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Office of Disability, Aging and Long-Term Care Policy

BARRIERS TO IMPLEMENTING TECHNOLOGY IN RESIDENTIAL LONG-TERM CARE SETTINGS

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Office of the Assistant Secretary for Planning and Evaluation

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BARRIERS TO IMPLEMENTING TECHNOLOGY IN RESIDENTIAL LONG-TERM CARE SETTINGS

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ABSTRACT

Technology plays a vital role in the lives of older individuals. Indeed, for those in need of long-term care, it can potentially improve the efficiency of care delivery while increasing the quality of that care and individuals' quality of life.

The purpose of this report is threefold: (1) to describe a range of existing and emerging technological solutions for select care issues salient to residential care settings; (2) to identify, based on a review of the literature and discussions with experts in the field, barriers to the successful implementation of technology in residential care settings; and (3) to propose initial steps to address the barriers.

To identify technologies we conducted extensive literature and Internet searches, consulted long-term care buyer's guides, and spoke with technology manufacturers and vendors at various conferences. To identify barriers we conducted an extensive literature review and also spoke with 16 experts representing four distinct perspectives in long-term care: regulators, providers, technology manufacturers, and other experts about their experience implementing technology in long-term care settings.

Our approach revealed a complex set of circumstances contributing to the current situation. Five themes emerged as particularly salient in experts' discussion:

- Lack of information about technologies and the residential long-term care market.

- Perceived lack of financial resources to develop and purchase residential long-term care technologies.

- Failure of the regulatory process to keep pace with technological advances.

- Industry's lack of standards for technologies in residential long-term care.

- Providers' lack of experience implementing and managing technological changes.

In light of these findings, our recommendations for next steps involve a series of educational and exploratory strategies around five areas designed to:

- Remedy existing gaps in knowledge about technologies in residential long-term care settings.

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

- Explore how best to reduce regulatory barriers to innovation.

- Encourage development of industry standards for residential care technologies.

- Educate providers about implementing and managing technological change.

EXECUTIVE SUMMARY

Technology plays a vital role in the lives of older individuals. Indeed, for those in need of long-term care, it can potentially improve the efficiency of care delivery while enhancing the quality of that care and improving individuals' quality of life.

Although the approximately 2 million older Americans living in nursing homes and other residential care settings[1] represent a minority of older persons, they constitute a group of interest for the development of technological applications for several reasons. First, nearly all persons in residential long-term care settings have physical or cognitive limitations that result in disability; thus, technologies targeted at residential long-term care can potentially reach large numbers of older people with the greatest needs. Second, the financial and societal costs associated with caring for this group are substantial and are projected to increase dramatically. In the year 2000, for example, nearly $100 billion was spent on nursing home care. Third, the number of older people in need of long-term care is expected to increase dramatically in the coming decades due to the aging of the baby boom generation. In particular, the number of older people with Alzheimer's disease, about half of whom are cared for in residential care settings, is projected to increase dramatically from about 4.5 million today to over 13 million by 2050. If designed and implemented appropriately, technology can potentially be an important instrument in attaining high quality cost-effective care for this population.

The residential long-term care industry is facing several inter-related challenges that heighten the need for attention to technological innovation. First, there is continued interest, by both providers and federal and state regulators to improve quality of care and quality of life for residents, particularly in the nursing home segment. Second, there is a nationwide shortage of nurses that is especially severe in long-term care. Third, there are financial constraints in the industry due in part to continued pressures on states to limit growth in Medicaid and also to the rising costs associated with risk management.

The purpose of this report is threefold: (1) to describe a range of existing and emerging technological solutions in residential care settings; (2) to identify, based on a review of the literature and discussions with experts in the field, barriers to the successful implementation of technology in residential care settings; and (3) to propose next steps to address the barriers.

To identify technologies we conducted extensive literature and Internet searches, consulted long-term care buyer's guides, and spoke with technology manufacturers and vendors at various conferences. To identify potential barriers we conducted an extensive literature review and also spoke with 16 experts representing four distinct

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[1] In this report, we define residential long-term care settings as a continuum of care that includes nursing homes, assisted living facilities, board and care facilities, continuing care retirement communities, and adult day care facilities.

perspectives in long-term care: regulators, providers, technology manufacturers, and other experts about their experience with barriers to implementing technology in long-term care settings.

Existing and Emerging Technologies in Residential Long-Term Care

Assistive technologies are being developed to assist older adults in remaining more independent, safer, and connected to the rest of the world. Although these technologies are generally geared to helping individuals maintain or regain as much independence as possible in their homes, they also may be used in residential care settings. Examples of these kinds of products include architectural elements such as door opening/closing devices, lifts and elevators, ramps, safety equipment and accessible showers; communication devices (such as assistive listening device) sensory aids (such as hearing aids, assistive listening devices); computers and adaptive computing devices; environmental controls (including remotely controlled door openers, telephones, lights and televisions); aids to daily living and mobility; orthotics and prosthetics; and modified furniture and furnishings (such as seat-lifting chairs).

In addition, there are a small but growing number of technologies designed mainly to assist caregivers in residential care settings. These include:

- wander management systems and products;
- fall prevention and management products;
- incontinence products;
- assistance call systems;
- assisted cognition products for individuals with dementia (sometimes called "cognitive orthotics");
- technologies to enhance interactions with families and friends;
- medication management systems; and
- software to manage information to support regulatory and business needs (e.g., MDS software; electronic medical records and recording devices).

For the purposes of this report, five aspects of care in residential settings--wander management, fall prevention, incontinence care, assistance call, and bathing--were identified as key areas in which to investigate technological developments.[2] These areas were selected with input from the project's Technical Advisory Group based on the prevalence and relative importance (in terms of quality of care and monetary and other societal costs) of the underlying clinical issue being addressed by the technology. In the area of *wander management*, both low and high-tech options are available. Low-technology options include visual deterrents that are placed on or across doorways and simple battery-operated door alarms that monitor a single door. Higher-tech options include complex alarm systems that monitor multiple doors and elevators; Infrared and

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[2] Detailed product information for these five areas is currently available on http://www.TechforLTC.org, Two additional product areas, medication management and transferring, will be added by September 2005. The web site was initially funded by the Office of the Assistant Secretary of Planning and Evaluation (ASPE) for the purposes of educating professionals about technologies available in long-term care.

radio frequency based elopement management systems that can monitor many doors, elevators, and outdoor areas; and tracking systems that enable caregivers and local authorities to locate residents who have left the facility.

Three distinct approaches to **fall management** include technologies aimed at reducing the risk of a fall, those that reduce the risk of injury given a fall, and those that notify caregivers when a resident has fallen. Technologies aimed at reducing the risk of a fall include products such as anti-slip footwear and matting that provide a non-slip surface, grab bars that provide support and stability in bathrooms and other areas, and wheelchair anti-rollback devices that prevent a wheelchair from rolling away when residents stand or lower themselves into the chair. Other technologies include chair, bed, and toilet alarms that signal a caregiver when a resident who is at risk for falling attempts to leave a bed, chair, wheelchair, or toilet unattended. In addition, rehabilitation equipment geared toward the restoration and maintenance of strength, endurance, range of motion, bone density, balance, and gait can help reduce the occurrence of falls and fall-related injuries in older adults. Technologies aimed at reducing the risk of injury when falls occur include hip protectors, bedside cushions, and technologies that notify caregivers when a resident has fallen (e.g., using accelerometer technologies, which sense a change in body position, body altitude, and the force of impact to determine when a fall has occurred, or mercury switches that present an audible alarm when the device is tilted from a vertical (upright) position to horizontal (fallen) position).

Incontinence technologies have been developed that prevent the leakage of urine; assist with restorative incontinence programs such as habit training and bladder retraining; and alert caregivers to an incontinent episode. Products that prevent leakage include urethral inserts for women that block the flow of urine at the bladder neck and penile clamps for men that put pressure on the urethra in order to prevent urine loss. Products that assist with restorative training include voiding reminders that encourage residents to void in intervals or predetermined times throughout the day; biofeedback devices that provide visual and auditory reinforcement while performing exercises to strengthen pelvic floor muscles; enuresis alarms that wake the wearer with a vibrating alert at the first sign of moisture in an effort to retrain the bladder; and bladder scanners, which are used to obtain precise readings of bladder volume. Products that alert caregivers to an incontinent episode include enuresis alarms, which can be used to alert caregivers at the first sign of moisture with an audible alert or flashing light.

There are three major categories of **assistance call systems**: wired, wireless, and telephone based. Newly developed assistance call systems provide two-way voice communications allowing staff to determine need before going to the room. Some of these systems go to a central nursing station, while others tie into a cell phone/pager carried by each staff. The latest development is the passive call system that incorporates strategically placed motion sensors and software with individually defined parameters. These passive call systems automatically alert caregivers when a resident is engaged in a behavior defined as outside their acceptable range (degree of movement, time spent in a bathroom without exiting, etc.).

Many high and low technology products are available to assist both the resident and the caregiver with accessing bathing facilities, as well as performing the actual task of **bathing**. Examples of products that enable residents to access showers and tubs more independently and safely include barrier free showers, bathtub and shower chairs, transfer benches, portable in-tub bath lifts, commode/shower chairs, grab bars, and anti-slip matting and materials. There are also products that enable residents to perform the actual tasks of washing more independently. For example, wash mitts offer a washing solution for those with decreased fine motor skills and an inability to handle a washcloth. Long handled brushes and sponges enable residents with limited reach to wash areas such as their back and feet. In addition, rinse-free bathing products enable residents to wash their body and hair without the need for water or transferring into a tub or shower. Other products are geared toward making bathing and shower tasks safer and more efficient for caregivers. For example, products that assist caregivers with the transfer of residents to showers and tubs include height adjustable bathtubs, easy entry bathtubs, showering cabinets, bath lifts, shower trolleys, and commode/shower chairs.

A number of emerging technologies may be of interest in residential long-term care. For the purposes of this report an emerging technology refers to new technologies currently in use in the community or acute care settings that have potential applications in residential care settings. We focus in this report on the areas of pervasive and proactive computing, cognitive orthotics, and navigation technologies to enhance mobility, which appear to be especially relevant.

Barriers to Implementing Technology in Residential Long-Term Care

Through our review of the literature and conversations with providers, regulators, manufacturers and other experts, the following five themes emerged as potential barriers to implementing technologies in long-term care settings.

Lack of information about technologies and the residential long-term care market. A pervasive theme was key groups'--manufacturers, providers, and regulators alike--lack of knowledge about the application of technologies in the residential care sector. Providers we spoke with said that they lack information about: (a) where to find technologies, (b) how to evaluate their applicability to their setting, (c) how to evaluate the stability of the technology manufacturer, and (d) how to assess cost-effectiveness of technology. Manufacturers we spoke with said they lack knowledge about how the long-term care market views the importance of technology. Regulators we spoke with said they lack information about the benefits of technology and the process by which to evaluate them.

Perceived lack of financial resources to develop and purchase residential long-term care technologies. A second major theme is the perceived lack of financial resources for manufacturers and researchers to develop useful products and to allow for providers to purchase them. Manufacturers expressed concerns about liability

exposure in both the health care and the long-term care industry. Almost all of the experts identified cost of technology, limited provider resources particularly for technologies that require a large initial investment, and limited reimbursement from private and public insurance as substantial barriers to purchasing new technologies. There was also a notable lack of discussion about the potential cost-savings or improvements in quality of care or quality life life.

Failure of regulatory process to keep pace with technological advances. A third major theme is that outdated regulations and the regulatory process hamper the implementation of new technologies and limit manufacturers' creativity in conceptualizing new products. Although newer standards and codes may be more inclusive of the latest technologies, many states do not update their regulations on a regular basis, and thus are enforcing codes that do not account for the latest technologies. The regulatory environment places great emphasis on documentation requirements as the primary means of assessing compliance with codes, as opposed to considering how technology can improve quality of care and quality of life.

Industry's lack of standards for technologies central to residential long-term care.   We found a pervasive frustration among providers, manufacturers, and regulators alike with the lack of standards to facilitate the integration of new technologies into residential care settings. Several providers emphasized that the technologies would be far more effective if they were integrated with one another and that standards may facilitate this integration. Several manufacturers explained that standards would help in their development of new products, which often face different codes from state to state. Regulators expressed the desire for standards to help facilitate their evaluation of new technologies and whether they meet the intent of codes.

Providers' lack of knowledge and experience with implementing and managing technological change. A majority of informants pointed to a lack of clarity about the most effective way to go about the process of incorporating technologies into residential care facilities. Providers cited "motivational" problems ranging from a lack of time, to the absence of a local champion, to simply ceasing to use of the technology after external supports are removed. The pattern of responses suggested that resistance was greater for technologies whose purpose was seen by staff to replace or reduce staff members to decrease the "human touch", or to monitor the staff. Providers with more successful experiences viewed the purpose of the technology to address a need expressed by the staff. Moreover, the pattern of responses suggested that technology introduced from the top-down met with resistance whereas providers who utilized a more participatory approach were more likely to describe their technology implementation experience as successful.

Next Steps

Our review of the literature and conversations with experts revealed a complex set of circumstances contributing to the current situation. The methodology we employed uncovered five general themes, but in many cases further 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.

1. ***Remedy existing gaps in knowledge about technologies in residential long-term care settings.*** Gaps could be addressed with a study to determine the size of the long-term care market, and what their needs are for technology, 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, further development of easily accessible resources designed to provide information to providers about available technologies, and the development of a forum to train regulators on new technologies for residential care settings.

2. ***Explore ways to encourage implementation of cost-effective technological innovations in residential long-term care settings.*** 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 long-term 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. In addition, better understanding of nursing home 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.

3. ***Explore how best to provide guidance to regulatory agencies.*** Guidance 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 technologies, 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.

4. ***Encourage development of industry standards for residential care technologies.*** Explore the best way to encourage and support voluntary standard development efforts by industry.

5. ***Educate providers about implementation issues.*** Study and educate providers about the relationship between the purpose of and process by which technology is introduced and the successful adoption and sustainability of the technology over time.

I. SCOPE OF ISSUE AND POLICY RELEVANCE

Technology plays a vital role in the lives of older individuals. Indeed, for those in need of long-term care, it can potentially improve the efficiency of care delivery while increasing the quality of that care and individuals' quality of life. There are important reasons to focus on technologies that are specifically suited to residential long-term care settings.

Although the roughly 2 million older Americans living in nursing homes and other residential care settings represent a minority of older persons, they constitute a group of interest for the development of technological applications for several reasons. First, nearly all persons in residential long-term care settings have physical or cognitive limitations that result in disability; thus, technologies targeted at residential long-term care can potentially reach large numbers of older people with the greatest needs. Second, the financial and societal costs associated with caring for this group are substantial and are projected to increase dramatically. In the year 2002, for example, over $100 billion was spent on nursing home care (Levit et al., 2004). Third, the number of older people in need of long-term care is expected to increase dramatically in the coming decades due to the aging of the baby boom generation. In particular, the number of older people with Alzheimer's disease, about half of whom are cared for in residential care settings, is projected to increase dramatically from about 4.5 million today to over 13 million by 2050 (Hebert, Scherr, Bienias, Bennett, & Evans, 2003; National Institute on Aging, 2000-2001). If designed and implemented appropriately, technology can potentially be an important instrument in attaining high quality cost-effective care for this population.

To understand the scope of the issue, we provide background information in this report on four distinct but related topics. First, we describe the current residential long-term care market. Second, we describe current challenges in the residential long-term care market that set the backdrop for understanding technological innovations. A third section describes what we know about the residential long-term care technology industry. A final section describes existing financing mechanisms for developing and purchasing technologies in residential care settings.

A. The Residential Long-Term Care Market

The residential long-term market is a continuum of care and includes nursing homes, assisted living facilities, board and care facilities, continuing care retirement communities, and adult day care facilities. The overwhelming majority of people in residential long-term care settings are elderly (Centers for Medicare & Medicaid Services, 2004); the majority has a physical disability and 70% have cognitive limitations, most often Alzheimer's disease or related dementias (Centers for Medicare

& Medicaid Services, 2004). In contrast, "aging services" (Center for Aging Services Technology, 2003) encompasses these residential long-term care settings as well as a variety of home-based care services and consumer products aimed at keeping older individuals living independently in the community as long as possible. Although products and services developed under the rubric of aging services most often focus on keeping individuals functioning independently in the community, many of these products can be used in a residential long-term care setting. In addition, the products developed explicitly for the residential long-term care market often seek to support caregivers, particularly in situations where residents have dementia, or to facilitate organizational functions.

In 1999, there were 18,000 nursing homes in the United States serving 1.6 million people. The majority of facilities (67%) are proprietary; 60% are affiliated with a chain; and 97% are certified by either Medicare or Medicaid. Nine out of ten nursing home residents in 1999 were age 65 years or older and nearly three-fourths were women. The severity of disability in this population has been increasing: In 1996, 82.9% of residents needed assistance with three or more activities of daily living (such as bathing, dressing, transferring, feeding, and toileting), compared to 71.8% in 1987 (Rhoades & Krauss, 1999). Annual expenses for nursing homes have been rising and a greater share is being paid by the government (Rhoades & Sommers, 2001). From 1980 to 2002, total expenditures for nursing homes increased from $18 billion to $103 billion and, in 2002, $66 billion was paid from pubic sources, primarily Medicaid (Levit et al., 2004).

Less is known about the fast-growing segment of the residential care market known as "assisted living." Assisted living offers supportive living environments for persons who need assistance but who do not require the 24-hour skilled nursing care available in nursing homes. The definition and terminology varies by state; other names for these kinds of living arrangements include residential care, personal care, adult congregate care, boarding home, and domiciliary care. At a minimum, assisted living facilities offer 24-hour supervision and assistance and two to three meals per day in a common dining area. Other common support services include housekeeping and laundry services, medication reminders and/or help with medications, help with personal care activities including bathing, toileting, dressing, and eating, transportation, security, health monitoring, care management, and activities. In a national study of assisted living conducted in 1998, there were 11,500 facilities serving approximately half a million people with disabilities, with about one-fourth of residents receiving help with three or more activities of daily living and about one-third having moderate to severe cognitive impairment (Hawes, Rose, & Phillips, 1999). Data for the year 2000 from the National Center for Assisted Living suggests the figure is approximately 33,000 residences housing about 800,000 people (National Center for Assisted Living, 2001b); a 2002 survey put the figure at 36,000 facilities serving 900,000 residents (Mollica, 2002). Unlike nursing homes, assisted living is most often paid for privately by individuals and their families; however, states have been expanding the use of Medicaid and other federal and state sources to help pay for care in an assisted living setting.

Other parts of the residential long-term care market include continuing care retirement communities, board and care facilities, and adult day facilities. Continuing care retirement communities offer a full range of housing, residential services, and health care in order to serve their older residents as their needs change over time.   A growing segment of the residential long-term care market, one relatively recent estimate suggests 350,000 residents live in these communities.   Group homes and board and care facilities offer a range of supported services, typically to younger adults with disabilities. Often these adults are diagnosed with mental retardation or developmental disability (MR/DD). In 2001, 387,000 individuals with MR/DD lived in 122,260 residential care settings. Adult day services are community-based daytime group programs designed to meet the needs of individuals with physical and cognitive impairments. Approximately 3,500 facilities serve on average 25 clients per day; most facilities are private pay and public funding is generally limited (Pandya, 2004).

B. Industry Challenges Pertinent to Technology

The residential long-term care industry is facing several inter-related challenges that heighten the need for technological innovations.

Increased emphasis on improving quality of care and resident quality of life.

Concern about quality has come from within the residential care industry, particularly from nursing homes that are part of the growing movement referred to as "culture change" or "resident centered care." The aim of this movement is to change the organizational system of care provided in nursing homes so that it is more focused on the quality of the relationships between residents/families and staff and between staff members themselves at all levels (Ronch, 2003). Members of the industry involved in this movement have a dual focus. One is a focus on exploring how the structure and processes of care need to be modified on an organizational level to improve outcomes. While many organizational models can be found in the business literature, researchers in long-term care have begun pointing to the difficulties in applying these models in the long-term care arena (Eaton, 2000). The second focus of the culture change movement represents a shift in values from the simple completion of tasks to be done (e.g., feeding a resident) to a focus in how the completion of these tasks can be modified to serve other, less mechanistic, goals (e.g., helping the resident be as independent as possible and feel respected and cared for while being assisted at meals). Although preliminary research suggests that programs such as the Wellspring model may reduce staff turnover and the number of deficiencies on surveys (Stone et al., 2002) more work is needed to determine what elements of these models might be most efficacious and how technology might be of service to facilities engaging in these innovative programs.

Federal and state regulators are also interested in improving quality of care for residents, particularly in the nursing home segment. Quality of care in nursing homes has been of interest to the Federal Government for many years. OBRA-87 and subsequent federal legislation established goals for quality care and patient quality of

life in nursing homes, requirements for resident assessment and care planning, and a new prospective payment system.[3] The regulations require that all certified nursing homes use a standardized comprehensive functional assessment tool (Minimum Data Set (MDS)) to assess all residents and assist in developing individualized care plans. In November 2002, CMS's Nursing Home Compare website (http://www.medicare.gov/NHCompare) began reporting quality measures based on MDS information for all certified nursing homes, with the aim of educating consumers and motivating nursing home facilities to improve care. These measures include, for example, assessing pain, pressure sores, and restraint use.

States are also applying increased pressure on facilities to improve their quality of care. Many states make state survey data available on publicly accessible websites. Again, these measures are intended to educate consumers and to motivate nursing home facilities to improve care.

Increased concerns about the quality of care in assisted living facilities have also been raised by federal agencies and others (U.S. General Accounting Office, 1999). In one study of four states, GAO investigators found one-fourth of the facilities they reviewed were cited by state licensing, ombudsman, or other agencies for five or more quality of life or consumer protection related deficiencies. State approaches vary widely but there has been a growing trend nationally toward regulating these environments and there is great variation in regulatory approach (Mollica, 2002). Still, assisted living facilities are generally subject to far fewer regulations than nursing homes.

Nursing shortage in long-term care. The nationwide shortage of nurses is especially severe in long-term care. Labor costs account for the largest share of nursing home expenses; approximately two-thirds of nursing home costs are related to labor (Centers for Medicare & Medicaid Services, 2003; Grabowski, Feng, Intrator, & Mor, 2004). In 1999 there were approximately 1 million registered nurses, licensed practical nurses, and nurses aides working in nursing homes (U.S. General Accounting Office, 2001) providing care to roughly 1.6 million individuals. Other segments of the continuum are also experiencing shortages.

According to projections developed by ASPE, by 2050 the demand for direct care workers in long-term care settings will increase by over 200%. During the same time period, only a slight increase is expected in the supply of workers who have traditionally filled these jobs (Office of the Assistant Secretary for Planning and Evaluation, 2003).

In a recent report to Congress, the Department of Health and Human Services (HHS) and the Department of Labor (DOL) identified a "comprehensive set of

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[3] Section 4432(a) of the Balanced Budget Act (BBA) of 1997 modified how payment is made for Medicare skilled nursing facility (SNF) services. Effective with cost reporting periods beginning on or after July 1, 1998, SNFs are no longer paid on a reasonable cost basis or through low volume prospectively determined rates, but rather on the basis of a prospective payment system (PPS). The PPS payment rates is adjusted for case mix and geographic variation in wages and covers all costs of furnishing covered SNF services (routine, ancillary, and capital-related costs). See http://www.cms.hhs.gov/providers/snfpps for details.

recommendations to address potential imbalances between the future demand for and supply of direct care workers in long-term care settings." One such recommendation involved enhanced use of technology to "explore use of new technology in recruitment, education and training, recordkeeping and patient care."

Financial pressures and change in Medicaid spending. According to the most recently available Health Care Industry Market Update on Nursing Facilities from CMS (Centers for Medicare & Medicaid Services, 2003), financial pressures in the industry continue due in part to continued pressures on states to limit growth in Medicaid.

Financed through a combination of federal and state funds, Medicaid continues to be the largest payer for nursing home care. Recent studies suggest that nursing home payment rates have thus far remained largely unaffected by state budget difficulties (Grabowski et al., 2004; U.S. General Accounting Office, 2003). The General Accounting Office report suggests that many states were able to avoid making significant changes to nursing home payment rates by relying on tobacco settlement funds and new taxes (including taxes on nursing homes), but payment reductions may be possible in the future. According to one study, in fiscal year 2004, 19 states cut or froze nursing home rates. In the future, the depletion of tobacco fund settlement, and phasing out of the intergovernmental transfers that have been used to increase federal Medicaid matching payments (Allen, 2004), may put additional pressure on states to limit Medicaid spending. At the same time, although the majority of Medicaid funds spent on long-term care continue to go to institutions, over the past decade or so, the Federal Government has provided states with options and tools to increase community-based long-term care options (Crisp, Eiken, Gerst, & Justice, 2003).[4]

Risk management issues. An additional source of financial pressure comes from the rising costs associated with risk management including litigation costs, liability insurance and costs associated with worker injuries. With respect to litigation, analysis of data provided by the long-term care industry suggests that the average number of claims per 1,000 beds has tripled over the past 10 years to 14.5 in 2002 (Centers for Medicare & Medicaid Services, 2003). A study of nursing home litigation attorneys found nursing home litigation to be substantial in terms of both the number of nursing home claims and the size of recoveries (Stevenson & Studdert, 2003). Dramatic increases in liability insurance and reduced access to such insurance also have been noted (Wright, 2003). With respect to worker's injuries, nursing homes and personal care homes continue to be a leading industry with respect to incidence of total nonfatal

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[4] For example, beginning in 1994 services under the Home and Community-Based Waiver services expanded steadily with the easing of state documentation requirements. In 2001, HHS announced the Real Choice Systems Change grant program to facilitate state compliance with the Supreme Court's 1999 Olmstead decision. According to the Senate Special Committee on Aging (Special Committee on Aging, U.S. Senate, 2002), states have responded by creating new coalitions of aging and disability advocates and by shifting resources to expand the array of community-based long-term care services available. More recently, the President's 2004 budget included a program to encourage states to transition individuals from nursing home and other long-term care institutions to the community. The "Money Follows the Person Rebalancing Initiative" provides incentives for states to design and implement strategies to re-balance their long-term care systems so that they no longer disproportionately allot Medicaid long-term care resources to institutional care.

occupational injury and illness, with 187,000 work-related injuries or illnesses reported in 2002, representing an incidence rate of 12.6 per hundred workers (Bureau of Labor Statistics, 2003). In 2002, the Occupational Safety and Health Administration (OSHA) began a National Emphasis Program to focus outreach efforts in nursing and personal care facilities with high injury and illness rates and in 2003 OSHA issued new guidelines for resident handling and transferring, one of the largest causes of injury in the industry.

Challenges of caring for persons with dementia in residential settings.
According to the National Institute on Aging (2002), 4.5 million people currently suffer from Alzheimer's Disease, and 377,000 new cases are diagnosed each year. These numbers are projected to increase to nearly one million new cases a year by 2050, as the proportion of people over 85 continues to increase (National Institute on Aging, 2002). Almost half of these individuals are cared for in various forms of shared residential care settings (National Institute on Aging, 2000-2001).

Research suggests the percentage of nursing home residents with dementia may be as high as 80-90% (Teresi, Morris, Mattis, Mattis, & Reisberg, 2000), although most researchers put the estimate closer to 70% (Maslow & Ory, 2001). The percentages are lower but still substantial for assisted living settings; for example, a 1998 survey conducted by the Assisted Living Federation of America found that 47% of residents in assisted living facilities experienced cognitive impairment (Assisted Living Federation of America, 1999). In addition, many people in these settings are indigent, have few family supports, behavior problems associated with dementia, and many co-morbidities (Kane & Kane, 2001).

Care responsibilities in residential care settings are different in many ways from those at home. Perhaps most important, the direct care worker in a residential long-term care setting is most often caring for multiple residents with dementia, each with individualized needs and preferences. Little attention has focused on the development of technologies to support caregivers in residential care settings.

C. The Residential Long-Term Care Technology Industry

There is little information available on the number and scope of technology firms who design, research, test, manufacture, and distribute products for use in long-term care residential settings. Some products have been designed to work across the continuum of aging services, working in multiple settings, such as home or hospital settings (e.g., traditional nurse call technology, grab bars; medication management systems). Other products are designed for and marketed to individuals with disabilities, irrespective of setting (e.g., mobility devices, communications devices). Finally, some technologies are created expressly for residential long-term care settings (e.g., call systems for residents with dementia; MDS systems).

There are important differences in emphasis between products designed for individuals with disabilities and those designed for use in residential long-term care.

Generally speaking, the aim of assistive technologies for people with disabilities is to enhance independence and participation; in a residential care environment, enhancing the caregiver's ability to provide care is also important. Moreover, although assistive technologies have been developed to address cognitive limitations related to traumatic brain injuries, learning disabilities, and developmental disabilities, there are relatively fewer products that address progressive dementia. This represents another gap or opportunity (depending on one's perspective) since in residential care settings dementia is pervasive, affecting on average 70% of residents.

Nevertheless, there is a great deal of overlap between the assistive technology industry and companies targeting residential long-term care providers. A recent report by the Department of Commerce (2003) suggests global sales by companies producing assistive technology products and services in the United States totaled $2.9 billion in 1999. The Department of Commerce also estimates approximately 1,600 firms make up the assistive technology industry (personal communication Margaret Cahill, U.S. Department of Commerce). Products are generally geared to helping individuals maintain or regain as much independence as possible and include:

- architectural elements such as door opening/closing devices, lifts and elevators, ramps, safety equipment and accessible showers;
- communication devices (such as augmentative communication devices);
- telecommunications devices (such as wireless and wireline telephones, text telephones, amplified telephones, talking pagers);
- sensory aids (such as hearing aids, assistive listening devices, tactile aids for the deaf/blind, alerting devices, Braille note takers);
- computers and adaptive computing devices;
- environmental controls (including remotely controlled door openers, telephones, lights and televisions);
- aids to daily living (including aids for dressing, toileting, washing, bathing, showering, dental care, skin care, housekeeping, handling and manipulating products, and orientation);
- mobility aids;
- orthotics and prosthetics;
- accessible items for recreation, leisure, and sports; and
- and modified furniture and furnishings (such as seat-lifting chairs).

All of these categories of products could potentially be used by older adults in residential care settings; however, in practice sales of these products for use by residents in these settings is likely a very small portion of sales, for two reasons. First, only 2 million (4%) of the approximately 50 million people ages 5 and older with a disability live in residential care settings. Second, a disproportionate share of people living in these residential care settings are poor: 60% of the nation's 1.6 million nursing home residents are covered by Medicaid (Jones, 2002) whereas only 16% of those living in the community with a disability are poor (Freedman, Schoeni, & Martin, 2004).

In addition to the kinds of products listed above, the residential long-term care technology market includes products designed mainly to assist caregivers in providing care to residents. Additional categories include, for example:

- wander management systems and products;
- fall prevention and management products;
- incontinence products;
- assistance call systems;
- assisted cognition products for individuals with dementia;
- products to enhance interactions with families and friends;
- medication management systems; and
- software to manage information to support regulatory and business needs (e.g., MDS software; electronic medical records and recording devices).

There are no estimates of the size of the residential long-term care technology industry. As of January 2005, we have identified 270 manufacturers and distributors of products related to wander management, fall prevention, management incontinence, assistance call, and bathing (for a complete list see http://www.TechforLTC.org).

No systematic information is available on the long-term care technology industry's research and development resources. However, the Department of Commerce (U.S. Department of Commerce, 2003) found that most assistive technology companies obtain funds for research and development from internal resources. Approximately $100 million (or 3.5% of revenues) was spent in 1999 by assistive technology companies; half of this or $50 million was spent by the largest 11 companies all of whom relied on internal resources. External funding from outside entities such as banks, venture capitalists, or state and Federal Government grant programs was obtained exclusively by small firms and made up about $3.5 million or 10% of research and developments expenditures by small firms in 1999. The report suggests that there is a need by many assistive technology companies to access outside capital sources but that companies do not appear to be aware of or know how to go about obtaining private and public sector funding opportunities. Small Business Innovation Research (SBIR) grants are one resource available to this sector; yet only 14% of firms surveyed applied for these funds over a 3-year period.(U.S. Department of Commerce, 2003)

D. Sources of Funding for Technology in Residential Care Settings

There is very little information available on sources of funding currently used to purchase technology in long-term care settings. Hence it is not clear who is paying for technologies (i.e., providers, family members, private donations, insurers). No data is available on private sources of funding. More is known about public sources, which are summarized below.

Medicaid. Medicaid coverage of technology varies by state, with each state implementing its own system under the federal guidelines. Reimbursement is based

upon broad categories of treatment rather than specific types of equipment. Medicaid is automatically available to recipients of SSI in 39 states. Certain services are required under the federal guidelines, but each state can establish their own definitions of what services are covered and what are not covered. Durable medical equipment (DME), such as mobility aids, prostheses and orthoses, hearing and vision aids are typically funded. Medicaid's Inpatient Hospital Care Program and Community-Based Waiver program are another avenue to obtain reimbursement for equipment. In keeping with the Medicaid statute to cover all phases of equipment deemed medically necessary, Medicaid will cover the cost of the evaluation, the equipment itself, and any follow-up training (Gradel, 2002). However, Medicaid only funds medical devices for individuals, not for organizations that provide services to Medicaid recipients.

Medicare. Medicare covers medically necessary assistive technology, including mobility aids, prostheses, and orthoses. Items that are not seen as being medical equipment, such as technology used in the bathroom and vehicle modifications, are not typically covered under the Medicare program. Medicare coverage is available to older persons (65+), persons who have a disability, those in renal failure, and persons who have received Social Security disability income for at least 24 months (Gradel, 2002).

Tech Act. The Tech Act mandates states to implement programs to improve persons with disabilities access to assistive technology (AT) and home modifications. Another option is the Alternative Financing Program (AFP), funded under Title III of the Assistive Technology Act of 1998. The AFP makes assistive technology available to persons with disabilities through low-cost financing, when they might not be eligible otherwise for conventional financing opportunities.

Through the AFP program, $3.8 million in federal grants were made available for the first time in October 2000 to persons with disabilities in six states, with matching funds coming from the states, which included Kansas, Maryland, Missouri, Pennsylvania, Utah and Virginia. The amount of loan money available, interest rate, and repayment terms vary from state to state. The grants made it possible for persons with disabilities to purchase assistive technology through low-cost loans that might not otherwise be available to them through conventional bank loans. In the first year of the program, 229 of the 315 requests for loans (65%) were funded. Of $8.6 million available loan dollars in the first year of the program, $2.3 million in loans was disbursed, with a median loan of $5,000. By FY 2002, both the number of states with AT loan programs as well as the amount of available loan dollars had risen, with $30 million loan dollars available to continue the AT loan financing program in 2002 (Wallace, 2003).

E. Purpose of this Report

Technology potentially offers to residential long-term care providers a means to improve quality of care and quality of life for residents while increasing organizational efficiencies. To the degree that technologies can facilitate the coordination of individualized care for multiple residents they may enhance the quality of care and quality of life of residents in these settings. To the extent that technologies can facilitate direct care worker's jobs, and enhance recruitment, education and training efforts, they may in part alleviate some of the ill effects of the impending shortage of long-term care professional and paraprofessional workers. To the degree that technologies can improve documentation and the flow of information, they may potentially improve the efficiency of care delivery. To the degree that technology can reduce worker injuries or lessen negative outcomes associated with resident wandering, egress, or falls, it is possible the costs of risk management in residential care facilities could be reduced.

The purpose of this report is threefold: (1) to describe a range of existing and emerging technological solutions for select care issues salient to residential care settings; (2) to identify, based on a review of the literature and discussions with experts in the field, barriers to the successful implementation of technology in residential care settings; and (3) to propose next steps to address the barriers.

We begin with a chapter that describes the methodology we used to gather information about existing technologies and barriers to their implementation. Chapter 3 describes five key care issues of interest in long-term care settings and existing technological solutions. Chapter 4 provides illustrations of emerging technologies that might be of use in long-term care settings. Chapter 5 provides a series of viewpoints on barriers and challenges to bringing technology into long-term care. We conclude with Chapter 6 with a series of policy recommendations and next steps.

II. DEFINITIONS, FRAMEWORK AND METHODOLOGY

Here we provide definitions of salient terms used in this report and propose a framework for thinking about the effectiveness of technologies in residential long-term care settings. We then describe the methodologies used to identify products and technologies, and barriers to implementation of assistive technologies in these settings.

A. Definitions

Technology is defined in this report as specialized equipment or product systems that may be commercially acquired and used to improve the quality of care, quality of life, or efficiencies of care delivered in residential care settings. This definition of technology excludes mainstream technology (e.g., cell phones, remote controls), medical technologies (e.g., pacemakers, defibrillators, feeding tubes) and universal design applications (e.g., lowered light switches), but potentially includes both high and low technology applications (e.g., sensor-based monitoring systems and anti-slip footwear), with preference given to highlighting technologies that are more sophisticated and more recently developed.

We focus here on technologies of use in *residential care settings*. Residential care settings include nursing homes, assisted living facilities, board and care facilities, day care facilities, and continuing care retirement communities. However, some products and issues may apply to community settings.

B. Framework

The purpose of technology in long-term care. In order to understand the barriers to implementing technology in residential long-term care, it is useful to review the meaning and purpose of technology in this setting. There is no agreed upon single purpose for technology. Moreover, the value technology brings may differ depending on one's role in providing care.

In our conversations with long-term care providers, explicit goals that were mentioned related to uniformity, efficiency, and enhancing care delivery through the use of objective information. Providers also acknowledged technologies may serve several, at times competing, purposes. Another provider noted that technology can provide information to manage liability risks or to act upon to enhance the quality of care and quality of life of residents.

Implicit in many of these statements is the notion that technological solutions will replace staff judgment and supplant value that caregivers bring to the caregiving

process. We did not speak with any direct care workers in preparing this report, so we do not have the direct voice of those who will participate in using the technologies on the front-line. However, a recent evaluation of the difficulties experienced during the implementation a call system in one facility suggests that direct care workers' goals and expectations for technologies also influence the process (Bower, Van Haitsma, & Curyto, 2003). In their final report, the authors note:

> "It will be productive for developers of long-term care technologies to learn the meaning its technology holds for users and to incorporate that meaning into its conceptualization and implementation. Similarly, an important step for long-term care facilities that are considering integrating a new technology into its care routines will be to explore the "fit" between the technology it wants to install and the needs, wants, and expectations of the people--at all levels…--who will be using it."

Framework in this report. In this report we conceive of technology as being potentially effective in three interrelated areas: enhancing the quality of care of residents; enhancing the quality of life of residents; and increasing efficiencies of care.

Improving **quality of care** is a primary goal of technological innovations. Quality of care in nursing homes has been a critical concern for many years. As highlighted in AHRQ's most recent report on the Quality of the Nation's HealthCare (Agency for Healthcare Research & Quality, U.S. Department of Health and Human Services, 2003) although the use of restraints has been reduced from over 45% in the late 1980s to less than 10% today, other quality indicators have room for improvement. For example, about 15% of long-stay residents experience a loss in ability to perform at least one of four ADLs (bed mobility, transfers, toilet use, or eating) and 8.5% experience pressure sores.   About 11% of long-stay residents experiencing pain are reported by staff to have moderate or excruciating pain in the last 7-day period. Many technologies exist to enhance quality of care in each of these areas. For example, technologies exist to enhance transfers and mobility (which are often painful events for the residents), to enhance functional competence in eating and toileting, to minimize incontinence (which may in turn reduce the development of pressure sores), and to enhance communication between resident and caregiver.

Resident **quality of life** also can be enhanced through technologies. Nursing homes have been characterized as places where older people are lonely, bored, and isolated. Quality of life domains have been developed by Rosalie Kane under contract by the Centers for Medicare and Medicaid Services (Kane & Kane, 2001). Kane and colleagues have defined eleven components of quality of life: autonomy, dignity, individuality, privacy, functional competence, relationships, meaningful activity, enjoyment, safety/security, comfort, and spiritual well-being.

Technologies may be targeted at one or more quality of life domains. For example, mobility devices may enhance functional competence and meaningful activity, computer technologies may facilitate relationships and enjoyment, wandering technologies may enhance safety/security and autonomy. In general, one of the

primary challenges in providing care for long-term care residents, particularly those with dementia, is how to balance the different domains of quality of life. For example, does the technology ensure safety/security without placing excessive restriction on individual autonomy?

Unlike the concepts of quality of care and quality of life, the domains associated with **organizational efficiencies** of care delivery in residential long-term care settings have not been identified conceptually or measured empirically. Yet one can imagine that technology may help minimize the time it takes to complete particular tasks, particularly with respect to communication, documentation, and other paperwork tasks. Or technology that prevents injury at work may minimize the number of employees one needs to recruit, hire, and train in the course of a year. Some new technologies rely on sensors to record information about resident behavior or location and transmit that information to mobile caregivers. New electronic medical records may facilitate and streamline documentation tasks. In other cases, equipment may help reduce worker injuries, for example, by facilitating ergonomically correct resident transfers.

Other technologies allow staff to shift the focus of their work from documentation or management activities to hands-on care. In fact, one provider envisioned the successful implementation of technology as shifting not the *number* of hours but the *type* of work carried out by the staff so that less time is spent on management activities and more on direct contact between caregiver and resident.

Note that enhancing functional independence through technologies could in some cases shift hands-on care to supervision of self-care, which could in some cases require *additional* labor hours.

Theoretically, implementation of technologies could either increase or decrease overall costs of care, depending on a number of factors. Potential cost-savings could occur, for example, if a technology reduced the occurrence of workers compensation claims, lowered staff turnover, reduced insurance, liability, and litigation costs, or reduced health care costs related to resident injury. On the other hand, costs of care could increase if a technology was not well-designed or not implemented appropriately

C. Methodology

Technology product identification. To organize our search for existing technologies, we first selected key care delivery issues based upon several criteria, including:

- the prevalence and relative importance (in terms of monetary and other societal costs) of the underlying clinical issue being addressed by the technology;
- the recommendations solicited from experts in the field of aging who served on the project's technical advisory group; and

– feedback from focus groups conducted with administrators and direct care staff in long-term care facilities.

From this process we initially identified four care issues to begin product searches: falls, wandering, incontinence, and assistance call. We later expanded the care issues to including bathing. All five care issues have been mounted on http://www.TechforLTC.org. We expect two additional areas--medication management and transferring--to be mounted on the web site by September 2005.[5]

To identify existing products of use in long-term care settings, we conducted extensive literature and Internet searches, consulted long-term care buyer's guides, and spoke with technology manufacturers and vendors at various conferences. The search for new products was concluded after exhaustive Internet sweeps yielded no additional products following two hours of browsing by a professional librarian. Products were then classified into meaningful, exhaustive, and mutually exclusive product types by the team's Rehabilitation Technologist.

Emerging technologies being developed for long-term care settings or in use in other settings were identified in several ways. The majority of these technologies were identified through detailed Internet keyword searches. Many of these searches led to resources that listed related research projects and products under development. Some examples of these resources include the Center For Aging Service Technology (CAST) Clearinghouse website and the University of Washington Department of Computer Science website. Additional information and resources was gathered from experts in the field of aging as well as technology and aging conferences and symposiums.

Barrier identification. We used a two-pronged strategy to gather information about barriers to the successful implementation of technology in residential care settings.

First, we conducted extensive internet and library searches. For each care issue, we searched for reports and publications related to barriers to implementing technology. We also searched state and federal codes to identify relevant legal barriers for specific types of technologies (e.g., requirements for hard wired or resident activated call systems; ADA specifications related to bathroom technologies; fire codes related to wandering technologies). We also gathered information on existing state technology outreach and financing programs available to long-term care settings.

Second, we spoke with 16 experts representing four distinct perspectives in long-term care: three regulators, six providers, four technology manufacturers, and three other experts about their experience with barriers to implementing technology in long-

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[5] Other issues that are under consideration to be added include mobility, transferring, medication management, and information systems. These issues are beyond the initial scope of http://www.TechforLTC.org and are therefore not included in this report except where mentioned during our conversations with experts.

term care settings. (See Appendix A for examples of the questions used.)[6] These experts were selected in part because of their experience with the first five care issues included in the http://www.TechforLTC.org web site: fall management, wander management, incontinence, assistance call, and bathing. Our conversations were intended to elicit general themes that cross cut many types of technologies but also to glean specific examples related to these five classes of technologies.[7]

The Project Coordinator, Co-PI and Consultant participated in these conversations, which lasted on average 30-45 minutes. Interviews were tape recorded with permission and verbatim transcriptions of the interviews were made (without identifiers). These transcriptions served as the basis for the qualitative content analysis. Each transcript was reviewed by two project team members and sorted into content categories. In addition to the three pre-identified content categories of "social", "regulatory" and "financial", the qualitative analysis yielded two other important categories--the perceived need for technological standards and concerns related to managing and implementing change.

Within each of these five categories, different themes were identified. A theme is an important, meaningful principle that shapes experts' perceptions of barriers to implementing technology in long-term care settings. The themes discussed herein were salient for at least three of the 16 individuals who participated in these conversations. The reader is reminded that themes were identified based on conversations with a small number of people and generally should be interpreted as areas for further systematic exploration.

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[6] The interview process did not suggest that we left out any critical groups. However, direct care worker views on barriers will be important to obtain (Bower et al., 2003) as are opinions of families and third party payers.

[7] The experts we selected also had experience with other broader classes of technology found in nursing homes and assisted living facilities; for example in the course of our conversations we learned about issues related to computing and internet access for residents; automated medical records; and pervasive computing. Examples related to these kinds of technologies are also included where relevant.

III. TECHNOLOGIES IN RESIDENTIAL LONG-TERM CARE

Technologies exist that compliment and enhance many areas of care provision and activities of long-term care residents including, but not limited to; assistance call, fall management, wander management, incontinence, mobility, lifting and transfers, communication, leisure, and medication distribution. We discuss five of those areas here.[8]

A. Fall Prevention and Management[9]

Scope of the issue. One half of nursing home residents fall annually (Przybelski & Shea, 2001), three times the rate for persons in the community (Rubenstein, Josephson, & Osterweil, 1996). The average incidence of falls in nursing homes is 1.5 falls per bed per year (Rubenstein et al., 1996). One in five nursing home residents who fall sustain soft tissue damage or fracture (Hegland, 1993). Nearly one-third of all nursing home claims nationally involve a fall (Stevenson & Studdert, 2003).

Not surprisingly, demands on long-term care staff increase significantly as a result of falls (Hill-Westmoreland, Soeken, & Spellbring, 2002) When falls are recurrent, nursing homes are subject to costly liability suits and hefty increases in insurance premiums (Hegland, 1993). Since 1994, liability premiums for long-term care facilities have on average increased 200 to 600% (Hyatt, 2003).

Technologies. Three distinct approaches to fall management include technologies aimed at reducing the risk of a fall, those that reduce the risk of injury given a fall, and those that notify caregivers when a resident has fallen.

Technologies aimed at reducing the risk of a fall include products such as anti-slip footwear and matting that provide a non-slip surface to stand on, grab bars that provide support and stability in bathrooms and other areas, and wheelchair anti-rollback devices that prevent a wheelchair from rolling away when residents stand or lower themselves into the chair. Other technologies include chair, bed, and toilet alarms that signal a caregiver when a resident who is at risk for falling attempts to leave a bed, chair, wheelchair, or toilet unattended. In addition, rehabilitation equipment geared toward the restoration and maintenance of strength, endurance, range of motion, bone density, balance, and gait can help reduce the occurrence of falls and fall related injuries in older adults.

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[8] The first four care issues are available on http://www.TechforLTC.org. Bathing is scheduled to be added to the site in September 2004.

[9] For additional information on key issues to consider about falls management technologies see: http://www.TechforLTC.org/ltc.cfm?pageid=168&careissue=1.

Technologies aimed at reducing the risk of injury when falls occur include products such as hip protectors designed to protect the hip from injury in the event of a fall. In addition, bedside cushions are meant to reduce the impact of a fall if a resident rolls out of bed.

Technologies that notify caregivers when a resident has fallen include devices that use accelerometer technologies, which sense a change in body position, body altitude, and the force of impact to determine when a fall has occurred. Other more simple devices use mercury switches that present an audible alarm when the device is tilted from a vertical (upright) position to horizontal (fallen) position.

B. Wander Management[10]

Scope of the issue. Although wandering refers to a group of related behaviors (up to 18 different kinds of wandering have been identified--(dbS Productions)), it most often is characterized by walking around without apparent purpose or direction. This type of behavior may increase a resident's risk for falls (see earlier discussion). When the behavior results in leaving a location unnoticed or unattended, the consequences can be even more detrimental and may include fractures, dehydration, hypothermia/exposure or death. The term *egress* is used to describe a situation when a resident leaves a facility unattended.

Studies suggest that between 52% and 69% of individuals with dementia have at least one episode of walking out of their residence and getting lost (Calkins & Namazi, 1991; Hope, Tilling, Gedling, Keene & Cooper, 1994; Teri, Larson, & Reifler, 1988). Every year, there are over 125,000 searches for people with Alzheimer's disease who wander from the safety of their residences (homes and long-term care settings). It is estimated that 46%-50% of these people die if not located within 24 hours (Koester and Stooksbury, 1995).

Walking away/getting lost is often cited as one of the most troublesome behaviors to caregivers, both family and professional. It is also cited as a primary reason why families make the decision to move an individual with dementia into a long-term care setting (Young, Muir-Nash, & Ninos, 1988).

One study suggests that 10% of all claims against health care facilities involve resident elopement (Foxwell, 1993-94). Insurance claims data reveals that 70% of elopement claims involve a resident death; 80% of elopements involve chronic (i.e., known) wanderers; and 45% of elopements occur within the first 48 hours after admission (Foxwell, 1993-94).

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[10] Additional information on wander management technologies can be found at:
http://www.TechforLTC.org/ltc.cfm?pageid=154&CareIssue=9.

Technological solutions related to elopement often include some form of security system that either alarms and/or secures doors or elevators. Doors and elevators in health care facilities are regulated by states through fire codes. The codes vary from state to state, but the majority follows either National Fire Protection Association (NFPA) or International Fire Code (IFC). However, the version each state has adopted and chooses to enforce varies widely. Using the NFPA codes as an example, different states follow the 1985, 1991, 1994, 1997, 2000 and 2003 versions. The latest version of NFPA requires secured doors to release within 15 (or in some cases 30) seconds upon application of force and there be a visible sign indicating the door can be opened by pushing, although this was not included in all of the earlier versions, which are still followed by some states. NFPA requires elevators to go to the first floor when the fire alarm is sounded (National Fire Protection Association, 2003). In order to be consistent with these codes, some of the high-tech wandering technologies described below require integration with existing fire alarm, security, and/or elevator systems.

Technologies. Both low and high-tech options are available to assist with wandering. Low-technology options include visual deterrents that are placed on or across doorways and simple battery-operated door alarms that monitor a single door. Higher-tech options include complex alarm systems that monitor multiple doors and elevators; Infrared and radio frequency based elopement management systems that can monitor many doors, elevators, and outdoor areas; and tracking systems that enable caregivers and local authorities to locate residents who have left the facility.

Other technologies developed for other applications have the potential to provide assistance to cope with wandering behaviors as well. For example, technologies that utilize global positioning systems (GPS) can notify caregivers when a resident has left a predetermined area and help track down residents who are lost. These technologies are commonly used for navigation purposes and to track down stolen cars. However, some companies are marketing this technology to track lost people as well. One company, for example, offers a device that enables the wearer to be tracked using GPS technology, digital wireless networks, and the Internet.

C. Urinary Incontinence[11]

Scope of the issue. Incontinence is the second most common reason (after dementia) for nursing home admission (McCliment, 2002). Currently, 44-65% of nursing home residents are incontinent (Gabrel, 2000; Sayhoun, Pratt, Lentzner, Dey, & Robinson, 2001). From 1987 to 1999, the prevelance of incontinence among nursing home residents ages 65-74 increased from 39-60% among men and from 45-59% among women (Sayhoun et al., 2001). The National Nursing Home Survey conducted in 1997 reported that 44% of nursing home residents are incontinent (Gabrel, 2000). In 1994, the cost per year of each institutionalized person with urinary incontinence was

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[11] Additional information on incontinence technologies can be found at
http://www.TechforLTC.org/ltc.cfm?pageid=168&careissue=3.

$3,687 compared with $552 for a community dwelling person with incontinence (Wilson, Brown, Shin, Luc, & Subak, 2001). Wilson and colleagues estimate that in 1994 $5.2 billion were incurred in nursing homes caring for residents with incontinence (Wilson et al., 2001).

Technologies. Products have been developed that prevent the leakage of urine; assist with restorative incontinence programs such as habit training and bladder retraining; and alert caregivers to an incontinent episode. Examples of the first type of products include urethral inserts for women that block the flow of urine at the bladder neck and penile clamps for men that put pressure on the urethra in order to prevent urine loss. Products that assist with restorative training include voiding reminders that encourage residents to void in intervals or predetermined times throughout the day; biofeedback devices that provide visual and auditory reinforcement while performing exercises to strengthen pelvic floor muscles; enuresis alarms that wake the wearer with a vibrating alert at the first sign of moisture in an effort to retrain the bladder; and bladder scanners, which are used to obtain precise readings of bladder volume.[12] Products that alert caregivers to an incontinent episode include enuresis alarms, which can be used to alert caregivers at the first sign of moisture with an audible alert or flashing light.

D. Assistance Call[13]

Scope of the issue. Assistance call systems allow residents to contact staff from the bed/bedroom, bathrooms, tub rooms and other key areas. In the earliest facilities, call systems were not needed because residents tended to be in wards. Pre-electric systems tended to involve the resident throwing something such as a slipper out the bedroom doors (which is why early codes started requiring the nursing station to be able to visually see bedroom entrances). Early electric systems presented an audible alert at the nursing station, sometimes with a room indicator light above the door, and staff members were required to go to the resident's room to investigate the need.

Today, assistance call systems are required by almost all states; requirements for assisted living facilities vary by state. Most nursing home call system regulations are modeled after hospital settings and do not take into account the residential aspects of the nursing home. As shown in Table 1, over half of states have call system codes that require the system to be at the residents' bedside, be physically activated by the resident (most often either through a button or pull cord), ring at the nurses' station, and that the signal be visible (most often at the entrance to a resident's room, or in the

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[12] This information is useful in the diagnoses, treatment, and management of urinary conditions. In addition, a series of bladder scans can help establish bladder volume and function patterns, which enable caregivers to develop individualized voiding schedules for residents.

[13] Additional information on assistance call technologies can be found at: http://www.techforltc.org/ltc.cfm?pageid=154&CareIssue=7.

corridor if there are multiple corridors). 48% of states have requirements that the system have an audible signal.

Although specific codes vary, many use variations in the language in older editions of AIA's Guidelines for construction and equipment of hospital and medical facilities. The latest version of these guidelines (2001) states (with newer provisions underscored):

> …a nurses calling system shall be provided….Each bed location and/or resident shall be provided with a call device….Calls shall be initiated by a resident activating either a call device attached to a resident's calling station, or a portable device which sends a call signal to the calling station and shall either: activate a visual signal, or activate a pager worn by a staff member, identifying the specific resident and/or room from which the call has been placed.…Alternate technologies can be considered for emergency or nurse call systems. (Facility Guidelines Institute, American Institute of Architects, 2001)

In our review of call system codes, we found only four states (Kansas, New York, South Dakota, Washington) specifically mentioned alternative technologies.

TABLE 1: State Code Requirements for Nurse Call and Emergency Call Systems		
Code Requirement	Number of States	% of States
Nurse Call System		
At bedside	31	62%
Visual requirements	31	62%
Physical activation by resident	28	56%
Must call nurses' station	27	54%
Audible requirements	24	48%
Electrically operated	5	10%
Emergency backup	2	4%
Deactivation at resident station	2	4%
Emergency Call System		
At toilet	36	72%
In bath/shower room	36	72%
Deactivation at resident station	9	18%
Must call nurses' station	8	16%
Signal distinct from nurse call	4	8%

Technologies. There are three major categories of assistance call systems: wired, wireless, and telephone based. Wired assistance call systems rely on wires for communication between the main components of the system. However, some wired systems allow for the addition of wireless features such as wireless call stations, wireless phones, pagers, and locator systems.

Wireless assistance call systems require no wiring for installation. All components of the system communicate wirelessly through radio waves. Wireless systems provide

the flexibility to easily move or add components of the system at a later date without rewiring. They can also be installed in older/existing buildings, providing a less expensive alternative to rewiring an outdated a hard-wired system and offer less disruption to residents during the installation process.

Telephone based assistance call systems use telephone lines to alert caregivers to a resident need. When a resident is in need of assistance, they press a wireless transmitter that they wear (typically a pendant or wristband) or a wall mounted transmitter that sends a signal to dialing device. The dialing device automatically sends a signal to a central CPU that alerts staff to the resident need.

More recent assistance call systems provide two-way voice communications allowing staff to determine need before going to the room. Some of these systems still go to a central nursing station, while others tie into a cell phone/pager carried by each staff. The latest development is passive call systems that incorporate strategically placed motion sensors and software with individually defined parameters. These passive call systems automatically alert caregivers when a resident is engaged in a behavior defined as outside of their acceptable range (degree of movement, time spent in a bathroom without exiting, etc.).

An example of a more advanced communications technology, not yet used in long-term care settings, is wireless LAN communication technology. Responding to the challenge of communication among highly mobile medical staff, some hospitals have begun to install systems that combine wireless LAN technologies, speech recognition software, and locator technology to provide instant, hands-free communication among healthcare staff. These systems utilize battery-operated wearable badges that connect to a wireless server. The wearer presses a button and speaks a command in to the badge. The system uses speech recognition technology to identify the individual(s) being contacted and connects the call. The system can also be used to locate staff and equipment. Although primarily used in hospital settings, this technology appears to have great potential to be adapted for use in long-term care settings. It may provide efficient communication, not only among caregivers, but also between caregivers and residents who are in need of assistance.

E. Bathing Technologies[14]

In recent surveys, bathing has been shown to be one of the most common ADL tasks that require assistance of a caregiver in residential care facilities. The National Center for Assisted Living (NCAL), in their Assisted Living Resident Profile, reports that 72% of residents in assisted living facilities require at least some help with bathing tasks, while 30% are dependent upon caregivers for bathing (National Center for Assisted Living, 2001a). In addition, the 1999 National Nursing Homes Survey found

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[14] Additional information on bathing technologies can be found at
http://www.techforltc.org/ltc.cfm?pageid=154&CareIssue=1391.

that 94% of nursing home residents received assistance with bathing tasks (Jones, 2002).

According to the Bureau of Labor Statistics, nursing and personal care facilities consistently have one of the highest rates of injury and illness among industries for nationwide lost workday injury and illness in 2000 (Bureau of Labor Statistics, 2003). This high rate of injury was attributed largely to three tasks: manual lifting, transferring, and repositioning patients/residents--all of which are associated with bathing (although not exclusively). In response to this high rate of injury, the Occupational Health and Safety Administration (OSHA) issued an ergonomics guideline for the nursing home industry (OSHA, 2003).[15]

Technologies. Many products are available to assist both the resident and the caregiver with accessing bathing facilities, as well as performing the actual task of bathing. Examples of products that enable residents to access showers and tubs more independently and safely include barrier free showers, bathtub and shower chairs, transfer benches, portable in-tub bath lifts, commode/shower chairs, grab bars, and anti-slip matting and materials. Barrier free showers offer accessible features such as low threshold heights for wheelchair access and easy step-in, increased clearances, accessible control locations, grab bars, and folding seats. All of these features can make entering and using shower facilities safer and easier for residents. Products such as tub chairs and shower benches provide residents with a surface to transfer in to the tub as well as a place to sit while showering. Portable in-tub bath lifts can be placed into a standard sized tub to offer a height adjustable surface for transfers and lowering the resident in to the tub. Commode/shower chairs can be pushed into barrier free and roll-in showers, providing a means of transporting the resident to the showering area (self propelled or pushed by caregiver) and providing seating during showers. In addition, anti-slip mats and materials can make the bathing safer by providing a slip resistant surface in wet areas.

In addition to products that increase access and safety to bathing areas, there are those products that enable residents to perform the actual tasks of washing more independently. For example, wash mitts offer a washing solution for those with decreased fine motor skills and an inability to handle a washcloth. Long handled brushes and sponges enable residents with limited reach to wash areas such as their back and feet. In addition, rinse-free bathing products enable residents to wash their body and hair without the need for water or transferring into a tub or shower.

Other products are geared toward making bathing and shower tasks safer and more efficient for caregivers. For example, products that assist caregivers with the transfer of residents to showers and tubs include height adjustable bathtubs, easy entry bathtubs, showering cabinets, bath lifts, shower trolleys, and commode/shower chairs. Shower trolleys and bath lifts can serve the dual purpose of transporting the resident to the bathing area and acting as a support surface during bathing. Trolleys are used for

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[15] This document presents guidelines on the use of transfer and lifting equipment, much of which is intended for use in bathing and showering areas.

non-weight bearing residents who cannot sit up. They support the whole length of the body while the resident is in a lying position during showering. Bath lifts are available in both seated and recumbent (reclined) styles and can be used to lower the resident into bathtubs that are compatible with the lift. Easy-entry bathtubs have sides that open like a door, providing residents with easier entry and exit from the tub. Showering cabinets also present a side opening design in combination with a sliding seat to assist with transfers in and out of the shower. Commode/Shower chairs enable caregivers to roll residents in to showers and over toilets, minimizing the amount of transfers required. Lastly, products such as shampoo basins, rinse trays, inflatable bathtubs, and rinse free bathing products can assist caregivers with the task of washing residents who need a large amount of assistance.

IV. TECHNOLOGIES IN DEVELOPMENT: POTENTIAL APPLICATIONS IN RESIDENTIAL LONG-TERM CARE

In an effort to meet the demands of care provision for a growing aging population, products are being researched and developed to assist older adults with remaining more independent, safer, connected to the rest of the world, and cope with a myriad of disabilities. This chapter focuses on several interesting areas that have potential for application in residential long-term care settings.[16]

A. Pervasive and Proactive Computing

Pervasive and proactive computing refers to equipping a person, multiple areas of their environment, and objects in their environment with sensors, which are linked to computers that interpret data and offer assistance. The goal of these systems, which are generally called SmartHomes, is to create intelligent environments that can support the older adult through unobtrusive pervasive technologies that remotely monitor health condition and vital signs, medications, nutrition, cognitive status and assistance, fall deterrence and detection, increase communications with caregivers and health professionals, provide home automation capabilities, and detect and respond to emergencies to name a few. At a basic level, these systems tend to include motion sensors and/or contact switches connected to a computer which track an individual's daily movement. More advanced systems may incorporate pressure sensitive pads, biosensors and special devices (such as medication dispensers). Typically, these signals are sent to a central computer, which reads and interprets the data, and may act on it.

There are several levels of responses the system may have. The more basic systems collect the data, format it, and send it to a website that a caregiver can remotely access to check up on the person. Virtually all systems can generate feedback reports, which may be useful to identify a steady decline in activity over time, yield early indicators of the onset or progression of a disease, and offer health care providers useful information to complement routine evaluations. Several systems will "learn" a person's normal routine, so that any deviation from normal activity (such as sudden inactivity occurred) is detected and automatically generates contact with a caregiver via Internet, cell phone, or other communications technology. The most complex systems will also provide cognitive assistance or reminders directly to the individual through visual or verbal cues.

For the most part, the language used to describe these projects seems to indicate that these technologies and systems are being developed with private residences in

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[16] Links to web sites featuring examples of these kinds of technologies are provided in Appendix B.

mind. However, they have great potential to be useful in long-term care settings as well. In his testimony to the U.S. Senate Special Committee on Aging (2004), Mr. Dishman states,

> "These technologies could also help improve the lives of long term care providers by automating the Minimum Data Set (MDS) that almost every skilled nursing facility must fill out on every resident they care for. Such computer systems could automatically enter the amount of care provided by the staff, thus improving accuracy of their reimbursement records and reducing the stress of the nursing staff that is exhausted by so much data entry and documentation." (Dishman, 2004)

There are a few versions that are being developed specifically for shared residential settings. Some are quite similar to the ones described above, using primarily motion sensors to detect activities and alert caregivers when individuals deviate from their normal routine. Others are more comprehensive and use biosensors and other digital technologies, provide behavioral cues to match an individual's cognitive abilities, act as an assistance call system, provide IR/RF (infra-red/radio frequency) based tracking and locating of residents and caregivers, provide home automation technologies to open doors and control temperature, offer Internet and email access to residents, and provide database reports about resident activity and care provision.

B. Cognitive Orthotics

Cognitive aids, sometimes a component of the proactive computing systems mentioned above, are being developed and researched to assist those with memory impairments with a multitude of cognitive tasks. Termed "cognitive orthotics", these systems assist with orientation, appointment and medication reminders, and provide step-by-step instructions to perform activities of daily life such as hand washing and cooking. Cognitive orthotics use artificial intelligence to proactively monitor the execution of tasks, problem solve for an individual, and offer assistance through cues when necessary.

These systems differ from other simple reminders, such as alarm watches and personal digital assistants (PDAs), which offer reminders at specific predetermined times. Cognitive orthotics are "intelligent" and are able to reason about whether and when to spontaneously offer reminders in an unobtrusive manner. The goal of these systems is not to take over thinking for the individual, but to only offer assistance when absolutely necessary. Several interfaces have been explored for these systems including mobile robotic assistants, PDAs, smart mobile phones, television sets, and verbal prompting through personal computers.

C. Mobility Technologies

Innovative technologies are under development to increase safe mobility of older adults, which is an issue both in the community and in long-term care settings. These technologies fall into several categories of products.

Navigation systems are being developed for canes, walkers and wheelchairs that can assist individuals who have both decreased mobility and vision issues. These devices assist the user with avoiding obstacles in their path, detecting steps and other drop-offs, and navigating through tight spaces. They use different technologies to detect obstacles, including laser scanners, infrared (IR) sensors, sonar, vision sensors, and ultrasound technology. The technology typically uses these sensors to "read" the environment, the data is processed, and information is given back to the user immediately, either in the form of voice messages or physical steering assistance.

New wheelchairs have recently come on the market that enable the user to easily negotiate architectural barriers and terrain that were difficult or impossible before. Some employ gyroscope technology that allows the wheelchair to balance itself on two wheels, enabling the user to reach high items and hold conversations at eye-level. This technology also allows the wheelchair to negotiate curbs and climb stairs. Other products have the look and feel of a manual wheelchair, but provide just the right amount of power assisted "boost" as the wheelchair is propelled over difficult terrain and inclines.

Finally, manufacturers are also exploring a variety of sensor and shoe technologies, which can increase balance and detect changes in gait patterns. One such product uses sensor technology to measure an individual's weight, gait, stride, and average pace. This technology, meant to complement emergency response devices, can notify caregivers when a resident's gait pattern deviates from the norm, possibly indicating a change in health status or that a fall has occurred. Another is examining the effect of vibrating insoles on balance. The theory behind the research is that alternating vibrations provided by specialized insoles amplify balance-related signals between the feet and the brain that may become dulled with age or illness. By amplifying these signals, balance can be increased, thereby reducing the risk of falls.

V. BARRIERS TO IMPLEMENTING TECHNOLOGY IN RESIDENTIAL LONG-TERM CARE

Through our review of the relevant literature and conversations with providers, regulators, manufacturers and other experts, the following five themes emerged as potential barriers to implementing technologies in long-term care settings.

- **Lack of information about technologies and the residential long-term care market.**

- **Perceived lack of financial resources to develop and purchase residential long-term care technologies.**

- **Need for regulations to keep pace with technological advances.**

- **Industry's lack of standards for technologies central to residential long-term care.**

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

We discuss each of these barriers in more detail below.

A. Lack of Information about Technologies and the Residential Long-Term Care Market

Each of the key groups--manufacturers, providers, and regulators--spoke of gaps in their (or others') information about technologies of use in residential long-term care settings. Designers (e.g., architects, builders) were also identified as an important group that could benefit from additional information on technologies.

1. Manufacturers' lack of understanding of the residential long-term care market.

Manufacturers indicated a general consensus that there was insufficient data about and understanding of the long-term care market. One manufacturer noted that there is a lack of information on the size of the market, how much they spend on technologies and for what purposes. He went on to suggest that technology companies would need the data to demonstrate that there is a large market opportunity.

Manufacturers, providers, and other experts also provided opinions suggesting that in place of market data were myths, stereotypes, and fears about the role of technology

in long-term care. One expert observed that companies prefer to market to the younger market. A manufacturer suggested that technology companies have a bias against working on products related to aging. A provider noted misconceptions by his management about direct care workers having a fear of technology. He went on to explain that in his experience he had found that nursing assistants adapted quickly to new technologies.

Even without data, manufacturers and providers alike characterized the residential long-term care market as an unattractive market. One manufacturer noted that hospitals have more funding options available while another commented that independent living facilities (retirement communities) constituted a much larger market than nursing homes and assisted living facilities. A provider noted that vendors focus on hospitals because that is where the dollars are; another noted that manufacturers do not view the long-term care market as profitable because margins are too low. Another provider suggested the long-term care is a risky market for manufacturers because they need a large market share to survive, and there are too many independent facilities to make it financially feasible to get a large enough market share.

Very little data on the technological need and spending of this market is available. One health care market analysis suggests margins are about 2% for for-profit and half a percent for non-profit nursing homes (Centers for Medicare & Medicaid Services, 2003) and that the largest nursing homes account for only 15% of beds in the industry. However, less is known about other aspects of the market, such as continuing care retirement communities and assisted living, where margins are likely to be higher because of lower reliance on publicly funded programs.

2. *Providers' lack of information about technology products.*

Two overarching themes emerged regarding providers' lack of information about technology. Many of the people we spoke with noted the lack of accurate information about technologies and how they work. A second set of comments related to the need for a framework for evaluating the cost-effectiveness or return on investment of technology purchases.

Need for accurate information about technologies. Although a few manufacturer-provided educational materials exist (for example, ARJO Hospital Equipment's *Guidebook for Architects and Planners*, 1996), there seems to be a lack of systematic, readily accessible, and accurate information about long-term care technologies. A provider pointed out the difficulty of finding out about what products are available; another provider suggested that there is a general lack of awareness on what technologies can achieve. A third provider expressed frustration with the lack of accurate information. He explained that the MDS systems he has purchased for facilities in the past did not provide information on what the system was actually supposed to do. One manufacturer explained that he had spent much time educating providers about his call system and how it worked.

The lack of information was linked to several misconceptions about technology. According to one manufacturer, providers and families believe technologies will invade residents' privacy, but in practice some systems use censors rather than cameras. At the same time, a provider admitted that they were not running a wireless system because his company had some security concerns about transmitting health information.

Another misconception mentioned several times was the misperception by staff that the introduction of technology reduces the human element of caregiving. Another provider asserted just the opposite, however. He argued that the purpose of technology was to give staff more time with the residents.

Need for framework to assess return on investment. There is also clearly a desire by providers to have more information on the cost-effectiveness of technology so they can better assess the financial risks and returns on investment. Several people we spoke with pointed out challenges in assessing both the costs and benefits of technology. There were calls for more research to demonstrate the cost-effectiveness of technologies specific to residential care settings.

On the cost side, providers mentioned not only the costs of purchasing technology but also the need for information on "hidden" costs associated with training, upgrading, initially doubling up systems, motivating staff to change their behaviors, and in some cases physical changes to the environment to accommodate the technology.

On the benefit side, providers had even less information on how to assess the financial and non-financial returns on their investment. For example, several providers mentioned that technology does not generate new revenues or directly reduce staffing costs.

Liability was mentioned as both a possible cost and a possible benefit. One provider noted that risk management is expensive and that technology could potentially provide significant mitigations of risk. Another provider noted that trying a new piece of technology could result in liability risks. A manufacturer suggested that such liability concerns might be holding providers back from trying new technologies.

3. Regulators' lack of information on technologies.

Several of the people we spoke with provided examples of regulators' misunderstanding either technology or the application of regulations pertaining to technology in residential care facilities. Although one regulator suggested that providers should approach regulators about new technologies to learn where they might conflict with codes, others suggested the lack of understanding and flexibility by regulators and/or surveyors posed a potential barrier. One provider, for example, described a situation in which they were surveyed during a transition toward electronic records. The surveyors found it troubling when some portion of the records handwritten and the rest computer-generated.

Another example we encountered relates to wireless call system technologies. A manufacturer suggested that in some states wireless systems are allowed only if the facility also installs a back-up hard-wired system. Yet, in our review of state regulations, we found only five states that require call systems to be "electronically operated" and only two states that require the system to have an emergency backup. In our conversations, we found the perception that some regulators have concerns about how wireless systems respond when there is a power outage, or if the computer fails, or the band-width the system uses potentially interfering with other equipment (e.g. pacemakers).

4. *Designers' lack of information on how to implement technologies into the design of spaces.*

Several individuals shared the opinion that often spaces in long-term care settings are not appropriately sized or laid out to support different technologies. Sometimes this is a result of older buildings built before a given technology was available (for example, smaller bathing rooms can make it difficult to use larger lift chairs and transfer devices). At other times, architects who design long-term care facilities appear to have gaps in their knowledge base. A manufacturer and regulator shared the view that some architects seem to have a lack of knowledge about the environments needed for specific types of equipment. Another regulator remarked that there is a lack of resources for architects to turn to for assistance.

B. Perceived Lack of Financial Resources to Develop and Purchase Residential Long-Term Care Technologies

A second major theme related to the perceived lack of financial resources to develop useful products, to protect manufacturers from liability, and to allow providers (and where applicable, individuals and their families) to purchase technologies.

1. *Perceived lack of resources for manufacturers to develop useful products.*

One expert we spoke with suggested that there are few opportunities to fund evaluations of technologies in these settings. He went on to suggest that there needs to be a rethinking of how the technology development efforts are funded. This was echoed by a manufacturer.

Part of the challenge, and cost, is creating technologies that meet the variations across states in codes and regulations. Another aspect relates to the cost of getting approval for a product, either through FDA or an independent testing lab such as Underwriters Lab. Several people noted that some manufacturers simply did not want to go through that process because of the time and effort and costs it involves. As one manufacturer said, referring to another company's reluctance to develop a medication

management system, there is reluctance to get involved in FDA approval by non-healthcare companies.

2. *Fear by manufacturers of exposure to liability.*

Several individuals commented that health care in general, and possibly long-term care in particular, is a market segment where the perceived risks of liability are substantial. This fear of liability on the part of manufacturers was noted as a barrier by both manufacturers and regulators alike.

One manufacturer representative commented that he cannot convince his upper management to work on technologies for aging services because of liability concerns. A regulator agreed that they hear on a regular basis that technology companies are particularly fearful of the liabilities associated around health-related activities.

3. *Perception of volatility among technology companies.*

Opinions were expressed that the technology company market is also volatile. One provider explained that there are concerns about spending a large amount of money on a system and then having the manufacturer go out of business. One expert suggested that the industry may be volatile because it may be difficult for manufacturers to obtain a large market share (which keeps costs low); this in turn may be linked to the fact that the industry consists of a lot of small independent providers.

Nursing home industry data support this view, in that the top ten companies accounted for only 15% of beds in 2003, down from 18% a year earlier (Centers for Medicare & Medicaid Services, 2003). Assisted living data suggest the top ten assisted living facilities companies account for less than 11% of units (Mollica, 2002; Mullen, 2003). Much less information is available about other aspects of the residential long-term care market.

4. *Perceived lack of provider resources and high costs of purchasing technologies.*

Every one of the providers and most of the manufacturers we spoke with perceived that providers lacked resources to purchase new technologies, which they described as costly. It is often not just the cost of the technology or equipment itself, but the associated costs. One manufacturer suggested it could take substantial investment ($35,000-$40,000) for a 100-bed nursing home to create a lift-free environment.

There are also the costs associated with finding and decision-making around new technology. Other costs mentioned include the costs of training, upgrading, and creating and sustaining momentum for change. For some technologies, such as wireless nurse call systems, additional costs have come from the fact that regulators have required both wired and wireless systems to be installed. In sum, as one provider put it you need a "critical mass" of resources to implement a new technology.

Notably absent from these discussions were remarks about the potential return on investment from technology--either in terms of costs saved by facilities or in terms of improvements in quality of care or quality of life of residents.

5. Lack of reimbursement.

Several providers and one manufacturer mentioned limits on insurance reimbursement as a barrier. More than one provider suggested that the reimbursement system does not provide incentives to improve quality of care through technological innovations.

A manufacturer noted that there were differences in reimbursement for community and nursing home-based residents. He explained that there is no reimbursement for bathing equipment in either environment and no reimbursement for nursing homes for lifts to transfer residents. But there is limited Medicaid reimbursement (a capped rental rate) for lifts for patients residing in the community. There are also some states (Michigan, Oklahoma, Florida) that have Medicaid waivers where they will pay for lifts if they are deemed medically necessary.

C. Failure of Regulatory Process to Keep Pace with Technological Advances

Opinions about the role of regulations in developing and introducing new technologies into long term care were quite mixed. Some provided examples of how regulations clearly lagged behind technologies; in other cases the regulations were not outdated but regulators and surveyors did not appear to have an adequate understanding of how the existing regulations apply to new technologies. Other expressed opinions that the regulatory environment in residential long-term care was itself a barrier to innovation.

1. Regulations lagging behind the technology.

There were a number of comments about regulations not keeping up with technology. Two regulators we spoke with suggested that technology changes too quickly for the codes to keep pace. Several examples follow:

- **Nurse call systems**. Regulations with respect to nurse call systems lag behind the technology in two respects: requirement of visual signals and calls and of physical activation by residents.

    - **Requirement of visual signals and calls to nurses' stations**. Thirty-one states have explicit requirements that nurse call systems provide a visual signal, typically outside the bedroom of a resident and, less often, at corridor intersections. The intent of the visual signal requirement outside the

bedroom entrance is to alert caregivers in the immediate vicinity of the desire for assistance. Twenty-seven states require the call system to call a nurses' station. These types of requirements are compatible with a medical model of care, but are less conducive to creating a more residential-style care setting, for several reasons. First, the call system to a nursing station assumes there is a staff person sitting at the station, which is not the way many long-term care settings currently operate. If there is not a person there, staff may have to travel back to the nursing station in order to determine who has requested assistance, then go to that person. While the visible signal at the door is designed to overcome this inefficiency, having alert call light outside every bedroom entrance does not reflect a residential style of architecture (it looks like a hospital), and the audible alarm signal contributes auditory stimulation, which can be disturbing to people with dementia. There are alternative systems that avoid these negative features. Some assistance call systems can be set up to send calls on a cell phone or pager to a single nursing assistant, to multiple nursing assistants and/or to the nurse simultaneously or as roll-overs if the call is not responded to in a timely manner. These newer systems are designed to reduce negative auditory stimulation, enhance the residential appearance of the setting by minimizing visible hospital-style equipment (signal lights at bedroom entrance) and enhance staff accountability in responding to calls.

- *Physical activation by residents*. In 28 states codes are written in such a way that calls must be physically activated by residents (typically either through a call button or pull cord). The traditional call system, found in hospitals, requires the person to know and be able to push the button to call for assistance. Systems have been developed that use sensors to automatically detect motion and movement, incontinence, and even falls, and which can be programmed to send an alert to staff without physical action by residents. We found only three states that made mention of wireless technology (Kansas, South Dakota, and Washington). In addition, New York considers such systems on a case-by-case basis.

- *Egress systems*. The *National Fire Protection Association's Life Safety Code Handbook* and the International Fire Code both call for egress systems with a delayed release system. That is, under normal circumstances (not emergency situations when the doors must release), if someone approaches a secured door and presses on the door opening/release device (also called a panic bar), the door sounds an alarm and will automatically unlock after 15 seconds (sometimes up to 30 seconds is allowed). Facilities are also required to put signage adjacent to the door that states that the door will unlock in 15 seconds after pressing the opening/release device. Providers expressed concerns over this system because it allows residents with Alzheimer's disease to leave a facility if they push on the door continuously for 15 or 30 seconds. Several providers suggested that such a regulation made the implementation of alternative egress control technologies far more challenging. There are a number of alternative

systems. Some use transponder tags that the resident wears, which sends a signal to lock the door as the person approaches or sends an audible alarm (at the door, to a remote site such as a nurses station, or to pagers/cell phones carried by the staff). Simpler systems secure the doors with electromagnetic locks, usually with a coded keypad to allow staff and visitor passage. In this case, the door is always locked for the residents (again, except in an emergency), unless they go through with a staff or family member. Without the 30 second delay and required signage, residents generally do not spend as much time at the doors trying to get out. The regulatory issue is whether this type of system creates a "locked" unit, which in some states requires the individuals to be deemed incompetent and committed by family or the courts to that unit.

2. *Regulations that appear to be misunderstood.*

Two examples of regulations that appear to be misunderstood were mentioned in our conversations, one related to the Americans with Disabilities Act (ADA) and the other to regulations around electronic signatures.

- *Transfer technologies and the ADA.* The ADAAG (Americans with Disabilities Act Accessibility Guidelines) specifies that toilets be 18 inches from the wall and that grab-bars be placed on the wall adjacent to and behind the toilet. This is based on the assumption of a side-to-side transfer, which is how individuals who are paraplegic transfer onto a toilet. But research consistently suggests that grab bar and toilet locations that comply with ADAAG specifications are among the most difficult for older adults who use a wheelchair to use (Sanford 2001). These individuals typically use a stand-and-pivot transfer technique (i.e., they bring their chair to the front of the toilet, stand, turn, disrobe and sit). Often, independent transfer is not possible, and one or two staff are needed to provide assistance standing, turning, disrobing, and sitting. Bathrooms that follow the ADAAG, placing the toilet 18 inches from the wall make it difficult for staff to position themselves between the toilet and the well, increasing the risk for injury. The problem is compounded when facilities are trying to use transfer equipment. In this case the code is not "outdated". Rather, the code does not take into account how older people typically transfer to the toilet, and the space needs for caregivers and equipment that might be needed to assist this process. New products, such as fold-down or swing away grab bars, allow toilets to be placed in different locations/positions and accommodate transfers in which people stand and turn, but still have an appropriate distance to the grab bar (optimally mounted at 14-16 inches from both sides of the toilet). These products are also helpful for people who prefer a side-to-side transfer. While there is an equivalency clause in ADAAG, it is often hard to get alternative designs approved. As one manufacturer said: "I think there are still a lot of places where the code officials believe that for rooms to meet ADA requirements, you have to keep the toilet 18 inches from the wall and there are others who…understand that a toilet that's further away from the wall…meets that equivalency standard. But the challenge is getting to those regulators who don't yet understand that."

- ***Electronic signatures***. One regulator noted what she perceived as a troubling conflict between state and federal regulations. She explained that the Centers for Medicare and Medicaid Services did not allow for electronic signatures in nursing facilities, but her state did. A provider we spoke with was under the impression that his state was slowly moving toward fewer paper requirements but that medications still required a written and signed order. It is unclear whether these are true barriers, or a misunderstanding on the part of regulators and/or providers. Since the time when these interviews were conducted, the Centers for Medicare and Medicaid Services has issued a Notice of Clarification on Electronic Signature Guidance. This Guidance Statement notes the existence of conflicting language related to electronic signatures within the State Operations Manual (as the regulator we spoke with mentioned). However, the decision put forth by this memo is that, effective October 15, 2004 "nursing homes may use electronic signatures in a clinical record, including the MDS when permitted to do so by state and local law and when this is authorized by the long-term care facility's policy (Centers for Medicare & Medicaid Services, 2004b). The language in this Guidance Statement does not specifically refer to electronic signatures related to medication orders. The only remaining barrier relates to state regulations that might prohibit the use of electronic signatures, which would supersede the federal standard.

3. *The influence of the regulatory environment.*

Several people also expressed the opinion that it is not the regulations per se but the regulatory environment that is problematic. They noted that the current regulatory climate introduces incentives that do not promote development or adoption of new technologies. One provider expressed the opinion that the technology industry was largely designing products to respond to regulatory changes, rather than undertaking strategic efforts to design beneficial products.

A similar theme appears in the gerontology literature. Schnelle and colleagues (Schnelle, Ouslander, & Cruise, 1997) argue that the regulatory environment is a barrier to implementation technologies--those that provide information about the process of improving the quality of care. The authors argue that providers react to the regulatory environment, which emphasizes paper compliance, by emphasizing documentation rather than changes in the provision of care. In two case studies of information technology implementation--one relating to incontinence program implementation and the other to restraint reduction--they found effective protocols were not sustained once research teams ceased their involvement. The authors concluded in both instances that the regulatory emphasis on documentation created a barrier to technologies that provide information to improve the process of providing care. The accurate data provided by the technology suggested additional care needed to be provided which conflicted with the (perfectly charted but inaccurate) documentation.

D. Industry's Lack of Standards for Technologies Central to Residential Long-Term Care

A lack of standards to facilitate the compatibility and integration of technology was cited as a barrier by providers, manufacturers, and regulators alike. Providers expressed frustration about the inefficiencies of having separate systems that could not talk to each other. From the manufacturer's perspective, a lack of standards adds to their manufacturing expenses. One manufacturer explained that it is expensive to write a new standard and have it tested. Another commented that there is no uniform plumbing code across states, which makes it difficult to build and adapt products that will meet needs across the country. A lack of standards is also time-consuming for regulators.

Regulators contacted for this report indicated there was a general lack of standards for evaluating new technologies. Sometimes regulators will require a new product to undergo and be certified by Underwriters Laboratories or a similar, third party testing organization. One of the three regulators we spoke with explained that they had conducted evaluations of wireless technologies themselves. They described a process in which they allowed several facilities to install the technology, then they evaluated the technology and amended the regulations to allow for it. The process, called "substantial compliance," allows the provider or builder to explain how the technology meets the intent of the regulation. It is unclear how many states have the resources to use the substantial compliance process to make regulations more compatible with new technologies.

In our review of the literature and in the course of our conversations we learned of several 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 that focuses on the application of technology and the policy issues that impact how technology will be used successfully and priced effectively to provide aging services, has created an Electronic Health and Wellness task group that participates in national data standards activities such as Health Level 7 (HL-7). CAST is also in the process of creating other work groups devoted to the development and promotion of standards to integrate aging service technologies such as data, communication, and hardware systems.

- The International Association of Plumbing and Mechanical Officials (IAPMO), the organization that maintains the Uniform Plumbing Code (UPC) and Uniform Mechanical Code (UMC), develops standards for plumbing and mechanical heating and cooling systems.

- The American Institute of Architects publishes hospital and health care facility design guidelines. The latest edition (2001) includes a chapter on nursing

facilities that provides guidelines for the number, placement, and type of call devices, as well the methods in which caregivers should be contacted. Within these guidelines are specific mention of wireless radio frequency call systems and issues of electromagnetic compatibility of internal and external sources. (Facility Guidelines Institute, American Institute of Architects, 2001)

A particularly illustrative example of a committee working on standards for assistance call systems in nursing home settings is The Healthcare Communications and Emergency Call Systems Group of the National Electrical Manufacturers Association (NEMA). This group is currently working with Underwriters Laboratories to modify UL1069 to include wireless functions. UL1069 provides safety requirements that cover the individual units employed to form a nurse call system intended to provide audible and visual communication between patients and care personnel as well as other signaling equipment employed in hospitals and care facilities. NEMA's work in this area includes defining the scope of the various types of wireless signaling that would be covered under UL1069 including call in signaling (Emergency or Normal call, bed exit call, monitor alarms, etc.) and wireless two way communication (voice and display). Also under consideration are more ancillary applications for hospitals, like television audio to bedside, as well as wireless personnel and asset tracking systems. The goal of this effort is to match up potential requirements within the scope of the current UL1069-- that is, how wireless systems would be evaluated as elements of a nurse call system.

This NEMA group is also working on a project to define and create UL standards for emergency call (wired or wireless) systems used in less monitored environments, such as assisted living. This project has grown out of a concern that no assistance call standards exist specifically for assisted living environments, which may have different emergency call applications than nursing homes. The goals here are to identify how the applications differ and develop standards that suit systems for these less monitored environments.

Note that the lack of standards per se does not prevent systems from being tested by Underwriter's Lab (UL). UL can use existing standards from other related products to evaluate new technologies. One person we spoke with pointed out that to evaluate a wireless system, UL could use a system with much higher criteria, such as a wireless fire alarm system. But he also shared that in his experience, manufacturers sometimes did not want their products to be tested, in part because of the cost.

E. Providers' Lack of Knowledge and Experience with Implementing and Managing Technological Change

Although not specified a priori as a theme of interest, a notable number of comments were made by providers, manufacturers, and other experts about the challenges associated with the process of implementing technologies in long-term care settings. This theme consisted of two main areas of discussion: (1) issues around

staffing, with respect to skill level, training, time resources, and turnover; and (2) issues around the process of change involving technology.

1. Staffing issues and logistics.

Providers and manufacturers alike cited a number of related issues regarding skill level of nursing staff, the challenges of training, the limited amount of time available, and the difficulties associated with turnover.

One provider explained that staff members need to be convinced to use the technology. He also described a situation where staff perceived that they did not have time to use the technology.

A manufacturer described a related challenge: high staff turnover in facilities. He explained that local "champions" have to continually train new staff to use the technology.

Other providers expressed the notion that staff seemed to resent technologies in which they felt monitored or which 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.

2. Managing the process of change.

Nine of the 16 people we spoke with mentioned the challenges of introducing change into a long-term care setting. Opinions related to the importance leadership and the difficulty overcoming resistance to change by staff. Providers and manufacturers alike expressed the opinion that leadership was critical in bringing about a technological change in a residential care setting. Words used to describe the kind of leaders needed included "dedicated" and "champion."

Our conversations highlighted a few examples where technologies that were introduced externally--by top level management, as part of strategic plans, or by researchers--faced significant challenges during the implementation process and were difficult to sustain. For example, we learned it took approximately 2 years for staff to be compliant with a new call system introduced by top-level management. Another provider remarked that he had spent 1½ years in 'pilot' mode with a palm-held system. One provider, whose company's strategic plan involved implementation of technology, reported that he found technology universally difficult to implement. Similarly, Schnelle and colleagues' (Schnelle et al., 1997) report two case studies of information technologies designed to improve the quality of care delivered in nursing homes. In both cases, the researchers developed and validated the technology, created an assessment procedure, and implemented the program in several nursing homes. Once the researchers left, however, the interventions ceased in nearly all the facilities, despite their demonstrated value.

In other cases, particularly those in which technologies were offered to direct care staff in response to a request from those staff, appeared to be much more easily integrated. One example illustrates a relatively smooth implementation of a palm device for direct care workers. The provider explained that they first queried a few locations about their information needs and then they developed an application on the palm. Their goal for the pilot was to get some feedback in a few locations, redesign the technology, and then roll it out on a more widespread basis. When they came to the end of the pilot test, the pilot sites had come to rely on the technology and were unwilling to give up the application, even in its preliminary state. A second example involved implementation of an elopement management system. The provider described a situation in which health care staff from an Alzheimers' unit approached him with concerns about elopement. The company responded by putting out an request for proposal, and then identifying and installing a system. In a follow-up conversation after installing the system, the provider confirmed that the staff was very appreciative of it and the main implementation challenges related to coordination with the fire alarm and elevator systems.

These limited conversations suggest that there may be a relationship between the way in which a technology is introduced and the success of the implementation. Investigation of this relationship warrants attention in future studies.

VI. NEXT STEPS

To the extent that technological solutions can improve quality of care, quality of life of residents, and potentially enhance efficiencies in residential long-term care settings, it is of interest to undertake steps to remove barriers to their implementation in this setting. To that end, we have in this report tried to identify barriers that exist to incorporating technology into residential long-term care settings.

Our review of the literature and conversations with a relatively small number of providers, manufacturers, regulators, and other experts revealed a complex set of circumstances contributing to the current situation. The methodology we employed uncovered five general themes, but in many cases further research will be needed to confirm the relative importance of each of these themes to the overall challenge.

In light of these findings, our recommendations for next steps involve a series of educational and exploratory strategies around five areas designed to:

- Remedy existing gaps in knowledge about technologies in residential long-term care settings.

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

- Explore how best to provide guidance to regulatory agencies.

- Encourage development of industry standards for residential care technologies.

- Educate providers about implementing and managing technological change.

Each of these areas of recommendation is discussed in more detail below.

Recommendation 1: Remedy existing gaps in knowledge about technologies in residential long-term care settings.

A pervasive theme was the lack of knowledge by key groups--manufacturers, providers, and regulators alike--about the application of technologies in the residential care sector.

- Providers we spoke with suggested that lack of information about where to find technologies, how to evaluate their applicability to their setting, how to evaluate the stability of the technology manufacturer, and the lack of a framework for assessing cost effectiveness of technology were all significant barriers to decision making about purchasing and implementing a technology.

- Manufacturers we spoke with expressed a lack of knowledge about how the long-term care market views the importance of technology. How much money are long-term care providers and residents (and their families) who live in these settings actually spending on new technologies? What types of technologies are being integrated? What technologies do facilities wish were in existence, but do not yet exist? Providers suggested that manufacturers did not fully understand the market.

- Regulators we spoke with expressed a lack of information about the benefits of technology and the process by which to evaluate them. Others expressed a concern about misunderstanding by regulators of codes related to technologies or benefits of technologies.

In light of these gaps in basic knowledge, we recommend the following steps be considered:

- Conduct a study describing the residential long-term care market, with an aim toward describing the current and future technology needs and expenditures across the entire residential long-term care continuum.

- Develop and test a framework for assessing the costs and benefits of different types of technology in residential long-term care settings.

- Encourage further development of easily accessible resources designed to provide information to providers and other key groups about available technologies. In this regard, ASPE has already provided initial funding for http://www.TechforLTC.org, a web site created by Polisher Research Institute and IDEAS describing products available for residential long-term care settings and key issues to consider. The site could be expanded to include additional care issues as well as technologies relevant to recruiting, retaining and training the long-term care workforce.

- Encourage development of educational resources specifically designed to address technology/design interface issues in residential long-term care settings.

- Provide surveyors and other regulators with a forum to receive regular training on new technologies for residential care settings.

Recommendation 2. Explore ways to encourage development and implementation of cost-effective technological innovations in residential long-term care settings.

A second major theme related to the lack of financial resources to develop useful products, to protect manufacturers from liability, and to allow providers to purchase technologies. Providers, manufacturers, and regulators raised the following issues:

- Manufacturers suggested there was a lack of resources for them to develop products for the residential long-term care industry.

- Almost all of the people we spoke with identified costs of the technologies and limited resources of providers as barriers. Large initial investments for some technologies were viewed as a substantial challenge. Yet providers and insurers have very little information about the "cost-effectiveness" of technologies. Hence, the potential cost-savings and improvements in terms of quality of care and quality of life often remain unknown.

- Manufacturers expressed concerns about liability in both the health care and the long-term care industry. Providers to a lesser extent raised issues around liability associated with new technologies.

We therefore recommend as next steps:

- Undertake efforts to educate large and small companies and the research community about existing mechanisms to support the development of residential long-term care technologies. Include education around private sources (e.g., how to raise venture capital) as well as federal mechanisms (e.g., SBIRs, Center grants, and traditional R01 and P01 mechanisms).

- Develop and test a framework to assess the costs and benefits of technologies in residential long-term 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.

- Explore how existing programs can be used to encourage implementation of cost-effective technologies in residential long-term care settings. For example, the Alternative Financing Program (AFP), funded under Title III of the Assistive Technology Act of 1998, makes assistive technology available to persons with disabilities through low-cost financing, when they might not be eligible otherwise for conventional financing opportunities. This program might serve as a useful vehicle for low cost loans for residential care facilities to purchase technologies that would benefit multiple low-income residents.

- Develop a better understanding of nursing home and health care liability issues, including the issue of liability for companies creating new technologies in this setting. The aim here would be to first determine whether this is a fear or a real barrier for manufacturers and providers.

Recommendation 3: Provide guidance to regulatory agencies.

Third, we found regulations can hamper the implementation of new technologies, and limit manufacturers' creativity in conceptualizing new products.

- Although newer standards and codes may be more inclusive of the latest technologies, many states do not update their regulations, and thus are enforcing codes that do not account for, and thus do not allow, the latest technologies.

- The current regulatory environment places great emphasis on existing documentation requirements as the primary means of assessing compliance with codes, as opposed to considering how technology-generated information (particularly automated versions) could replace existing systems. This limits what providers are willing to consider (for fear of bad surveys), and thus what manufacturers perceive as being desired by the marketplace.

Based on these findings we recommend.

- Encourage states to consider adopting updated codes on a regular basis (e.g., no more than 2 years after they are adopted by the relevant national or international body).

- Encourage the appropriate national agencies, such as the American Institute of Architects and the International Code Council, to provide for interim interpretations of their codes that specifically respond to new and emerging technologies. This might include a national conference between regulators, providers, designers and manufacturers to proactively identify the areas of most critical need for new technologies, and how regulations might need to be modified to allow for their incorporation.

- Develop a process or committee that can help provide guidance, in a timely manner, whether new technologies meet the intent (not just the specific language) of the relevant code. This could include an on-going funding stream for research related to determining whether new technologies are supportive of resident-centered care principles, which are embodied in OBRA '87 and the Nursing Home Reform Act. To the extent that all states choose to follow the same codes/guidelines, the results of these tests could be applied nationally.

Recommendation 4: Encourage development of industry standards for technology.

We found a pervasive frustration by providers, manufacturers, and regulators alike about the lack of standards to facilitate the integration of new technologies into residential care settings.

- Several providers indicated that the technologies would be far more effective if they were integrated with one another and that standards may facilitate this integration.

- Several manufacturers explained that standards would help in their development of new products, which often face different codes from state to state.

- Regulators expressed the desire for standards to help facilitate their evaluation of new technologies and whether they meet the intent of codes.

- Several efforts to develop standards are underway that could have implications for residential care technologies.

- We recommend that the government explore the best way to encourage and support these voluntary standard development efforts by industry.

Recommendation 5: Educate providers about implementation and change management issues as they related to technology.

In talking with informants we observed that there is a lack of clarity about the most effective way to go about the process of incorporating technologies into residential care facilities. Several themes emerged:

- Providers cited "motivational" problems ranging from a lack of time, to a lack of a local champion, to simply stopping the use of the technology after external supports are removed. These "motivational issues" clearly have cost implications for the organization as well.

- The pattern of responses suggested that these providers were more likely to have introduced the technology from the top-down, whereas providers who utilized a more bottom-up approach were more likely to describe their technology implementation experience as successful.

- Several informants hint that some of the "motivational" issues might be related to the perceived purpose of the technology (e.g., to replace or reduce staff numbers, to decrease the "human touch", or to monitor the behavior of the staff in general). Providers with more successful experiences tended to view the purpose of the technology to fulfill an expressed need of the staff care providers.

Clearly, there is a need to better understand what methods of technology implementation produce desirable and sustainable outcomes for residents, staff and the organization. We therefore recommend:

- Additional study of the relationship between the origin of the introduction of the technology and the successful adoption and sustainability of the technology over time.

- Augmenting the training (initial coursework or continuing education) of persons in key leadership roles within residential care, typically the nursing home administrator and/or director of nursing. These individuals may benefit from curriculum topics such as what technologies are available or being developed and change-management techniques.

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APPENDIX A. TALKING POINTS USED TO SOLICIT INPUT ABOUT BARRIERS

As detailed in Chapter 2, we conducted conversations with 16 experts representing a variety of viewpoints. Here we provide a sample of talking points we drew upon to guide our conversations with technology manufacturers, long-term care providers, and regulators. These examples are intended to be illustrative and not exhaustive:

Technology manufacturers:

- Tell us a little about the market your company sells to. What proportion is long-term care or a broader market? Is the broader market similar to long-term care in any way?
- Tell me about the process you went through in developing and marketing [this product]?
- How was the idea for the product generated?
- How easy was it to gain support in your company?
- Did you face any regulatory hurdles to bringing your product to market? Did the product require FDA or similar approval, and what was this process like?
- Does this product generate a profit?
- How many years did it take for the product to turn a profit?

Long-term care providers:

- What is most difficult, for you and for others, about bringing in or incorporating new technology in long-term care? What is easy?
- If the facility is using a specific technology identified for inclusion in the lexicon: What was the most difficult part about making the decision to incorporate this technology? What was the easiest part?
- What new technology would you like to see that would make your life easier or make life better for the residents?
- When a new technology is introduced at your facility, tell me how it usually gets introduced, and then how you think it should get introduced. This can include making the decision about getting it and about getting people to use it.
- Are companies marketing to you?
- Are there new technologies that you are not accepting? That you would like to integrate but cannot? What are the challenges?
- Are there strategies that would make new technology easier or more acceptable to people-strategies that aren't being used now?
- Is there a technology you're using that you don't like--that you'd like to get rid of and go back to the old way of doing something? Describe the technology and why the old way is better.

Regulators:

- When a long-term care project wants to incorporate a new technology, what process do you use to determine whether it's both appropriate and allowable?
- Are there certain criteria you use in evaluating it? What are these criteria?
- Are there times when you think a technology should be allowed but the codes, as written or interpreted, won't allow it? Can you give some examples?
- Is/are there a technology(ies) people have desired to include in a project that you couldn't or wouldn't approve? What was it (were they) and why wasn't it approved?
- If regulations restrict you from approving certain technologies, are there ways the codes or code review process could be altered to make it easier to allow new technologies in long-term care projects?

APPENDIX B. SELECT EMERGING TECHNOLOGY REFERENCES

Pervasive Proactive Computing and Smart Home Technology:

- Intel - Proactive Health Research: http://www.intel.com/research/prohealth/
- Georgia Tech. - Aware Home: http://www.cc.gatech.edu/fce/ahri/projects/index.html
- University of Virginia - MARC Smart In-Home Monitoring System: http://marc.med.virginia.edu/projects_smarthomemonitor.html
- University of Texas at Arlington - MavHome: http://mavhome.uta.edu/
- MIT - Project Oxygen: http://oxygen.lcs.mit.edu/Overview.html
- Elite Care - Creating an Autonomy-Risk Equilibrium (CARE): http://www.elitecare.com/oatfield-tech.html

Cognitive Orthotics and Assisted Cognition:

- University of Washington - Assisted Cognition: http://www.cs.washington.edu/assistcog/
- University of Michigan - Autominder: http://www.eecs.umich.edu/~pollackm/Pollack-web_files/distrib/ras03.pdf
- University of Toronto - Cognitive Orthotics: http://www.ot.utoronto.ca/iatsl/publications.htm
- Rehabilitation Engineering Research Center on Successful Aging - Cognitive Assistance: http://www.phhp.ufl.edu/ot/rercdev/

Mobility and Balance:

- Haptica - Guido Smart Walker: http://www.haptica.com/id2.htm
- University of Virginia - MARC Robotic Walker: http://marc.med.virginia.edu/projects_eldercarerob.html
- University of Virginia - MARC Gait Monitoring Device: http://marc.med.virginia.edu/projects_gaitmonitoring.html
- Boston University - Vibrating Insoles for Balance: http://msnbc.msn.com/id/3131081/
- Attila A Priplata, James B Niemi, Jason D Harry, Lewis A Lipsitz, James J Collins. Vibrating insoles and balance control in elderly people. *The Lancet. Volume 362,* Issue 9390, Page 1123
- Independence Now - iBOT 3000 and iGLIDE Wheelchairs: http://www.independencenow.com

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Reports Available

Barriers to Implementing Technology in Residential Long-Term Care Settings
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      HTML   http://aspe.hhs.gov/daltcp/reports/2005/techbarr.htm
      PDF   http://aspe.hhs.gov/daltcp/reports/2005/techbarr.pdf

PRESS RELEASE: New TechForLTC.Org Web Site Offers Comprehensive Information on Technologies for Health Professionals in Long-Term Care Settings
      HTML   http://aspe.hhs.gov/daltcp/reports/2004/techPR.htm
      PDF   http://aspe.hhs.gov/daltcp/reports/2004/techPR.pdf

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