

An exploratory study of barriers to implementing technology in U.S. residential long-term care settings

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V.A. Freedman, M. Calkins, K. Van Haitsma, An exploratory study of barriers to implementing technology in U.S. residential long-term care settings. Gerontechnology 2005; 4(2): 86-100. **Background** If designed and implemented appropriately, technology can potentially be effective in increasing efficiencies and enhancing the quality of care and quality of life for older people living in nursing home, assisted living, continuing care retirement communities. Yet, technologies remain rare in these settings in the United States. The purpose of this exploratory study is to identify common themes about barriers to adopting technologic innovations in U.S. residential long-term care settings. **Methods** We conducted semi-structured interviews with 16 individuals in the United States who had expertise with technology in residential long-term care settings. Unlike previous studies, we included four distinct perspectives: providers, technology manufacturers, regulators, and other long-term care experts. We defined technology broadly but paid particular attention to technologies for five care issues that are especially prevalent and/or costly in residential care settings—wandering management, fall prevention, incontinence care, assistance call, and bathing. Using content analysis, comments were grouped into four content areas (social, financial, regulatory, and change management) and themes within each area were identified. **Results** We identified 12 potentially important themes for further study: lack of information about cost-effectiveness of technologies; lack of information about other aspects of technologies; lack of information about residential long-term care market; limited resources for providers to purchase technologies; concerns about liability and associated costs; lack of reimbursement for technologies in these settings; limited resources for manufacturers to develop useful technologies; lack of standards to facilitate integration; discouragement of innovation by the regulatory environment; specific regulations inhibiting new technologies; staffing-related challenges, and the challenges of managing the process of change. **Conclusions** There is considerable agreement across providers, manufacturers and regulators in the United States about the major barriers to implementing technologies in residential care settings. Additional research is needed to shed light on effective strategies for overcoming these barriers and increasing the effective integration of technology in residential long-term care settings.

Keywords: long-term care, nursing home, assisted living, content analysis

Over 2 million older Americans currently live in nursing homes and other residential long-term care settings, including assisted living facilities and continuing care retirement communities. Although they represent a minority of older persons, these frail older adults constitute an important group of interest for the development of technological applications. Nearly all persons in these settings have physical or cognitive limitations that result in disability¹; thus, technologies targeted at this population can potentially reach large numbers of older people with the greatest needs. Moreover, the financial and societal costs associated with caring for this group are substantial: in the year 2002, for example, over \$100 billion was spent in the United States on nursing home care alone² about half of which was financed by government sources. In the future, the number of older people in the U.S. needing long-term care is expected to rise, even if recent declines in the prevalence of disability continue.³

The U.S. residential long-term care industry is facing several inter-related challenges that heighten the need for technological innovations. There is continued interest by federal and state regulators⁴ and providers⁵ to improve quality of care and quality of life for residents, particularly in the nursing home sector. Moreover, the nationwide shortage of nurses is especially severe in long-term care. Projections suggest that by 2050 the demand for direct care workers in these settings will increase by over 200% but only a slight increase is expected in the supply of workers who have traditionally filled these jobs.⁶ Finally, there are severe financial constraints in the industry due in part to continued pressures on States to limit growth in Medicaid⁷ and the rising costs of risk management.^{8,9}

Such challenges raise hopes that if de-

signed and implemented appropriately, technology can potentially be effective in achieving several inter-related goals: enhancing the quality of care of residents; enhancing the quality of life of residents; and increasing efficiencies of care. Yet, relatively little attention has focused on technological innovations for the residential care sector (see, for example, *Gerontechnology* 2(1)) and only a few studies have explicitly focused on factors influencing the adoption of technological innovations in this sector.^{10,11} A separate but related literature has focused on barriers to adopting service innovations in long-term care^{12,13} and barriers to adopting technologies in hospitals or other health care settings¹⁴⁻¹⁷ but such findings are not systematically translatable to a discussion of technologies in the elder residential care market.

Existing studies share several common limitations. First, research to date lacks an overarching framework developed specifically for the heavily regulated and often resource-limited residential long-term care settings. Instead studies have emphasized limited aspects of the innovation-adoption process. For example, Armer and colleagues found support for the Concerns-Based Adoption Model in their evaluation of the adoption by nursing homes of telemedicine.¹⁰ Originally developed to study change among educators,¹⁰ the model emphasizes individuals' need for appropriate information at each stage of concern: self-oriented concerns (how will it affect me?), task oriented concerns (how do I do it?) and impact concerns (how will this change work for others?). Alternatively, focusing on economic factors, Castle found that an organization's early adoption of innovation depends upon organizational (e.g., bed size, chain membership, percentage of private pay residents) and market (e.g., Medicaid reimbursement methodology) characteristics.¹² A second limit-

ation is that studies have generally focused on a single type of innovation; thus it is unclear at this point to what extent findings about barriers are generalizable across many technological innovations. Third, studies thus far focus primarily on the providers' perspective. Yet barriers to implementing technological solutions in the residential care sector may relate to the development of technologies or to regulatory impediments to their use. Hence, it is important to consider the views of technology manufacturers and regulators as well as providers.

The purpose of this exploratory study was to identify, based on semi-structured interviews with 16 experts, potential social, economic, and regulatory barriers to the implementation of technology in U.S. residential care settings. Our primary objective was to provide the basis for suggesting research and educational strategies to begin to address barriers. Unlike previous studies, four distinct perspectives were included: providers, technology manufacturers, regulators, and other long-term care experts. Rather than focusing on a single intervention, technology was defined broadly, but particular attention was paid to technologies for five key areas of care that are especially prevalent and/or costly in residential settings—wandering management, fall prevention, incontinence, assistance call, and bathing. This paper discusses cross-cutting themes that emerged through content analysis of semi-structured interviews. We conclude by discussing implications of our findings in the context of current literature and describe a series of educational and exploratory research strategies to be considered as next steps.

BACKGROUND

One of the earliest and most comprehensive theories on innovation diffusion was put forth by Rogers.¹⁹ He first sug-

gested in the 1960s that this process involves (i) exposure to and understanding of the innovation, (ii) formation of a favorable attitude towards it, (iii) committing to its adoption, (iv) implementing the innovation, and (v) confirming or reinforcing use based on a positive outcome. Rogers also theorizes that an increased rate of diffusion will occur if the innovation: is perceived to have relative advantage, is compatible with existing culture, is not overly complex, is trialable, and offers visible results. He also discusses the central role of leaders and change agents in innovation diffusion. Further, he suggests that there are different adopter categories ranging from "innovators" (who adopt first) to "laggards" (who adopt last). The former are characterized as risk takers, who undergo a fast decision process, with ample financial resources whereas the laggards have a lengthy decision process and limited resources.

The literature relevant to technology adoption in residential care settings, though small, offers some support for Rogers' concepts. Armer and colleagues, for example, found in qualitative interviews with nursing home staff that information is central to decisions about the adoption of telemedicine.¹⁰ In a qualitative study of computerized care planning, Lee found that the perceived characteristics of an innovation matter.¹⁴ Based on semi-structured interviews with senior management at 26 hospitals, Poon and colleagues identified, among other factors, the salience of strong leadership within the hospital for adoption and implementation of computerized physician order entry systems.¹⁷ Castle found that having a higher percentage of private pay residents (a marker for more financial resources) is positively related to the early adoption of innovative services in nursing homes.¹² And Lekan-Rutledge found Roger's framework to be useful for

designing, implementing, and evaluating the adoption of a prompted voiding intervention in a nursing home setting.¹³

Despite its usefulness, Rogers' theory does not explicitly recognize three critical features of the residential long-term care market. First, the choice to adopt a technology is generally made by decision makers in an organization (e.g., chief financial officer, chief information officer, administrator, director of nursing or information technologies) and the ultimate users—often certified nursing assistants and other direct care workers—must make adjustments accordingly.²⁰ Second, the residential care market, particularly nursing homes, is highly regulated and the government is a major payer for residential care services, principally through the Federal-State Medicaid program. Regulations may influence an organization's demand for technology, for example, by introducing uncertainty into the certification (survey) process or by requiring the adoption of particular technologies. Finally, barriers in the residential long-term care setting likely relate not only to the *adoption* of the innovation but to the *development* of innovations by manufacturers that are explicitly designed for this sector.

METHODOLOGY

With these complexities in mind, we developed semi-structured instruments to guide our conversations with 16 experts representing four distinct perspectives in long-term care in the United States: 3 regulators, 6 providers, 4 technology manufacturers, and 3 other experts (including 2 researchers) about their experience with barriers to implementing technology in long-term care settings. Experts were selected in part because of their experience with technologies for care issues identified by an expert panel to be highly prevalent and/or high cost: (wander management, fall prevention, incontinence, assistance call, and bathing)

and also in part according to group-specific criteria as follows. Providers were purposefully selected to include management from nursing home, assisted living, and continuing care retirement communities; all providers had experience with implementing technologies. Manufacturers were selected from companies selling wandering and fall management systems, bathing products, assistance call systems, or communications technologies. Regulators were purposefully drawn from states representing more and less progressive approaches to long-term care regulation. Other experts were selected for their in-depth knowledge of aging and long-term care research, policy, and practice. Future studies may wish to solicit the opinions of direct care workers²¹ as well as families and third party payers.

We used a semi-structured qualitative interview to elicit themes about social, economic, and regulatory barriers to implementing technology in long-term care settings. Providers were asked about their experiences incorporating new technology in their residential care setting. Manufacturers were asked about the processes of developing and marketing residential care products. Regulators were asked about their experience determining whether new technologies are appropriate and allowable. Other experts were asked about their views on barriers to bringing technologies into residential long-term care settings. Our conversations were intended to elicit general themes about barriers that cross cut many types of technologies but also to glean specific examples related to the five care issues of interest. Interviews lasted on average 30-45 minutes.

Interviews were tape recorded with permission and verbatim transcriptions of the interviews were made (without identifiers). The transcriptions served as the

basis for the qualitative content analysis. Each transcript was reviewed by two analysts who sorted the content into three a priori content categories: social (including informational), regulatory (construed broadly to include government and self-regulation), and financial issues. The qualitative analysis yielded one other important category-concerns related to managing and implementing change.

Within each of these five categories, sub-categories (referred to as "themes") were identified and discussed by the analysts for content validation. A theme is an important, meaningful principle that shapes experts' perceptions of barriers to implementing technology in long-term care settings. Themes were constructed by bringing together components of ideas or experiences across multiple informants to form a picture of their collective experience.

Minor discrepancies in the grouping of content into themes were resolved through discussion amongst the analysts. Consistent with qualitative protocols for reporting thematic findings, we illustrate such themes with verbatim quotations. Such quotations use the words of one individual respondent to illustrate and represent a point that was made by multiple individuals. The quotes also remind the reader that themes were identified based on conversations with a small number of people and generally should be interpreted as areas for further systematic exploration. We discuss the most common themes that emerged within each content area; each theme was mentioned by at least 3 of the 16 informants.

FINDINGS

Through our conversations with providers, regulators, manufacturers and other experts, we identified in each of the four content areas themes about bar-

riers to implementing technology in U.S. residential care settings. Themes within each content area are summarized in Table 1 and discussed in more detail below.

Lack of information

Several themes emerged about the lack of knowledge by key groups – manufacturers, providers, and regulators alike – about different aspects of technology in residential care settings.

Half of the individuals we spoke with, representing all four perspectives (providers, manufacturers, regulators, and other experts), explicitly mentioned that lack of information about cost-effectiveness of technologies was a significant barrier. Some also recognized that obtaining information on cost-effectiveness was not altogether straightforward. One provider discussed the complexity of linking cost savings to technological innovations in nursing homes. He explained that because there are minimum staffing standards, most places would not be allowed to cut staff. He went on to say:

"They might save money in...other efficiencies... [but] it's harder to link it directly back to the technology you bought. [For example], how much of the wound prevention really is related directly to the purchase of our new care planning program? Somebody [should] do a study linking the efficiency to cost savings in less tangible areas: medication costs, anti-biotic use, wound care, fall risk."

A second theme, mentioned by 5 people with whom we spoke (including providers, manufacturers, and regulators) suggested that lack of other, more basic information about existing technologies was a significant barrier to decision-making about purchasing. One provider summarized the challenge as follows: "[There is a] lack of awareness of

Table 1. Summary of Barriers to the Implementation of Technology in Residential Long-Term Care Mentioned in Semi-structured Interviews (N=16); P=provider; M=manufacturer; R=regulator; O=other

Content area and theme	Number mentioning theme	Perspectives mentioning theme
LACK OF INFORMATION		
Lack of information about cost-effectiveness of technologies	8	P, M, R, O
Lack of information about other aspects of technologies	5	P, M, R
Lack of information about residential long-term care market	3	M, O
FINANCIAL CONCERNS		
Limited resources for providers to purchase technologies	13	P, M, R, O
Concerns about liability and associated costs	5	P, M, O
Lack of reimbursement for technologies in these settings	4	P, M, O
Limited resources for manufacturers to develop useful technologies	4	P, M, O
REGULATORY CONCERNS		
Lack of standards to facilitate integration	8	P, M, R
Regulatory environment discourages innovation	7	P, R, O
Specific regulations inhibit new technologies	5	P, R
CHALLENGES OF MANAGING CHANGE		
Staffing-related challenges	12	P, M, O
Managing the process of change	8	P, M, O

what the technology [does], what technologies are available, and what it can achieve.”

Two manufacturers and one other expert expressed a lack of knowledge about how the long-term care market views the importance of technology. One individual summarized the lack of market data in the following way:

“How large is the aging services field? How much do they spend on IT [information technology] today? What percentage of their total budget? What are the top 3-5 usages of that technology...? No one can answer [these] question[s].”

Perceived lack of financial resources

A second major content area is related to a perceived lack of financial resources. We discuss four themes that

emerged in this content area: the lack of resources to allow providers to purchase technologies, concerns about liability, the lack of reimbursement for technologies, and the lack of resources to develop products.

Nearly all people that we spoke with perceived that providers lacked resources to purchase new technologies, which they described as costly. One manufacturer talked about the resources needed to create a lift-free environment. Such an environment is one in which residents are transferred with technology assistance rather than lifted, as is now recommended by the Occupational Safety and Health Administration (OSHA)’s new guidelines for resident handling and transferring.²² The manufacturer reported in the following way:

“It takes substantial investment for [pro-

viders] to acquire this type of equipment and... it might involve some renovation... An average nursing home, say 100-bed nursing home, to put in a lift-free environment, may have to spend anywhere from \$35,000 to \$40,000."

We also heard repeatedly that it is not just the cost of the technology or equipment itself, but the associated costs. Other costs mentioned include the costs of locating new technology, training, upgrading, and creating and sustaining momentum for change. For some technologies, such as wireless nurse call systems, additional costs have been imposed by requirements that both wired and wireless systems are to be installed. A researcher we spoke with noted that early adopters face even higher initial costs and more risk because of the uncertainties associated with new initiatives. In sum, as one provider put it, a provider needs a "critical mass" of resources to implement a new technology.

Five individuals described liability concerns as a barrier. For example, one expert talked about technology companies' fear of liability in the following way: "You[']ve got a lot of companies out there now who [have]... never been involved in health-related areas who are now working on technologies...and [they are] fearful of all the liabilities that [are] associated around health-related activities. We hear that on a regular basis."

Providers' concerns about liability were also noted. For instance, one manufacturer explained why providers were reluctant at first to try a new assistance call system:

"I think [another] dominant theme is also lawsuits. [Providers thought it was] a great idea, people would like to do it, but no one [wanted] to take the first step, no one was willing to set the precedent."

We heard similar concerns directly from providers. One provider explained that in his experience families would request chair alarms, thinking the technology would prevent falls. He described a process in his facility to minimize liabilities associated with the technology. First, he explains to families how the technology works, emphasizing that the technology does not prevent falls but instead signals the nursing staff. Next, he asks families to sign agreements that state they understand there are risks associated with the use of the technology. He describes liability in terms of tradeoffs among quality of life, independence, and risks:

"There are liability issues related to implementing this technology [the chair alarm]. You can improve the [residents'] quality of life ...and you can even improve their independence but it also increases their potential for risk. [There are] risks inherent in technologies that enhance independence."

Four individuals mentioned limits on insurance reimbursement as a barrier. One provider explained that reimbursement systems are not structured to reward improvements in quality of care that might be conferred by technology. He described the barrier as follows:

"One, there's not really definitive criterion as to what's 'clinical excellence.' Then two, there's not a payment mechanism in place that rewards that."

Manufacturers and other experts also raised the issues of limited reimbursement.

A final theme in this content area is related to the perceived lack of resources to develop useful products. Four people provided comments to this effect (two providers, one manufacturer and one other expert). One expert we spoke with shared the following opinion about resources to develop new products:

“There’s an obvious need for technology that can facilitate the quality of care, facilitate productivity, etc. But the real struggle is that there is very little opportunity to fund those initiatives, or fund the analysis to determine what kind of value a given technology might have at the organization, or what kind of outcomes and results that a given project, or a given technology might yield.”

Regulatory barriers

A third major content area related to regulations in the residential care sector. We construed this area broadly to include self-regulation by the industry as well as regulations imposed by the government. Three clear themes emerged in this content area: the need for standards to promote integration of technologies, the largely negative influence of the current regulatory environment, and the barriers imposed by outdated regulations.

The most commonly mentioned theme in this content area was the need for more standards to facilitate the compatibility and integration of technology. This theme was mentioned by half of the people with whom we spoke, representing a mix of providers, manufacturers and regulators. One provider noted:

“On one of my campuses, I may have a fire system, I may have a nurse call system, I may have a wandering system...four or five different independent systems. Each one of those delivers value. But the fact that they each deliver those values independently from the other is a very, very significant impediment to effectively deploying the full benefit from them.”

From the manufacturer’s perspective, a lack of standards adds to their manufacturing expenses. A lack of standards is also time-consuming for regulators. Regulators contacted for this project indicated there was a general lack of stand-

ards for evaluating new technologies. Usually, regulators will require a new product to undergo testing and be certified by the Food and Drug Administration, Underwriters Laboratories, or a similar, third-party testing organization.

A second theme emerged in conversations with seven people who addressed the role of the regulatory environment. They noted that the current regulatory climate in residential care settings introduces incentives that do not promote development or adoption of new technologies. One provider expressed the situation as follows: “the [technology] industry [has] become oriented toward regulation and that becomes a proxy for their own effort to design a product and strategy.” A related theme has appeared in the gerontology literature. For example, Schnelle and colleagues found in two case studies of information technology implementations in nursing homes that effective protocols were not sustained once research teams ceased their involvement.²³ The authors concluded that the regulatory emphasis on documentation creates a disincentive for providers to employ technologies that provide accurate information to improve the process of providing care.

Not all the people we spoke with described the regulatory environment as a barrier. For example, one nursing home provider described the regulatory process as helpful for obtaining a variance to implement a wander prevention system in nursing home:

“The regulations are still there [on the books] but you just get a waiver. So, you still have a process to get through. And basically that process is really... just to make sure...that you’re implementing the technology properly. I see that as helpful...”

A final theme that emerged was the fact that some regulations are out of date.

In our discussions, all three regulators and two providers offered us examples of regulations that clearly lagged behind technologies. One regulator summarized the issue as follows: "Technology is moving so fast that the codes can't keep up."

A useful example relates to assistance call systems in nursing homes. A manufacturer described a system that has been developed, which uses sensors to automatically detect motion and movement, incontinence, and falls, and which can be programmed to send an alert to staff without physical action by residents. The manufacturer explains that codes that require physical activation of the call system by residents make it difficult to sell systems to nursing homes, which in some cases have been required to put in two systems.

Indeed, in our search of U.S. state regulations we found only three states that made specific mention of wireless technology (Kansas, South Dakota, and Washington), whereas New York considers such systems on a case-by-base basis. At the same time, 28 state codes are written in such a way that calls must be physically activated by residents (typically either through a call button or pull cord).

A regulator shared an example of the process they use to revise outdated regulations that have to do with technology. "We allowed several facilities to install the wireless technology, evaluated how well it did, and then we amended the regulations to allow for it..." They were able to allow installation through their "substantial compliance" clause, which essentially requires the provider or builder to explain why the technology meets the intent of the regulation. She explains, "[If], after review by staff here, we determine that it does meet the intent of regulation, we will issue a letter of what

we call 'substantial compliance' and that letter essentially says that you ...could do what you've asked for and we will monitor its effect on residents or staff through the survey process. And if we find that it does not meet the regulatory intent, we could rescind the substantial compliance."

It is unclear how many states have the resources to use the substantial compliance process to make regulations more compatible with new technologies.

Providers' lack of knowledge and experience with implementing and managing technological change

Providers, manufacturers, and other experts made a number of notable comments about challenges associated with the process of implementing technologies in long-term care settings. This content area consisted of two main themes: issues around staffing logistics (for instance, with respect to skill level, training, time resources, and turnover) and issues around leading the process of change in the face of resistance to new technologies.

Twelve of the people we spoke to (including providers, manufacturers, and other experts) mentioned issues related to staffing as a barrier to implementing technology. One provider explained that non-profit nursing homes in particular attract people who prefer 'high-touch' rather than 'high-tech' care. Another noted nursing staff's limited technical knowledge and low comfort with technologies. A manufacturer of technologies for the senior housing market explained that training was key to successful implementation of technology. He remarked: "At the end of the day we are more about training and change management than about technology implementation." The time consuming nature of implementing new technologies was also noted by several providers. One ex-

plained, "You've got to invest a lot of time and energy before you get a long-term result..." Difficulties associated with staff turnover were also noted.

Half of the people we spoke with mentioned the challenges of leading change in a long-term care setting. Providers and manufacturers alike expressed the opinion that leadership was critical in bringing about a technological change in a residential care setting. One provider described the leader in the following terms: "In order to bring ...a real cutting edge technology into a long-term care facility... you have to have people...that are really dedicated...who really want to make it work..." Another noted, "they need to be a champion..." A manufacturer explained, "I think [its success] depends on who champions it, and when it arrives someone makes sure that it works..."

Another explained the leadership challenge as follows:

"It's sort of a catch 22. On one side, to implement technology, you need everybody to buy in to it. If people don't buy in, it's not going to work....But on the other side, you've got to also mandate to a certain extent because if you don't mandate, it's always going to be pushed aside."

Resistance to the process was noted as a challenge. For example, one provider explained, "I say technology by itself is pretty simple. Technology works. If it doesn't, you make it work. [The difficult part is] to get the human side to work with it. It's convincing people that it's better for them."

Providers indicated that staff seemed to resist technologies in which they felt monitored or that were intended to supervise their work. In contrast, tools to help them accomplish their tasks appeared to be welcomed by management

and direct care workers alike.

In the conversations we had with providers, we noticed what appeared to be a striking pattern in which technologies that were introduced externally - by top level management, as part of strategic plans set by boards of directors, or by researchers - faced significant challenges during the implementation process and were difficult to sustain. Several exchanges illustrate this apparent relationship. In the following exchange, a provider describes the slow and difficult process implementing technology initiatives, including a touch-screen application for direct care workers. In this setting, the application was adopted in response to the company's strategic plan. Interviewer: "Are there particular settings in which you find technology more difficult to implement?"

Provider: "We find technology universally extremely difficult to implement."

Interviewer: "Any examples of where it went more easily than you expected...?"

Provider: "No...We have examples of where things go easier than you expected, but often those are...because you've gone through a period of great difficulty... "

Another provider describes the implementation of an assistance call technology driven by senior management:

Provider: "We're now at a point where the staff is pretty compliant..."

Interviewer: "When did you first bring in this technology?"

Provider: "About 2 years ago."

Interviewer: "And how long would you say that it took for compliance?"

Provider: "About 2 years."

In contrast, those technologies offered to direct care staff in response to a request by those staff appeared to be much more easily integrated. One example illustrates an implementation involving a palm device for direct care

staff to record clinical documentation as they observe activities; when the device is put back in the cradle, the clinical documentation is automatically updated. The provider explains:

"[We] queried a number of our locations about what they needed relating to capturing that information, and then we developed an application to do that on the palm and then we took it out and piloted it at some locations. Our goal for the pilot was that ... we would allow them to work with it for a period of time, they'd give us some feedback as to the good things and bad things about it, then our plan was to go back and to make changes and adjustments to the application and roll it out on a broader scale to implement it. When we came to the end of our pilot time training, our pilot sites were willing to give us the information about [the experience] with it. But they refused to give up the application. They said, "There's no way we're going to give this up. Even in its draft state, in its preliminary state, it is such a productivity lift and such an aid and a benefit to our professions...we don't want to give it up."

A second example involved a wander management system. The provider described a situation in which health care staff from an Alzheimer's unit approached him with concerns about elopement.

"[They asked us] 'What can we do about it?' So we put a Request for Proposal (RFP) out to look at the various wandering systems... And we chose the company. They demo-ed the system, came down here and actually next week, we're going to start installing...The thing about that is [the process] was driven by them [Alzheimer's special care unit staff]. They're going to love it because they can see an immediate pay back."

In a follow-up conversation after installing the system, the provider confirmed, "They ...are very appreciative of it..."

DISCUSSION

Through semi-structured interviews with 16 experts in the field of technology and residential care settings, we identified 12 potentially important barriers for further study in four areas: information needs; financial concerns; regulatory concerns; and the challenges of change management. Our findings expand upon the small literature to date on this topic. Consistent with Rogers' theory of innovation diffusion, and with findings by Armer and colleagues¹⁰ and Lee,¹⁴ we find a lack of information is recognized by key perspectives as being an important barrier to technological innovation in the residential care industry. We also identified themes, consistent with Castle,¹² that suggest market considerations are important in encouraging innovation in residential care settings. We heard from a number of experts that financial barriers are great and that regulatory considerations matter – not just in terms of reimbursement but regulatory process as well. Moreover, consistent with Rogers' theory¹⁸ and findings by Poon and colleagues,¹⁷ providers, manufacturers and regulators alike mentioned that leadership was crucial to the successful implementation of technologies in the residential care market. Our findings are also suggestive of a new hypothesis for further testing: namely, that the process of introducing a technology (from top management vs from the front-line staff) predicts the level of resistance from staff.

Our study has a number of important limitations. The small sample size and lack of systematic sampling means that we could not provide quantitative evidence that is generalizable. Nor did the

qualitative methodology we adopted allow us to compare the relevant importance of various themes that emerged or to determine if perceptions that were reported to us were accurate. Nevertheless, by incorporating multiple perspectives and asking more generally about technologies, this study provides the first broad analysis of the issue. Prior studies only provided partial solutions. Our research, conversely, suggests that improving information alone, for example, without changing regulations or training providers to manage change, is unlikely to be sufficient.

What do our findings suggest for next steps to ensure the frail older adults living in these settings in the United States are not left behind? The methodology we employed uncovered 12 themes, but in many cases further qualitative and quantitative research will be needed to confirm the relative importance of each of these themes to the overall challenge. In light of these findings, we provide a series of educational and exploratory strategies to be considered. We organize the remainder of the discussion along the content areas identified in our analysis and describe recent advances and next steps that can be taken to better understand the nature and causes of the barriers.

Assess and address information gaps

Gaps in knowledge about technologies in residential long-term care settings could be remedied in a number of ways. A study to develop and test a framework for assessing the costs and benefits of different types of technology in residential long-term care settings would clearly be useful. U.S. government funded resources designed to provide information about available technologies, such as www.TechforLTC.org and www.abledata.com, should be evaluated for their usefulness in informing pro-

viders' purchasing decisions. Gaps could also be addressed with a study to determine the size of the long-term care market, and what their needs are for technology, or by adding questions about technologies to the national provider surveys.

Explore ways to encourage implementation of cost-effective technological innovations in residential long-term care settings

In the future, states will likely face additional pressures to limit Medicaid spending, a major source of payment for residential long-term care.⁷ Studies geared toward exploring whether technologies are indeed cost effective, and if so, the manner in which cost savings occur in residential care settings, would be very useful to aid in reimbursement decision making.

The implementation of cost-effective technologies could be encouraged by development and testing of a framework to assess the costs and benefits of technologies in residential care settings. Such analyses would help providers make informed decisions about investments and may also provide guidance to private and public insurers interested in covering such technologies. This area is particularly challenging, as savings may accrue to a different sector of the health care field. For example, reducing the number of serious falls in nursing homes will likely reduce hospitalization costs, but not necessarily reduce (and in some cases increase) actual expenditures in the residential care. In addition, better understanding of residential care and health care liability issues is needed. Finally, the existing state assistive technology alternative financing programs might serve as a useful vehicle for making low cost loans available to residential care facilities who serve low-income residents.

Encourage development of industry standards for residential care technologies and explore how best to provide guidance to regulatory agencies

In our review of the literature and in the course of our conversations we learned of several industry efforts underway to promote standards for technologies that are in use in residential long-term care settings. For example, The Center for Aging Services Technology (CAST), a program of the American Association of Homes and Services for the Aging, has created an Electronic Health and Wellness task group that participates in national data standards activities such as Health Level 7 (HL-7). Standards for call systems for nursing facilities were included in the 2001 edition of the American Institute of Architects' guidelines on hospital and health care facility design. Within these guidelines are specific mention of wireless radio frequency call systems and issues of electromagnetic compatibility of internal and external sources.²⁴ The Healthcare Communications and Emergency Call Systems Group of the National Electrical Manufacturers Association (NEMA) is currently working with Underwriters Laboratories to modify nurse call safety requirements to include wireless functions. This NEMA group is also working on a project to define and create standards for emergency call (wired or wireless) systems used in less monitored environments, such as assisted living. Additional studies exploring the best way to encourage and support voluntary standard development efforts by industry would be valuable.

Guidance to regulators could be enhanced by encouraging states to adopt updated codes on a regular basis, by encouraging the appropriate private associations to provide for interim interpretations of their codes, by developing partnerships with industry representatives to guide regulators around new technolo-

gies, by identifying states that are at the forefront of modifying regulations to enhance technological innovation, and by encouraging more information on the benefits of technology in residential long-term care settings. The process of developing new regulatory standards could be facilitated by supporting a demonstration project that reimburses care based on quality not cost. In addition, states that have long track records in advancing regulatory innovation could be enlisted to teach others about the process of substantial compliance. Finally, a theme that emerged was the need for industries to adopt standards so that technologies are more compatible. While this theme is endemic to health care settings in general, long-term care in particular places demands on organizations to coordinate high-quality efficient care using a comprehensive and holistic approach.

Educate providers about implementation issues

Finally, our study points to the need to further educate providers about the relationship between the purpose of and process by which technology is introduced and sustained over time in residential care settings. Focus on this topic is further supported by ongoing discussions within the residential care community itself which has increasingly called for the need to focus on leadership and change management surrounding all care-related issues.

In sum, there appears to be considerable agreement across providers, manufacturers and regulators about the major barriers to implementing technologies in U.S. residential care settings. Additional research is needed to shed light on effective strategies for overcoming these barriers and increasing the effective integration of technology in residential long-term care settings.

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References

1. Centers for Medicare and Medicaid Services. MDS active resident information report: third quarter 2004. Washington: Centers for Medicare and Medicaid Services; 2004
2. Levit K, Smith C, Cowan C, Sensenig A, Catlin A, The Health Accounts Team. Health spending rebound continues in 2002. *Health Affairs* 2004;23:147-159
3. Waidmann TA, Liu K. Disability trends among elderly persons and implications for the future. *Journal of Gerontology* 2000; 55:S298-S307
4. U.S. General Accounting Office. Assisted living: quality-of-care and consumer protection issues in four states. Washington: U.S. General Accounting Office; 1999
5. Weiner A, Ronch J. Culture change in long-term care. New York: Hawthorne Social Work Practice Press; 2003
6. Assistant Secretary for Planning and Evaluation. The future supply of long-term care workers in relation to the aging baby boom generation, report to Congress. Washington: Assistant Secretary for Planning and Evaluation; 2003
7. Centers for Medicare and Medicaid Services. Health care industry market update: nursing facilities. Baltimore: Centers for Medicare and Medicaid Services; 2003
8. Stevenson DG, Studdert DM. The rise of nursing home litigation: findings from a national survey of attorneys. *Health Affairs* 2003;22:219-229
9. Wright B. Nursing home liability insurance: an overview. Washington: AARP Public Policy Institute; 2003
10. Armer JM, Harris K, Dusold JM. Application of the concerns-based adoption model to the installation of telemedicine in a rural Missouri nursing home. *Journal of Nurses Staff Development* 2004;20: 42-49
11. Bulat T, Powell-Cope G, Rubenstein LZ. Perceived barriers and facilitators for the use of external hip fractures. *Gerontechnology* 2004;3:5-15
12. Castle NG. Innovation in nursing homes: which facilities are the early adopters? *Gerontologist* 2001;41:161-172
13. Lekan-Rutledge D. Diffusion of innovation. A model for implementation of prompted voiding in long-term care settings. *Journal of Gerontological Nursing* 2000; 26: 25-33
14. Lee TT. Nurses' adoption of technology: application of Rogers' innovation-diffusion model. *Applied Nursing Research* 2001;17: 231-238
15. Berner ES, Detmer DE, Simborg D. Will the wave finally break? A brief view of the adoption of electronic medical records in the United States. *Journal of the American Medical Informatics Association* 2005; 12:3-7
16. Poon EG, Kaushal R, Jha AK, et al. Assessing the level of healthcare information technology adoption in the United States: a 2003 snapshot of the Boston and Denver markets. *Medinfo* 2004;1815
17. Poon EG, Blumenthal D, Jaggi T, Honour M, Bates D, Kaushal R. Overcoming barriers to adopting and implementing computerized physician order entry systems in U.S. hospitals. *Health Affairs* 2004;23:184-190
18. Hall GE, Hord SM. Change in schools: facilitating the process. SUNY series in educational leadership; 1987
19. Rogers EM. Diffusion of innovations (5th edition). New York: The Free Press; 2003
20. Zaltman G, Duncan R, Holbeck J. Innovations and organizations. New York: John Wiley; 1973
21. Bower AR, Van Haitsma K, Curyto K. Tech-

nology and environment: the benefits and costs of integrating a passive nurse call technology into the nursing home: experience and meaning. Annual Meeting of the Gerontological Society of America. San Diego; 2003

22. Occupational Safety and Health Administration. Guidelines for nursing homes: ergonomics for the prevention of musculoskeletal disorders. Washington: Occupational Safety and Health Administration;

2003

23. Schnelle J, Ouslander J, Cruise P. Policy without technology: barrier to improving nursing home care. *Gerontologist* 1997;37:527-532

24. Facility Guidelines Institute, American Institute of Architects. Guidelines for design and construction of hospital and health care facilities: 2001 Edition. Washington: American Institute of Architects; 2001
