As more and more Baby Boomers are growing into their senior years, technology applications are being developed and marketed to increase their ability to remain independent in their own homes for as long as possible. This article reviews currently available devices and products that are intended to meet home safety needs of the elderly. The purpose of the article to share with nurses who care for elderly patients and their families some of the products and services that are currently available. Data regarding acceptability and efficacy of these products are still needed. (Geriatr Nurs 2009;30:384-389)

During the past century, life expectancy in the United States increased from 48 to 72 years among men and from 51 to 79 years among women. As individuals reach and exceed 80 years of life, their needs for health care, including management of chronic illnesses and assistance with routine activities of daily living, increases. At the same time, more individuals continue living independently as they grow older.

Family caregivers are often called upon to care for their older family members as their needs for assistance grow, however, caregivers face a host of challenges to keep older adults safe. To help ease the burden on strained family caregivers, the Institute of Medicine recommended exploration of the use assistive technology devices and applications. Ensuring the safety of the senior adult is crucial to their independence and quality of life. Technologies may help both healthcare providers and family caregivers assist the senior adult to remain both independent and safe. For example, Gitlin and associates found that therapy sessions that instructed independent living individuals ages 70 and over in compensatory strategies, home modifications, home safety, fall recovery techniques, and balance and muscle strengthening exercises extended their lives by up to 3.5 years. Subjects at moderate mortality risk experienced the greatest benefit. Yet, few health care providers are well informed about the technologies available to assist older adults remain safely independent in their homes.

The purpose of this literature review is to describe various technologies designed to optimize home safety. This information is important for geriatric nurses because families and patients often turn to nurses first for information.

A search of CINAHL, Information Science and Technology Abstracts, Academic Search Complete, Science and Technology Collection, and MEDLINE was conducted on August 6, 2009. The search terms used were “technology” and “elderly” and “home safety” revealed only eight publications. A broader search using only the terms “technology and aging” revealed over 12,000 publications. The information included in this article primarily comes from specific searches about specific device or technology types.

Desired Characteristics of Safety Devices/Technologies

Desirable characteristics of safety devices and technologies include reliability (can it do what it promises), minimal obtrusiveness, and reasonable cost. Product reliability, the purview of the manufacturer, is often limited to testing completed in laboratory settings designed to simulate potential end user environments. Therefore, when a product enters the market, early users are not only challenged with implementation as product support services have no experience with its use in real environments, but information about product’s reliability is often not known because it is dependent on its use history in real environments.

Obtrusiveness of assistive technology is another important feature. Hensel defines the
concept of obtrusiveness as a user’s summary evaluation of the characteristics or effects associated with the device/technology that are “perceived as undesirable and physically and/or psychologically prominent” (p. 430). Assistive technologies with low obtrusiveness are those that will be most acceptable to users. Therefore, it is important that an assistive technology has low obtrusiveness to bolster its acceptability to older adults. Although the concept of obtrusiveness has been articulated, there are no instruments to measure obtrusiveness. Therefore studies have relied on focus groups.

Research of obtrusiveness and acceptability of assistive technology devices is scant. Studies that were found explored senior adults’ perceptions and attitudes toward general as well as healthcare related home technologies. In general, younger and more affluent subjects were more likely to look favorably upon technology. Although older persons might look favorably upon home safety devices, unless they perceived a need for such an application, they were unlikely to purchase or use such devices. When Tiger-Place, an innovative independent home living environment, was first developed at the University of Missouri, new residents forgot about the presence of such technology within a few weeks; only reported greater peace of mind. In some cases, when technology devices represented an innovative use of existing technology such as telephone linked care, it was more acceptable. Telephone linked care provided recorded information and counseling to caregivers of disabled persons and was well accepted.

Finally, the cost of a safety device/technology is an important feature of an assistive technology. Often the cost is dependent on the way in which it is implemented. For most devices/technologies there is an initial expenditure to acquire the device/technology. If the device/technology connects to a monitoring service, then a monthly fee or subscription must also be paid. Both sources of costs are important to assess cost. Perceived cost is also relative to the senior adult and family’s income and resources.

Safety Devices/Technologies

Safety devices and technologies are modifications of the environment that claim to improve safety and lower risk of injury to inhabitants. They fall into five categories, general adaptive technologies, passive environmental sensors, assistive technologies, wander management systems, and appliance technologies.

General Adaptive Technologies

General adaptive technologies are often the most “low tech” of all applications and include such things as lever door handles, amplifiers on door bells and telephones, grab rails and handrails in appropriate locations, ramps, stair lifts, external lighting with passive infra-red, lowered light switches, raised electrical outlets, level thresholds, wider doors and corridors, and electric window and door openers. Devices currently available combined with those in development have the potential to help seniors stay independent in their homes longer, delaying expensive moves to congregate living arrangements while maintaining quality of life.

Passive Environmental Sensors

Environmental sensing devices are devices that monitor the safety features of the home as well as individuals in the home. They are generally considered to have low obtrusiveness (see Table 1) as they are entirely passive. Examples of passive environmental sensors include devices to monitor gas leaks, carbon dioxide, and other potential hazards. Their usefulness in increasing safety for senior adults and in helping to maintain their independence is illustrated in a telecare program implemented in 2007 in the United Kingdom. As part of the program, carbon dioxide monitors, natural gas detectors, flood detectors, smoke detectors, and temperature extremes sensors placed into the home notified the senior adult or caregiver of the need for corrective action. In some situations, such as gas/natural gas, shut off valves were placed which automatically shut off the gas when a leak was detected. Research by Tinker (2005) and Lansley (2004) indicate that they can be effective in almost every home.

Another example of passive environmental sensors are motion and pressure sensors. The primary purpose of motion and pressure sensors is to protect and maintain the security of older adults in their home, and thus, may be useful to family caregivers caring for a cognitively impaired elder in their own homes. They are
typically placed in out-of-sight locations such as under the flooring; under the mattress, on the walls of passageways, and in windows and doors. Acquisition and installation of the sensors are typically low in cost, but many systems are tied to monitoring services which include a monthly fee for service.

When installed beneath the floor surface, the sensor and associated monitoring system can detect movement as well as its absence. When no movement has been detected for a pre-set specified length of time, the monitoring system can query the resident and initiate a plan of action based on the resident’s response (or its absence). These systems are designed to monitor and report events such as falls and thus useful for a person who is at high risk for falling. The Gator-Tech Smart Home (GTSH) is one example of a home that has a smart floor with pressure sensors located in the floor that track the movement and location of residents of the home.18

Another variety of sensors are pressure sensors. This device is placed under the senior adult’s mattress and can turn on bedside lights when the senior adult gets out of bed. It can also be programmed to activate an alarm if the person does not return to bed in a set period of time.15 Sensors placed in entry doors can also detect a person leaving the home. They can be combined with alerting systems that send messages to caregivers informing them that the senior adult has left the premises.

Passive environmental sensors when used in combination with monitoring systems connected

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<th>Application</th>
<th>Reliability</th>
<th>Obtrusiveness</th>
<th>Cost to the consumer</th>
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<td>Pressure sensing</td>
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<td>Motion detectors</td>
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<td>Remote monitoring</td>
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<td>Wander management</td>
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Table 1. Characteristics of Safety Technologies
to the internet can alert caregivers residing in locations remote to the home of the senior adult. Such monitoring systems permit monitoring of the senior adults’ status and some systems, such as GTSH, allow the caregiver to interface with the senior’s home to turn lights on and off, turn off appliances, and open and close blinds. Such systems might be useful for distant caregivers to monitor a family member with mild cognitive impairment. They are used primarily to monitor home appliances and energy use and conservation. Obtrusiveness of such systems is intended to be low however costs could be extensive (see Table 1).

Assistive Technologies

Assistive technologies are intended to aid the elderly in meeting their daily needs and may be very useful for older adults who are physically disabled, but still cognitively intact. They include simple aids such as walkers, canes, and telephones. Recently, Samsung© has marketed a modified cell phone to meet the needs of older adults by making the numerical displays larger and simplifying operating procedures. Cell phones are also available with voice activation or command technologies which allow an individual to make a call by simply giving a voice command.

Other voice activation technologies for the home may require the user to wear a tie-clip microphone connected to a wireless transmitter to issue voice commands to activate various functions within the home. In such systems as GTSH, voice commands control lights, blinds, television, security system, and front door capabilities.

Several “smart” technologies are available to help older adults conserve energy by foregoing frequent trips to the mailbox or front door. The smart mailbox notifies the resident when mail is delivered. It also can include alert systems to notify the senior resident of mail delivery and when someone is at the front door. The smart mailbox has an audio system which notifies the resident when mail is delivered. The smart front door is equipped with a camera activated by the door bell. When a visitor rings the doorbell, the camera projects the visitors’ image onto screens located throughout the residence. The resident then has the option of opening the door via voice activation or manually. Both features are aids to help the older adult conserve energy foregoing frequent trips to the mailbox or front door. The GTSH system also has the capability of alerting the elderly resident if a door or window is left open and can check the security status of the house upon command (when the resident retires or leaves the home). When residents were studied after two years of living in such an adapted “smarthome,” only 68% of the functions were used by the residents who reported that they only used functions they perceived as beneficial.

Assistive technologies may be viewed along a continuum of obtrusiveness. Such devices/technologies that are more familiar (walkers and canes) may be viewed as less obtrusive than are less familiar ones (cell phones). More recently introduced devices/technologies often entail substantial initial costs as well as monthly fees and maintenance costs.

Wander Management Systems

Unattended wandering is a serious problem for cognitively impaired older adults who can become lost within their own communities. The Alzheimer’s Association estimates that 60% of people with Alzheimer’s wander each year. Wander management systems were first developed for use in nursing homes and assisted living facilities where cognitively impaired residents might wander outside of a safe environment. Project Lifesaver is a nationwide partnership of law enforcement, civic groups, local businesses, and caregivers. This system tracks patients with cognitive impairments (CI) such as Alzheimer’s, Down’s syndrome, and autism through a watch-sized bracelet that emits a silent, low-level radio frequency. The system is activated only when a caregiver reports the CI adult is missing; participating local authorities can then “tune in” the specific frequency for the device issued to that individual. This technology would be considered to be intrusive, since it requires the individual to wear a device (see Table 1). The approximate cost is $400.00, and to ensure the unit remains functional caregivers must agree to check the battery function daily. This technology application could also be utilized by family caregivers caring for a CI individual at home.

Another wander management system is Care Watch, a home monitoring system developed to assist informal caregivers in the care of people with CI. The system was developed to help prevent adults with CI from unintentionally exiting...
the home, especially at night, and to help increase uninterrupted sleep by the caregiver. The system has a daytime and nighttime mode and has the adaptability for future changes to accommodate changes in the individual’s needs. In the daytime mode, the caregiver is alerted via an alarm when the patient exits an outside door. In the nighttime mode, alarms alert the caregiver when the patient arises from bed. This system has the advantage of being unobtrusive, but requires continuous monitoring by the caregiver. In a trial of the technology, participants were so pleased with the device that they asked to keep it beyond the trial period.

Safe Return is a program developed in collaboration between Alzheimer’s Association and MedicAlert. The impaired adult’s medical information, as well as information about their caregiver, is entered into a national database. The impaired adult is issued an identification bracelet or pendant which lists the person’s impairment, identification number, health conditions, and a toll-free, 24 hour emergency hotline. The first time enrollment fee is $50.00, with a $25.00 annual renewal cost. The reliability of this system is dependent upon the wearing of the identification bracelet by the CI adult. This technology could be utilized for cognitively impaired individuals regardless of whether they were cared for at home or in a nursing care facility.

Appliance Technology

Microwave technology has moved to the next level using the smart wave. Using radio frequency identification, the smart wave has the capability of recognizing the type of food product selected, and based on the selection; an instructional video is displayed indicating the steps for preparation. The smart wave has the ability to program itself for the appropriate cooking time, and upon completion, notify the person via audio and video announcement that the food is completed, and cautions the user when handling the food. Although tantalizing, this technology would actually be fairly intrusive because of the demand for learning to interact with new technology. There is no information on cost to the consumer or if the desired outcomes are actually achieved.

Summary and Conclusions

Ensuring the safety of older adults is critical to their independence and quality of life. Technologies may help both healthcare providers and family caregivers assist the older adults to remain both independent and safe. Widespread use of devices and technologies depends on their reliability, obtrusiveness and cost. While many promising technologies and devises are available, little research exists to document their acceptability among senior adults. Older adults are interested in technology applications for which they perceive a need. There has been little study, however, of senior adults’ views on obtrusiveness of aides that prolong their independence. Moreover, many of the technologies raise ethical concerns that warrant additional study. This information is essential to inform caregivers and manufacturers as well as elderly consumers. Knowing what degree of obtrusiveness is acceptable to the senior adult and how views of obtrusiveness change as level of independence changes are key to prolonging both independence and quality of life.

Research is needed to help elders, their families, and healthcare providers decide which applications are right for them. Nurses, regardless of setting, should be familiar with the available technology which could improve the safety of their older patients and families as well as potential costs and resources.

References


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