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Technology-Enhanced Nurse Monitoring in Assisted Living: Results from Focus Groups with Housing Managers

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ABSTRACT

This article describes technology-enhanced nurse monitoring services (using sensor technologies). Qualitative data were collected during three focus groups with 12 housing managers from 12 assisted living facilities deploying these systems. The findings are based on a content analysis of transcriptions of audio recordings from focus groups. Qualitative findings support the value and limitations of using these services in assisted living facilities. Technology-enhanced nurse monitoring services offer an innovative strategy to support clinical care coordination. These services help manage risks associated with adverse health events by supporting timely interventions that may help reduce subsequent health care expenditures. The cost-effectiveness of these services will be evaluated in the future as part of a larger study.

INTRODUCTION

The role of the assisted living facilities within the long-term care continuum continues to evolve. Assisted living facilities are likely to see continued growth in response to demographic changes, consumer demand, interest groups, and public policy (U.S. General Accounting Office, 1999; Hawes & Phillips, 2007). Policymakers and payers in federal and state agencies often see assisted living as a more economical and less institutional alternative to nursing homes (Chapin & Dobbs-Kepper, 2001). State policies and regulations increasingly support aging in place by allowing residents with greater levels of impairment to remain in assisted living facilities and thereby avoid relocation to nursing homes (Hawes & Phillips, 2007). On the other hand, there is growing recognition among providers, regulators, consumers, policymakers, and other stakeholder groups that assisted living facilities where nursing care is not available will likely play a limited role in the future provision of health care services to an increasingly at-risk aging population served by these facilities (Hawes & Phillips, 2007). Two studies estimate the mean number of hours of licensed nurse care per resident per day at 0.28 hours and direct care aide per resident per day at 1.8 hours (Kane, Chan, & Kane, 2007).

There is growing consensus about the scope of services that should be offered by assisted living facilities. Services commonly found in assisted living include assistance with activities of daily living, meal service, housekeeping, preventive health or wellness programs, assistance with medications, emergency call systems, transportation, incontinence care, social services, 24-hour security, and rehabilitation (Kane et al., 2007). A fundamental disagreement remains about *whether* and *how* assisted living providers should address the health care needs of their residents. Some states prohibit the provision of nursing care within assisted living facilities, while others allow providers to offer daily nursing care. Major differences exist among assisted living providers related

to whether or not they offer nursing care. Some providers choose not to offer nursing care and instead encourage residents to contract for these services with outside nursing or home health care agencies. State regulations differ in terms of requirements for licensed nurses, nursing assistants, and other support staff (Hawes & Phillips, 2007).

Over the past few years, technological innovations such as technology-enhanced nurse monitoring services (using sensor technologies) have been introduced to help licensed nurses and other staff members coordinate health care services within assisted living facilities. Remote monitoring systems using a variety of sensors are now being deployed and tested. Although these systems have not been deployed on a widespread basis within assisted living facilities, licensed nurses, unlicensed staff, and/or family members can monitor residents from geographically remote locations. Early pilot studies of sensor technologies in assisted living facilities suggest that these systems can have a positive impact on residents' quality of life and help support care coordination for primary care providers (Alwan et al., 2006).

Related technologies have been tested on a limited basis within home health care agencies; e.g., technology-enhanced nursing practices have been tested using Web-based self-management information, self-monitoring tools, and messaging services for patients with chronic cardiac disease. Patients exposed to technology-enhanced nursing practices achieved better quality of life and self-management of chronic heart disease over the short term (four weeks post-discharge); however, long-term gains were not seen in symptom management or health status achievements (Brennan et al., 2010).

Telemonitoring systems also have been deployed within intensive care units (ICUs) in hospitals via eICUs. In this model, intensivist physicians and nurses working at a remote central monitoring station track care of patients across multiple ICUs located in different hospitals (Berenson, Grossman, & November, 2009). Staff working in eICUs monitor the patients' vital signs fed from bedside monitors,

laboratory results, and other data in the hospital's health information technology systems. Clinical leaders in hospitals hold strong views about the value of these innovations, but there is little objective information that can be used to validate the efficacy of these telemonitoring systems. Common reasons why hospital systems adopt eICUs include supporting clinical process improvements and patient safety.

Remote patient management (RPM) technologies have been used by the Veterans Health Administration to implement physiologic monitoring, protocol-driven decision support, newly defined roles for clinical and non-clinical providers, and telecommunications (Coye, Haselkorn, & DeMello, 2009). A review of the research literature (Parè, Jaana, & Sicotte, 2007) shows that telemonitoring of patients with chronic diseases produces accurate and reliable data. Patients also accept these technologies. Telemonitoring positively affects patient attitudes, behavior, and satisfaction. Reductions in emergency room visits and hospital admissions were achieved for patients with pulmonary and cardiac disease, but the results are inconsistent for diabetes.

Background

The LivingWell@Home (LW@H) program is sponsored by the Evangelical Lutheran Good Samaritan Society (GSS), the largest nonprofit provider of long-term care services in the U.S. This article describes technology-enhanced nurse monitoring services offered to assisted living facility residents through the LW@H program. Findings from qualitative research conducted to evaluate the LW@H program are presented. Perceptions and experiences of housing managers working in assisted living facilities utilizing technology-enhanced nurse monitoring services are described.

As part of a larger study, a research team from the University of Minnesota is evaluating technology-enhanced nurse monitoring services through a randomized trial. Randomization was achieved at the facility level through a draw of cards. A total of 32 assisted living facilities located in four states

(Minnesota, Nebraska, North Dakota, and South Dakota) were randomly assigned to an experimental or control group. Residents living at experimental sites received technology-enhanced nurse monitoring services using sensor technology, while residents at control sites did not get monitoring services. Randomization at the facility level reduces the probability of selection bias because each facility has an equal chance of being assigned to the experimental or control group. Research subjects were recruited from 32 assisted living facilities until sample size requirements were met; i.e., approximately 200 experimental research subjects and 200 control subjects. Research subjects could not be blinded to the intervention because the sensors are clearly visible and residents were informed if monitoring services were provided at each facility. All research participants gave informed consent as required by the recruitment protocols approved by the Institutional Review Board at the University of Minnesota. Participation in the research study and the LW@H program was voluntary.

All assisted living facilities participating in this research utilize some type of emergency call system. Emergency call systems are commonplace in assisted living facilities and are offered by an estimated 93% of facilities (Kane et al., 2007). In most assisted living facilities, emergency call systems are hard-wired into resident units using pull-cords or wall switches. Fewer facilities use a wireless emergency call system using wristwatches and/or pendants worn by the resident. Onsite staff usually locally monitor these hardwired and wireless emergency call systems. Relatively few assisted living facilities use personal emergency response systems that are monitored remotely (e.g., at a centralized call center); however, individual residents within assisted living facilities may choose to purchase these services.

In the LW@H program, emergency call systems are augmented with a suite of sensors that provide information to licensed nurses to help them monitor resident health status from a geographically remote location. Sensors send wireless signals that monitor

sleep patterns, motion, falls, bathing, toileting, and other activities of daily living. A suite of sensors has been deployed in experimental assisted living units, including motion sensors, humidity sensors, vibration sensors, and bed sensors. These sensors are linked to a data management system that monitors the resident's activities occurring 24 hours a day. These remote monitoring systems augment onsite monitoring by linking the telemetry generated by sensors to a computerized data management system. Algorithms are used to identify deviations from "normal" or "baseline" behavioral patterns using statistical analyses of key activities (e.g., toileting, movement, or sleep). These data are transmitted via landline (or cellular) communication systems to a team of registered nurses (called clinical nurse specialists) and trained staff members who monitor daily activities related to toileting, bathing, sleep, and other activities. The LW@H team working at GSS's corporate headquarters in Sioux Falls, South Dakota (aka National Campus), review the telemetry generated by these systems daily. The data management system creates online reports to alert clinical nurse specialists to emergent health problems among seniors living in assisted living facilities. These reports show trends over time in sleep patterns, bathroom use, showering, movement, and impacts due to falls. They also show deviations from what would be considered within a "normal" range for each resident.

When potential problems are identified, clinical nurse specialists contact GSS staff at the assisted living facility for follow-up action using "trigger forms." These are two-page forms that are sent via fax or as email attachments to the housing manager (or a nurse from a GSS home health care agency serving the assisted living facility). These forms identify the nature of the triggering event such as irregularities in sleep, movement, impacts due to falls, frequent bathroom use, and other potential adverse events.

When notified by a clinical nurse specialist, staff at the assisted living facility contact family caregivers, home care agency nurses, and/or primary care physicians to follow up as warranted. Trigger forms are used to document each triggering event, record staff interventions or actions taken in response to the triggering event, and describe how the triggering event was resolved. Technology-enhanced nurse monitoring may help clinical teams (e.g., nurses, physicians, and primary care providers) and provider organizations (e.g., assisted living facilities or home health care agencies) identify and respond to sentinel health events proactively (e.g., irregular or disturbed sleep patterns identified by sleep sensors have warranted adjustments to prescription medications). Increases in the frequency of bathroom visits identified by motion sensors in bathrooms have warranted a urinalysis that identified a urinary tract infection early on, with subsequent treatment that most likely prevented a hospitalization.

METHODOLOGY

Twelve housing managers from 12 different GSS assisted living facilities using technology-enhanced nurse monitoring services participated in three focus groups. All focus group participants signed informed consent forms assuring confidentiality.¹ The first focus group was completed in June 2011 in Sioux Falls about six months after deployment. Eight housing managers from eight different experimental assisted living sites participated in the first focus group. Two more focus groups were completed in January 2012, approximately 12 months after deployment. A second focus group with six housing managers from six different experimental assisted living sites was held in Osceola, Nebraska. A third focus group was scheduled for Waconia, Minnesota,² with five housing managers from five different experimental assisted living facilities. Eight housing managers (two-thirds) participated in both

¹The Institutional Review Board at the University of Minnesota approved these protocols.

²The third focus group session was completed via teleconference call due to poor driving conditions related to inclement weather.

the six-month and 12-month focus groups.

The purpose of these three focus groups with housing managers was to capture qualitative information about how the sensor technologies are being used at GSS assisted living facilities. Separate focus groups have been conducted with other stakeholder groups, including clinical nurse specialists, home health agency nurses, residents, family members, and senior managers at GSS. Author Leslie A. Grant facilitated the group discussion during all three focus groups. Each focus group lasted between 75 and 90 minutes. Audio recordings were made of each focus group and then transcribed. Grant used NVivo10 software to conduct the content analysis of the transcriptions. Content analysis is a method that is used to identify themes that emerge based on an analysis of thematic content to answers to open-ended questions. Each focus group was semi-structured; i.e., the discussion was very fluid and conversational, as opposed to following a fixed or predetermined set of questions. A series of questions and follow-up probes were posed to housing managers, including the following:

- Is there a learning curve when it comes to using the LW@H technologies? If so, what is it? Is there a learning curve around how to use the technologies? What are some of the key things that you've learned so far?
- How have the LW@H technologies affected clinical and/or organizational processes?
- What are some challenges, barriers, or suggestions that you may have to improve how the technologies are being used at the Good Samaritan Society? Are there things that make it hard for you to use it? Do you know of any barriers? What ways can you think of to make this system work better?
- What is the value, from your perspective as a housing manager, of these technologies? What does it do for you that makes your life easier, or makes you sleep better at night, or keeps you awake, or whatever? Is there a value that you see? What's the value of the technology in terms of the different sensors?
- Have you had any challenges related to the LW@H research and/or technologies? Can you describe any challenges that you've had, either in terms of the research for the LW@H project or any challenges related to the technologies that are being used in the LW@H project? Are there any other technology issues that you are encountering at this point in time?
- If you were talking to residents or family members about the LW@H program, what would you tell the residents and their families about this program? What would be your message to this stakeholder group?
- What would you like to tell the folks at National Campus about the LW@H project?
- If you were telling other housing managers about the LW@H program, what would you want to tell them about its benefits, advantages, or disadvantages? What would be your message to other assisted living housing managers? What would you tell your colleagues about this program?
- Does the research create barriers for you in terms of how you market this program to family members and/or residents?
- So, looking back, are things getting better? And if so, what has gotten better? How can this program be improved? Do you have any suggestions or recommendations? How have things changed over time? What's gotten better? What hasn't changed? What is your general sense of where this program is going?
- Have any of you had what I call "success stories" or "catches" of things that have gone awry where the technologies have made a difference?
- When someone refuses to use this technology, or declines, or chooses not to want to have it, why do you think that is?
- If you had to do this over again, what would you do differently? What could be done from your vantage point to make LW@H more successful? Do you have any other ideas around that question?
- Is there anything else that you want to tell me

about LW@H that we haven't talked about?

- If you were putting together a manual or training guide for housing managers or for other users about this suite of technologies, what would be some of the chapters? What are some of the key points you would want to put in the user's guide?
- So, looking forward to the next year, are there any issues that you anticipate with this program that might affect its sustainability? Are there other things that you anticipate in terms of challenges in the next year or next six months?

RESULTS

NVivo 10 software allows for systematic analysis of qualitative data using the focus group transcriptions. The software provides an easy way of quantifying the number of times each theme occurs in the transcription (described as the number of coding references). A total of 795 coding references across 66 themes were coded using transcriptions from three focus groups. The 10 most frequent themes are shown in rank order in **Table 1**. Themes are rank-ordered by the frequency that each theme occurred. All top 10 themes were "recurring" in the sense that they emerged during all three focus groups. A description of each theme is provided in the second column. The valence (i.e., positive, neutral, or negative directionality) of coding references is shown in the last column for four themes with directional content: a) positive versus negative benefits/value propositions; b) positive versus negative value propositions of sleep sensors; c) false positives and false negatives; and d) positive versus negative value propositions of technology-enhanced nurse monitoring services for family members. Ambivalent coding references with both positive and negative valence were assigned to a "neutral" category. Coding references lacking a clear positive or negative valence also were coded as "neutral." Discussion about non-directional system errors related to sensor technology was categorized as "errors" because they could not be classified as either false positives or false negatives.

Theme One: Benefits

The most common theme had to do with perceived value propositions. This theme was mentioned 116 times during the three focus groups. This theme included both positive value propositions (69% advantages) and negative value propositions (21% limitations and/or disadvantages) related to using technology-enhanced nurse monitoring services. One positive value proposition had to do with competitive advantages in the marketplace. One manager described these innovations as a "great marketing tool. The technology can be a bridge from those in the community that have the technology at home. They could have that same technology as they come into assisted living. But I think it's a great marketing tool. It could be a great bridge. This is something unique that nobody else has."

Another benefit is what was called "validation," which refers to the availability of objective data and information that can be used to inform decision making related to the delivery of care and/or services. Housing managers and family members often see value in having "valid" objective information (i.e., as opposed to relying on resident self-reports). Validation helps formal and informal caregivers assure resident safety, provide additional services as needed, manage risks to the resident, and justify transitions to higher levels of care as warranted. The availability of valid information about the resident is critical to assuring resident safety and supporting independence. These systems provide "valid" data and information that may not be available from resident self-reports or other sources. One manager noted: "Validation is what the technology does. It validates. That's what it primarily, in my opinion, does." Another noted: "It also backs [you] up when you have to talk to a family member. Frequently, you'll end up having a form of a care conference... Before, it was just our feelings and the few things that we can sense. Well, right now, it's accurate data. And we can print out some of those things [in reports] and show them...Unfortunately, this doesn't lie."

Other benefits were related to the early identification of sentinel health events such as urinary tract infections, early memory loss, sleep disturbances, elopement risks, falls, adverse reactions to medications, and other health-related issues. One manager stated: “I have a lady who had horrible sleep patterns. They started her on a sleep medicine, and all of a sudden she was up in the middle of the night cutting her sheets apart and talking to the mirror. I mean, huge, huge issues. So, I said we can not have this sleep medicine on board.” Another housing manager remarked: “A gal in our facility usually goes to the bathroom 22 times a day. Well, she started going 34 times a day. So, she had some increased creatinine levels going high, and she had some kidney function issues. Anyway, [we] sent her to the emergency room, and the emergency doctor calls me and says, ‘There’s nothing wrong with this patient. Why are you sending her to me?’ I says, ‘Well, if you’ve read the technology, on an average she was going to the bathroom 22 times, and now she’s going to the bathroom 34 times.’ He says, ‘Oh, oh, I didn’t know that.’...So, she ended up having a kidney infection, and he admitted her to the hospital. But without that technology, he would have sent her right back and told me that there was nothing wrong with her.”

Although most housing managers saw benefits in technology-enhanced nurse monitoring services, not all housing managers viewed it positively. Negative value propositions were mostly related to the limitations in the sensor technologies and especially the timeliness of the online reporting systems that caused delays in getting “triggers” from clinical nurse specialists. One manager noted: “We had one little lady that the trigger form came in three days later. Out of the last 24 hours—three days ago—she was in bed 20 of those hours. Well, by that time she’d already been sent to the hospital and had a stroke and was put in skilled [nursing]...But in that case, the trigger form [was] really a bit useless...because it was a done deal.” Another stated: “I told you about...two or three UTIs [urinary tract infections] that we captured on people that are living here indepen-

dently. If somehow there were not the time lag...I would say in the last year we’ve probably had at least 15 or 20 UTIs...but most of those...were captured by the staff just bein’ in there doing other services, and they could capture more foul odor. Or maybe so and so needed to use Depends [commercial brand of diapers], and they needed to order them more often...We actually captured a whole lot more ourselves from being in there...But by the time we got the sensors [trigger form], we had already had a UA [urine analysis] run and had them on medication.”

Theme Two: Triggers

Issues related to communication and coordination of care using trigger forms were a theme that was referenced 37 times. Several examples of delayed triggers were described previously. One manager summarized this challenge as follows: “We know the persons that live here so well that a lot of times we’ll catch it [problems] before the triggers will show up.” Improvements in communications with clinical nurse specialists also were noted: “I would say that National Campus has made huge strides in the last year at honing the nurse clinical specialist for that—whatever those gals are called that monitor it up at National Campus—in terms of when to trigger, what to trigger, how often to trigger...separating the technology triggers [false positives] from the regular triggers [true positives]. To me, right now the system is way better than it was a year ago.”

Theme Three: Costs

Concerns about the high cost of technology-enhanced nurse monitoring services were raised 34 times. One manager raised this issue from the resident’s perspective: “Why should I pay for another monitoring program when I thought the staff was going to be here 24 hours a day?” Costs for these technologies and monitoring services are estimated to be about \$90 a month.

Theme Four: Invasion of Privacy

Issues related to invasion of resident privacy came up 29 times. Whether or not it is warranted, resi-

Table 1. 10 Most Prevalent Themes.

Theme	Description	Number of Coding References (% Coding References)	Valence Number (% Theme)
1) Benefits (value propositions including both advantages and disadvantages)	Factors that add value or limit value of technology-enhanced nurse monitoring services (including LW@H research) for different stakeholder groups	116 (15%)	Positive = 80 (69%) Neutral = 12 (10%) Negative = 24 (21%)
2) Triggers (and responses)	Issues related to communication and coordination between clinical nurse specialists and assisted living staff when potential problems are identified by technology-enhanced nurse monitoring	37 (5%)	Not Applicable
3) Costs of technology	Concerns about high costs and affordability of technology-enhanced nurse monitoring for residents	34 (4%)	Not Applicable
4) Invasion of privacy (objectivity of technologies)	Resident concerns about technology-enhanced nurse monitoring services invading their privacy (and references to the objectivity of these technologies compared to resident self-reports)	29 (4%)	Not Applicable
5) Technology versus staff observations	Relative value of sensor technologies in assisted living facilities versus staff who are likely to be more responsive (than technologies per se) to resident needs	28 (4%)	Not Applicable
6) Improvements	Suggestions about how to improve sensor technologies and online reports generated by data management systems	28 (4%)	Not Applicable

Table 1, Continued. 10 Most Prevalent Themes.

Theme	Description	Number of Coding References (% Coding References)	Valence Number (% Theme)
7) Marketing and sales	Issues related to marketing and sales of technology-enhanced nurse monitoring	27 (3%)	Not Applicable
8) Sleep	Positive and negative value propositions offered by using sleep sensors to monitor resident sleep patterns	26 (3%)	Positive = 20 (77%) Neutral = 1 (4%) Negative = 5 (19%)
9) False positives, false negatives and system errors	False positives and false negatives, and system errors generated by sensors (especially bed sensors)	26 (3%)	False Positives = 16 (62%) Errors = 5 (19%) False Negatives = 5 (19%)
10) Family members	Value propositions offered by technology-enhanced nurse monitoring services for family members with aging relatives who are at risk	24 (3%)	Positive = 20 (83%) Neutral = 1 (4%) Negative = 3 (13%)

dents often fear involuntary relocation to a nursing home. This phenomenon has been referred in literature as the “cultural aversion hypothesis” (i.e., fear of nursing home placement grounded in one’s cultural values and normative expectations that are deeply imbedded; one’s cultural beliefs and life experiences).

In America, many seniors place a high value on their independence and self-reliance. Accordingly, many residents do not want to be seen as a burden to others. Some residents may be in denial about their aging and personal frailties. Denial as a coping mechanism helps support a more positive “self-concept” compared to objective reality (that may be evidenced in the data tracked by sensors and information collected by the data management system). Accordingly, some residents may “mask” their frailties by concealing adverse events such as falls. Other residents deny infrequent bathing or showering when the objective data show otherwise.

This type of “cognitive dissonance” can pose challenges in convincing at-risk or frail seniors that they would benefit from these technologies. One manager noted: “I have learned that your residents will mask their symptoms to make you think that they are healthier than sometimes they are.” Another states: “Well, sometimes I think that they want to portray to us that they are healthy so they can stay at the assisted living. They have this fear of going to the nursing home, and they feel, like, if I have one more UTI or one more fall, they’re gonna get rid of me. This technology doesn’t lie. I mean, it gives you a real view of what is happening to them. And some of them would not consent to the program because they did not want us to have access to that [information]. You know, they felt it was an invasion of their privacy.”

Theme Five: Technology Versus Staff Observations

This theme occurred 28 times. It has to do with the relative value of the monitoring technologies compared to staff observations described in Theme One: Benefits (described as negative value propositions). Some managers saw greater value in staff observations due to the late trigger notifications generated by the data management system. One manager stated: “Well, because of the assisted living environment, they’re [residents] out three times a day [for meals]. We’re checking on them more than that with all the medication passes. We can catch it [problems] probably 80% of the time before the sensors catch it, if not more.” Another stated: “Pneumonia we can catch quicker because we are in constant contact with them. We’re giving them meds every day. They are eating every day, and we see them every day. Like I say, we’re to the doctor and back before the trigger even comes.”

Theme Six: Improvements

Numerous suggestions were made about how to improve technology-enhanced nurse monitoring services. This theme occurred 28 times. Some of these issues have been noted previously, such as developing more timely or “real time” reporting capabilities. Other suggestions for improvement included the following ideas: developing direct intercom communications between residents and clinical nurse specialists; providing broadband connections, as opposed to analogue connections over telephone lines, to speed up the rate of data transfer in the data management system; providing better training for assisted living staff about how to use the capabilities of the data management system; and developing standardized protocols for when and how triggers are sent by clinical nurse specialists.

Theme Seven: Marketing and Sales

Potential challenges in marketing technology-enhanced nurse monitoring services to assisted living residents came up 27 times. Issues related to its

costs and affordability were described previously in Theme Three: Costs (costs of technology). Some housing managers believe that these services would be easier to market to seniors living at home than to those living in assisted living facilities. One manager commented: “I think that the technology is probably geared for those living at home. They want to stay at home anyway, and it would be great to market that they can stay at home. And at a certain price, it’s [more] affordable to have the technology put in their home than for them to move into assisted living or a nursing home.”

Theme Eight: Sleep

Issues related to sleep patterns and sleep sensors were referenced 26 times. Of all the sensors deployed, sleep sensors were the most challenging to install and maintain. Bed sensors yielded more false positives, leading to more false triggers from clinical nurse specialists than other sensors. False positives accounted for most (77%) of the coding references under the theme of sleep. On the other hand, some managers saw tremendous value in reports about resident sleep patterns. One manager noted: “I am big on sleep. I really think that people need sleep, so I always look at their sleep and how well they sleep and how well they’re rested...If they’re not sleeping very well, there is something wrong. They are coming down with something.”

Theme Nine: False Positives and Negatives

This theme came up 26 times. Many false positives occurred due to faulty sensors. Most coding references under this theme were false positives (62%). Non-directional system errors and false negatives each accounted for 19% of the total. As noted previously, faulty bed sensors caused many false positives. One manager described his experience as follows: “I have never had that happen where it [bed sensors] sent a signal that they were in bed and they weren’t. Mostly it’s that they’re in bed, but it’s not sending. There is so many variables with the beds. I mean,

with the mattresses and the form and getting it off-set, or broken wires, or connections, or the box [local data storage and transmission device used in the data management system]. I mean, there's just so many variables with the bed sets. Yeah, that's 90% of our technology problems."

Theme 10: Family Members

This theme came up 24 times during the focus groups. Families of assisted living residents are clearly an important stakeholder group. Family members, including housing managers who have firsthand experience caregiving for a parent, generally see value in these technologies and especially so within community-based settings where an at-risk senior is socially isolated. Frequently, the caregiver is "caregiving from a distance." In these situations, these technologies offer "peace of mind" that may help alleviate "caregiver burden." The caregiver knows that his/her parent's safety and well-being have a higher degree of assurance through technology-enhanced nurse monitoring. Most value propositions for family members (83%) were positive. One manager recounted her personal story: "My mother was in the independent housing out in the state of Washington a year ago, and my sister found her on the floor. She was out cold, and she probably had been there for a few hours. It all started with a UTI [urinary tract infection], but she spent four months in a nursing home due to a UTI. But if she had had this thing [nurse monitoring] where she lived...if that had been in her apartment...which I would have been more than willing to pay for...she probably never would have had that hospital stay. Well, she was in the hospital seven times, back and forth in that four-month period, plus in the nursing home. We probably could have avoided that because increased bathroom things [visits] would have been captured by these monitors." Another manager noted: "I think the families value anything that is going to decrease hospital visits, doctor visits, ER [emergency room] visits."

CONCLUSION

Study Limitations

This study presents descriptive information about the value of technology-enhanced nurse monitoring services within GSS assisted living facilities. Our preliminary findings generally support the value of these services for housing managers and family members. The many limitations of these services also are highlighted. Our ultimate goal is to evaluate the effectiveness and cost-effectiveness of these services more systematically in future research, using quantitative methods. When Medicare claims data become available, we will compare costs associated with deploying these systems with potential savings in health care costs. Future analyses testing the economic value of these services will be vital to persuade public and private insurers to provide broader reimbursement to improve affordability and access to these services.

This study has a number of limitations. The analysis is based entirely on subjective perceptions of 12 housing managers at 12 GSS assisted living facilities, collected during focus groups, so there is the possibility of response-set bias whereby respondents give "socially desirable" responses as opposed to expressing their "true beliefs." And these findings may not generalize to other assisted living sites. All three focus groups described herein were completed with housing managers, so other stakeholder groups were excluded from the analysis. The value propositions and perceptions of these services, as well as the LW@H program, are likely to diverge across key stakeholder groups.

Implications

To study potential privacy concerns raised by residents, researchers should develop a typology or taxonomy of connected health technologies and services. At present, the lack of a meaningful classification system makes it challenging to evaluate these services systematically; e.g., connected health technologies may be differentiated along key dimen-

sions related to potential privacy concerns such as the following:

- voluntary versus involuntary nature of the device or intervention
- obtrusiveness versus unobtrusiveness of the monitoring devices
- active versus passive nature of the interaction between the client and the monitoring devices
- remote versus onsite monitoring of telemetry generated by the monitoring devices
- human versus computerized (machine) monitoring of telemetry

Using these five criteria, systems that are involuntary, obtrusive, passive, and monitored remotely by a human are more likely to raise privacy concerns among clients, compared to systems that are voluntary, unobtrusive, active, and monitored on site by a computerized system. Using this or another taxonomy, research should be conducted to determine which set of connected health technologies is more likely or less likely to be perceived by clients as posing a threat to their privacy.

To support more widespread adoption of technology-enhanced nurse monitoring services, research must demonstrate improvements in health outcomes with concomitant cost savings. Research also must identify the types of individuals (i.e., subpopulations) who are most likely to benefit from these services. Are there specific sub-populations (e.g., persons with dementia, heart disease, pulmonary disease, or other chronic conditions) who are most likely to benefit from technology-enhanced nurse monitoring services? From a cost-effectiveness perspective, identifying and targeting those who are at greatest risk will be critical to achieving a positive return on investment. How can these services be provided in a way that make it affordable for low-income seniors and simultaneously yield cost savings and/or produce positive outcomes at a reasonable cost (e.g., to Medicare, Medicaid, private insurance, or other third-party payers)? Current monthly costs for the sensor technologies and monitoring services are about \$90 a month within a typical GSS assisted liv-

ing facility. Cost is a concern raised by some housing managers, residents, and their family caregivers. The pricing model that is used to market these services will be important not only regarding the sustainability of this service line for the GSS but also regarding its affordability to clients.

Technology Limitations

Technology-enhanced nurse monitoring services offer an innovative strategy for providers to improve the coordination of health services within assisted living facilities. To date, these practices have not diffused widely within the assisted living industry. Can assisted living providers use these services to better address the health care needs of their residents? This analysis shows how these services can identify clinically relevant events, such as urinary tract infections, that warrant proactive intervention and/or early treatment. On the other hand, there remain a number of limitations that are likely to create barriers to adoption, including reliability of the information generated by sensors (e.g., false positives); timeliness of the reporting systems; challenges in communication (e.g., between clinical nurse specialists and frontline staff); high costs and limited affordability of these technologies; perceived invasion of privacy among residents; challenges installing, maintaining, and utilizing these devices effectively; limited value of these systems, given the availability of staff observations; challenges marketing these services; and need for improvements (especially more timely or real time data and reporting capabilities). Despite limitations, stakeholder groups, including housing managers and families of assisted living residents, generally see positive value in these innovations. For housing managers, these services offer “validation” to help manage risks proactively. Family members gain added assurance knowing that nurses are monitoring the safety and well-being of their relative.

Organizations implementing remote nurse monitoring systems must develop processes to deploy, maintain, and use these new technologies effectively; e.g., providers must develop systems to document

false positives and false negatives, and conduct root cause analyses to minimize these “errors.” Providers should develop strategies to facilitate communication between geographically separated monitoring teams and frontline staff working at the point of service. To gain “buy-in” from diverse stakeholders, providers must adopt implementation strategies to optimize value across multiple stakeholder groups.

To date, payment for technology-enhanced home monitoring services has remained limited on the part of federal and state programs as well as private insurers. Federal and state programs currently do not pay for these services except on an extremely limited basis. Reimbursement for technology-enhanced home monitoring services needs to be expanded to make these services more affordable for seniors on limited incomes. Moreover, public and private insurers need to establish a common nomenclature to differentiate technology-enhanced nurse monitoring services from related systems (e.g., telemonitoring, telehealth, telemedicine, and other connected health technologies). Insurers must develop common definitions for these services, implement payment structures for covered devices, and define the scope of services provided using these systems. Alternatively, these services could be included as part of the scope of services provided within a bundled payment system (e.g., under a risk-sharing contract).

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