criteria include Alzheimer's disease or dementia, most forms of cancer, drug and alcohol abuse, as well as skilled nursing facility residents.

#### Data Sources and Tools Used

Program participants were identified through billing from Medicare and HCC-risk adjustment scores, which resulted in many false-positives and false-negatives. Because of these errors,



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the procedure was augmented with a screening and referral process.

### Ranking/Stratification Methodology

Once patients are identified, there is no further patient stratification.

### Ongoing Data Collection Methods

WVMC uses the Epic electronic medical record (EMR) system to track follow-up lab results and appointments. The program is developing new registries with hypertension, coronary artery disease, and heart failure to identify those patients that are high-risk with those diagnoses. They also monitor the hospitalization and emergency department (ED) usage by Medicare Advantage patients.

## Assessment

### Assessment Elements

The assessment includes:

- A full review of the patient's medical history (including all diagnoses)
- Health concerns
- Psychosocial needs (including screening for depression)
- Risk of falling
- Caregiver support
- Medications
- Activities of daily living

Program case managers use this information to determine individual questions or bundles of questions (by diagnosis) that should be asked by the device each day and then program the device accordingly.

### Timing and Location

Patients are sent an outreach letter from Medicare and from their physicians inviting them to join the program and letting them know that a case manager will be reaching out to them soon to arrange an orientation. After the patient agrees to join

the program, the patient is assessed. The assessment takes place in the medical office.

## Care Management Team

### Team Composition

Program case managers serve as the primary point of contact for patients.

### Team Roles and Education

Case managers use health coaching and motivational interviewing techniques to change behavior.

### PCP Involvement

For those patients who need more in-depth clinical care management, program case managers monitor the participants and provide interventions. Through the use of EMRs, program case managers contact the patient's primary care physician (PCP) to discuss patient changes reported through the Health Buddy system and to discuss next steps.

### Shared Management

Case managers frequently meet with the patient before or after an appointment. Most collaboration with physicians occurs by email, by phone, or through the EMR message system. On a rare occasion, the case manager would accompany the patient to the exam by the physician.

### Health Buddy

Once patients complete their orientation, they take home the telehealth component, the Health Buddy, and answer daily questions regarding their condition. The Health Buddy provides feedback in response to the patient's answers, including education on their disease process and information about medications. Patients self-report weight, blood glucose levels, blood pressure, and subjective data about how they feel.

The Health Buddy system includes an easy-to-use, four-button device; a web-based Health Buddy desktop application for providers; and more than 100 health management programs for a variety of single and comorbid conditions.

Every day, the system sends a new session to the Health Buddy device in the patient's home. Each session is comprised of vital sign gathering, symptom review, standard assessment surveys (e.g., SF-12, PHQ-9), education, and positive behavior reinforcement. Through the use of branching logic, the patient can get feedback to a variety of questions, and a program case manager is able to obtain additional context to help understand impending and existing changes in the patient's condition.

Once completed, the data from the daily session are sent to the Health Buddy system, which then:

- Sends these data to the desktop application for review by the case manager with color coding based on predefined levels of risk to aid in early identification of patients that may require more urgent assessment and intervention
- Sends a new session to the patient for the next day

The Health Buddy device is able to gather vital sign data from a variety of peripheral devices, either through self-reporting or through wired or wireless connectivity.

The Health Buddy has an embedded algorithm with each program that determines if the patient is a red, yellow, or green risk. Case managers use physician-approved algorithms to adjust medications or change treatments, and the physician is always notified about any changes made from the algorithms. During orientation, the program manager works with the patient to choose an appropriate Health Buddy program, an effort to engage patients in self-management of their care.

## Ongoing Care

### Caseload

One full-time, fully dedicated registered nurse case manager manages a caseload of 125 patients.

### Frequency of Outreach

Every 90 days, the patients get an electronic, 15-question Geriatric Depression Scale (GDS), and a patient health status through the SF-12 Health Survey.

## Services

Based on answers that the patient gives to follow-up questions, the Health Buddy can trigger alerts to program staff to change medications, alter dosages, check on the patient, or arrange immediate medical attention, if needed.

Case managers have regular contact with patients by phone or in person, and they also interact with patients at their annual wellness visits with their PCP. Case managers also help patients who face other obstacles (e.g., financial troubles, caregiver support, transportation issues); they take a holistic approach to managed care to help patients get healthier and participate in their communities. Case managers educate patients about conditions that can be seen in the physician's office and those conditions that need to be seen in the ED.

## Care Transitions Support

Case managers call within 48 hours of a patient's discharge from the hospital to follow up on:

- Medication reconciliation: Was the prescription filled and is the patient taking it?
- Family/caregiver support: Is the support adequate?
- Community resources
- Red flags that indicate that the patient needs to be evaluated
- Follow-up appointments with PCPs and specialists

## Tools

In addition to the Healthy Buddy device itself, Epic is used for documentation of interventions by case managers. The program also uses the care coordination notes in Epic to document patients' case management plan. The Health Buddy application has a progress notes page, from which the care team frequently copies this information to the EMR. For regular interactions with patients that do not require an intervention, the care team simply makes a note in the Health Buddy application.

## Outcomes

### Results

Analysis in a 2011 *Health Affairs* article showed that patients with congestive heart failure and COPD had greater spending declines than those patients with diabetes mellitus.<sup>1</sup>

Significant cost savings and mortality reduction versus propensity score matched case controls were also noted as seen in Table 1.

**Table 1. Mortality Difference and Cost Reductions  
Patients with Congestive Heart Failure and COPD**

GROUPS	MORTALITY DIFFERENCE	COST REDUCTIONS PER QUARTER (over 24 months)	
Intervention (n=1,767)	-2.7% (p<0.05)	7.7% to 13.3% (p<0.01)	\$312 to \$542
Control (n=1,767)			

Results from the first three-year program include:

- Total cost savings of 7%
- Reduction in readmissions of 18%
- Increased outpatient visits to physician offices
- Decreased length of stays
- Decreased number of hospitalizations

### Ongoing Measures for QI

The program tracks process measures, including LDL cholesterol and HbA1c testing rates, as well as rate of those with an outpatient visit for diabetes. The program also tracks outcome measures for HbA1c control, LDL control, and blood pressure level, as well as a composite measure for percentage with all three in control. See Table 2.

**Table 2. Demonstration Results: Quality Measures**

YEARLY SCREENING OR VISIT FOR...	2008 HEDIS COMMERCIAL 90% PERCENTILE (CY 2007)	INTERNAL WVMC GOAL	WVMC OVERALL (2007)	WVMC OVERALL (2009 YTD through August 31)	CMS DEMO PATIENTS (2007)	CMS DEMO PATIENTS (2009 YTD through August 31)
HbA1c (1 or more tests in 12-month period)	93.2%		80.02%	89.16%	93.60%	93.94%
HbA1c (2 or more tests in 12-month period)		75%	70.01%	72.86%	85.60%	86.74%
HbA1c result <7.0		60%	65.99%	63.99%	75.21%	68.56%
Average HbA1c result		<7.0	6.88	7.06	6.84	6.66
LDL	88.8%	88%	83.04%	85.75%	92.00%	94.32%
LDL result <100	52.3%	60%	61.66%	62.34%	75.65%	79.52%
Blood pressure ≤130/80	39.7%	45%	46.24%	53.37%	51.64%	60.23%
Diabetic outpatient visit		90%	87.97%	90.02%	94.40%	91.67%
Managed: HbA1c <7, LDL <100, urine microalbuminuria tested, and blood pressure ≤130/80			11.84%	14.19%	26.45%	25.00%

Source: Adapted from P. Rutherford, J. Sanderson-Austin, L. Smet: "Intensive Care Management Supported by Technology: An Effective Approach to Managing Complex Chronic Disease. *Group Practice Journal*, January 2010, pp 10–13.

## Evolution of Program

Over the six years of the program, patients became more self-reliant in caring for themselves. For example, the care team would call a patient in response to a “red” alert to find that the patient had already called the doctor’s office. Even after the end of the program, the connection between the case managers and patients has been maintained. Case managers continue to receive calls from their Health Buddy patients or get stopped by patients in the clinic to chat. The development of these personal relationships was one of the keys to the program’s success.

## Challenges

The Health Buddy Program faced several challenges, including:

- Outreach and enrollment
- Engagement of patients for the entire three years
- Physician buy-in
- False-positives with patient identification
- High-resource consumers in the PCP practice that physicians wanted to include but couldn’t
- Difficulty engaging patients outside the clinic system and difficulty maintaining communication with outside physician groups

## Costs

Program one-time acquisition costs included:

- Implementation fee (clinical content review and release, training, and workflow/program design and implementation)
- PCs and software
- IT interface between WVMC and Bosch
- Nurse training time
- Outcomes report design

Annual costs included:

- Patient identification and recruitment
- Outbound marketing and installation
- Health Buddy device

According to results of an actuarial analysis conducted by Medicare contractor ARC, the program exceeded cost savings targets and generated positive return on investment over the entire population despite only 36% of the population engaging in the program. See Table 3.

**Table 3. Presentation of ARC Results in RTI International Revised Final Report for CMS, April 2011**

	DURATION OF PROGRAM	TOTAL GROSS SAVINGS*	GROSS SAVINGS PBPM*	ROI
Original population	38 months	\$4,572,116	8.1%	2.01
Refresh population	26 months	\$1,961,909	6.0%	1.12

Overall *excess savings* over duration of study: \$1,319,593<sup>†</sup>

\*Adjusted by ARC for outliers and baseline differences with comparison population.

†Excess savings = gross savings, net of accrued fees – minimum required savings (5% for original population and 2.5% for refresh population).

## Technology/Innovation

### Future Direction

While the three-year demonstration program is over, both WVMC and Bosch felt an ethical obligation to continue to care for the 50 patients who were still using the Health Buddy system since they had seen such an improvement in patient care.

The Health Buddy Program is now looking for a new payer to fund the next phase of the project.

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### Endnotes

1. Laurence C. Baker et al., “Integrated Telehealth and Care Management Program for Medicare Beneficiaries with Chronic Disease Linked to Savings,” *Health Affairs* 30, No. 9 (September 2011): 1,689–1,697.

To learn about other complex care management programs, visit [www.chcf.org](http://www.chcf.org).