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Critical Topics in an Aging Society

Using Technology to Improve Care of Older Adults

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Current Major Challenges in Aging and Targets for Technology

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Increasing numbers of people are living longer with multiple chronic conditions and diminished ability to remain independent. Our current tools and strategies are not well aligned to providing high-quality health care to this aging population. Therefore, there is a critical need for improvement in the areas of health care, services, and support, such as resource allocation, service delivery, continuity of care, and chronic disease management, for the elderly adult population. Fortunately, these components of care and others may all be enhanced with thoughtfully designed and implemented technology. This chapter provides insight into the demographics of aging, and an overview of potential benefits and challenges of using technology to help older adults.

THE AGING POPULATION—A NATIONAL AND GLOBAL CHALLENGE

It is estimated that the U.S. population aged 65 years and older will more than double to nearly 90 million by 2050 (Figures 1.1 and 1.2; U.S. Census Bureau, 2014), with 21% of the population over the age of 65 years by 2050, nearly a quarter of which will be over the age of 85 years (Figure 1.3). To complicate the challenge, from 2010 to 2030, the proportion of the U.S. population in the prime caregiving years is expected to increase by only 1%, while the number of people 80 years and older who are in need of long-term services and support (LTSS) is projected to increase by a staggering 79% (Redfoot, Feinberg, & Houser, 2013).

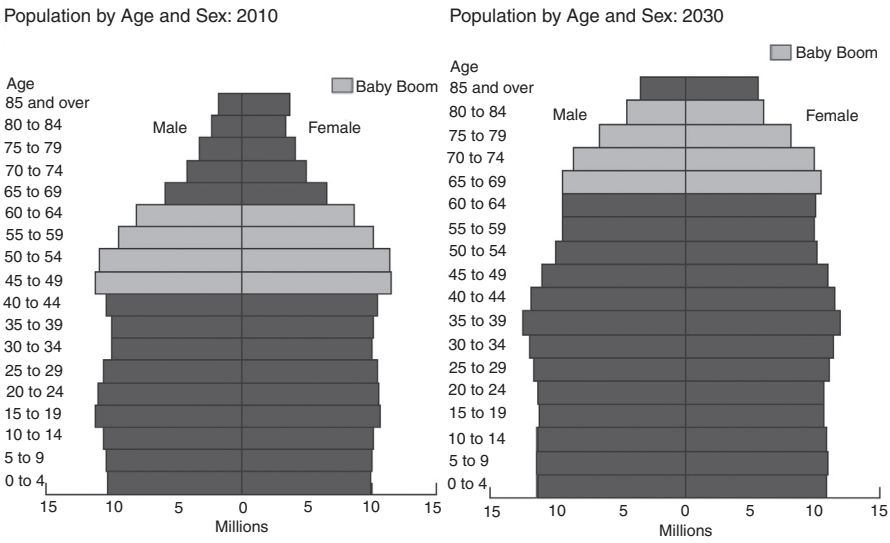

FIGURE 1.1 U.S. population by age and sex in 2010 and 2030.

Source: U.S. Census Bureau (2014).

This phenomenon is not unique to the United States, as both developed and developing nations worldwide face, or will face, the challenges of aging populations. On a global scale, the number of elderly will increase

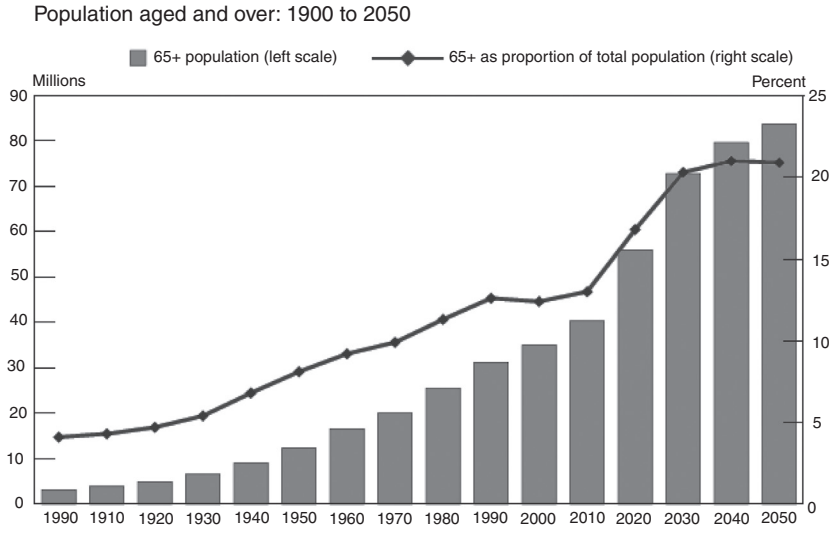

FIGURE 1.2 Population aged 65 and over: 1900 to 2050.

Source: U.S. Census Bureau (2014).

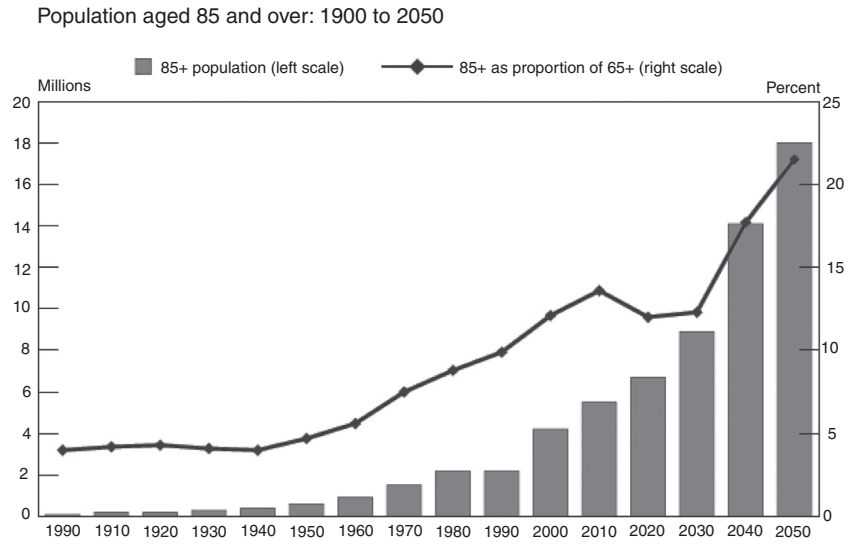

FIGURE 1.3 Population aged 85 and over: 1900 to 2050.

Source: U.S. Census Bureau (2014).

from 8.5% of the population in 2015 to a projected 16.7% in 2050 (U.S. Census Bureau, 2016).

Population aging results from a combination of decreased fertility rates and increased life expectancy. As the number of children born decreases, the relative number of people of working age and older in the population proportionally increases. As they age, so does the population. By 2047, the number of persons aged 60 years and over in the world is expected to exceed the number of children (United Nations, Department of Economic and Social Affairs Population Division, 2013, p. xii). In the past, such demographic shifts tended to occur over the course of a century or more (as was the case with France), but more recently, the pace has accelerated, leaving some countries with just a few decades to adjust to these tectonic demographic pressures (Brazil, China, and India being some examples of the latter; World Health Organization [WHO], 2015, p. 43; WHO et al., 2011, p. 4). Consequently, major shortages are projected in the number of health professionals available to care for older adults, both in the United States and worldwide, which, if not augmented by technological solutions, may result in poorer patient outcomes.

World population aging will bring about great changes. Whether these changes are for the better or worse depends on what can be done to ensure active and healthy aging. Some society-level benefits that could result from

population aging include economic productivity related to seniors serving as a strong and experienced component of the labor force, not to mention the sheer numbers of older prime consumers in the marketplace (Fried, 2016, p. S167). However, at the moment, the pendulum is swinging in a less favorable direction. In the United States, for example, 70% of Americans over the age of 65 years are expected to require some form of long-term care for at least 3 years (Bowser, 2013), along with an estimated 91% of older adults with at least one chronic condition, and many more with functional limitations and disability (Dessem et al., 2013, p. 2). Worldwide, close to a quarter of the global death and illness burden is concentrated in people aged 60 years and over (WHO, 2014b). With strong associations between aging and morbidity, public spending on health and social care for aging populations is expected to proportionally accelerate, possibly threatening worldwide economic stability (Prince et al., 2015, p. 549). With limited time, infrastructure, and resources available (Institute of Medicine, Committee on the Future Health Care Workforce for Older Americans, 2008), far-reaching and scalable changes are needed to be designed and implemented on a population level to meet this challenge.

Disability can impact individuals of any age, but is much more prevalent in older populations. In efforts to better understand disability, it can be organized into intrinsic attributes and changes at the individual level (e.g., genetics, behavioral, or lifestyle choices) and extrinsic or environmental factors (e.g., access to public transportation, health care, and basic amenities; WHO, 2015, p. 50). To address the latter, part of a proposed response to an aging population lies in expanding responsibility for health and treatment to a societal infrastructure approach (Beard, Officer, & Cassels, 2016, p. S164). This social model of disability has, for example, been adopted by WHO in the holistic approach recommended for building age-friendly cities that support active aging (Bauman, Merom, Bull, Buchner, & Fiatarone Singh, 2016; WHO, 2007).

Another framework for organizing the goals and needs of population health is the Triple Aim. This ambitious strategy was developed by the Institute for Healthcare Improvement (IHI) a decade ago in its effort to redesign the U.S. health care system, and has since been adopted by more than 150 organizations around the world (Lewis, 2014). The three intertwined goals of the Triple Aim are to improve the individual experience of care; improve the health of populations; and reduce the per capita costs of care for populations (Berwick, Nolan, & Whittington, 2008). This outline for delivering higher value care can be utilized as a guiding force in the design and development of solutions to match the many needs of our growing older

population. With these shifts in conceptualization and need, we can expect the development and application of technologies of care to broaden beyond the individual to include the surrounding environment, caregivers, and health care systems.

FOUR CHALLENGES OF AN AGING POPULATION AND THE ROLE OF TECHNOLOGY

The following sections outline four interconnected challenges of an aging population. With the expected increase in care needs that coincides with an aging population, the first challenge presented here is the question of how to provide relevant high-quality care to older persons. Second, with fewer caregivers available in relation to the growing population in need, we can expect that the relative burden of care experienced by caregivers—including both physical and emotional—will increase. We explore how caregiver burden can be reduced through the use of technology. The third challenge is to increase the relative number of healthy and independent seniors by taking a more proactive approach with prevention and health maintenance strategies. The final challenge addressed here concerns the development of health care systems and policy changes that are more inclusive of needed assistive technologies and medical devices.

First Challenge: How to Provide Care to an Aging Population

As the number of older people in need of care has risen, there has been a simultaneous shortage of skilled labor and resources available to provide health care services (Redfoot et al., 2013; Stone & Harahan, 2010). More specifically, the *old-age support ratio*—the number of people of working age (ages 20–64 years) per persons aged 65 years or above—has been declining. By 2050 this ratio is expected to drop below the threshold of two working-age persons per every one 65+ person for 7 Asian countries, 24 European countries, and 4 countries in Latin America and the Caribbean (United Nations, Department of Economic and Social Affairs Population Division, 2015, p. 7). While this has broader implications for the global economy, unfavorable support ratios, such as this, will put pressure on countries' health care systems, the ability to deliver high-quality care, and other core aspects for these societies.

In the past, family members, usually a daughter or daughter-in-law, provided care to older parents (Beard & Bloom, 2015, p. 659; Stone & Haraham,

2010, p. 111; WHO, 2015, p. 130). However, worldwide, women are entering the workforce in greater numbers, generations are more likely to live in separate households, and seniors increasingly live alone. In 2010, 28% of all noninstitutionalized older persons lived alone in the United States. Among persons aged 85 years and over, almost half (48%) lived alone in 2010 (U.S. Census Bureau, 2014). This trend is not just an artifact of necessity, living alone in the home has been demonstrated to be a preference by many seniors, with more than 40% of women aged 65 years and over in European countries electing to do so (WHO, 2011, p. 22). This trend extends even to countries with strong traditions of joint family households and family caretakers, such as Japan (WHO, 2011, p. 23).

This rise in the number of seniors who remain in their own homes for the latter years of their lives is a phenomenon popularly referred to as *aging in place*. The sustained need to provide them with in-home support presents a challenge of how we can support independent living even in the face of physical and/or cognitive decline. The potential solutions that technology can offer are manifold—some of the more promising options include mobile health monitoring, telehealth, and various assistive technologies.

Remote patient-monitoring technologies have the potential to provide regular or even continuous real-time information about those who use them. While some older adults have resisted monitoring devices out of a concern for invasion of privacy and loss of autonomy (Garcon et al., 2016), these options are increasingly welcomed by seniors because they promote independence with the added sense of safety that if something went wrong they could receive timely assistance (Center for Technology and Aging, 2009; Fischer David, Crotty, Dierks, & Safran, 2015, p. 4; Pol et al., 2016). This remotely obtained health information can be shared electronically with medical providers or family. Remote patient monitoring and communication technologies include a variety of specific solutions such as glucose monitoring devices, activity-tracking wearables, medication management tools, fall detection technology, and global positioning system (GPS) tracking devices. These tools may be mobile or represent solutions that are directly built into the living environment. A number of chapters in this book provide in-depth review of these types of technological solutions.

While many remote patient–monitoring technologies are stand-alone devices, they are also being integrated with other technologies, or a network of devices and "smart appliances," to monitor and regulate the home environment. The potential goals of these integrated systems include environmental control such as temperature and lighting, as well as appliance activity monitoring, thereby promoting efficiency and safety

(Coughlin, 2014). Sensor data may be integrated into on-site software or processed off-site with specific computer algorithms to assess and mitigate potential adverse events, such as falls. These same tools can alert medical providers, emergency services, caregivers, or family members when appropriate to expedite care (Center for Technology and Aging, 2009). As such, "smart homes" are an important step for effective health monitoring at one's residence, enabling older adults to remain independent and in the home. Companies such as Samsung, Amazon, Intel, and Motorola have seen a market in these types of services and have invested significantly in research and development of smart homes (Center for Technology and Aging, 2009, p. 22). Major barriers to greater incorporation of smart devices and smart home innovations are cost, safety, and reliability (Lee, 2014). Growing public conversation, as well as investment in integrative smart devices, is reflective of shifts in health care approaches, from curing chronic diseases and disability to supporting persons with such conditions (Beard et al., 2016, p. S164).

Other interrelated technologies that can be applied to help seniors remain independent in the home and reduce the need for outside care include e-Health or *telehealth* technologies (see Chapters 4, 10, and 11) that digitally connect older adults with care providers, health education, and emergency services (Garcon et al., 2016, p. S295). Telehealth technologies allow older adults to interact with health professionals using a variety of interfaces, most popularly through video teleconferencing. As a result, health care providers can assess a patient's health condition at a distance to allow remote diagnosis, recommend a course of treatment, coordinate care, and collaborate with other remote providers (Thomas & Applebaum, 2015). Additionally, for seniors with limitations that keep them home bound, for those who live in rural hard-to-reach settings (see Chapter 5), and for those who have limited access to transportation, e-Health and telehealth provide convenient and more equitable access to quality medical care. The use of such information and communication technologies offers an opportunity for more timely intervention and care for many conditions and illnesses that, if left unmanaged, may lead to more permanent and costly complications. Telehealth technologies also reduce exposure to nosocomial infections, increase convenience, and lower transportation costs (Boots, Widdicombe, & Lipman, 2016; Dunn, Hongyung, Almagro, Recla, & Davis, 2000). Research has shown that with these solutions, the number of in-person visits made to medical care providers and overall expenditure decrease while contact hours between provider and patient increase (Thomas & Applebaum, 2015, p. 59).

Although the focus of this book is advanced health technology, relatively simple but effective traditional assistive devices should not be overlooked when implementing a holistic care strategy. For example, research has demonstrated that basic assistive technologies such as those that aid in vision and hearing (glasses and hearing aids), mobility (canes, walkers, and walking frames), toileting, hygiene, and comfort (cushions for adjusting beds and furnishings), are invaluable contributors to quality of life and health (Garcon et al., 2016, p. S295; Marasinghe, Lapitan, & Ross, 2015; WHO, 2014a; WHO, 2015, p. 111). Additional analogue interventions include ramps, rails, stair lifts, retexturing of floors, and bathroom modifications. Research has shown a drop in reliance of in-person home service by seniors when multiple traditional assistive devices and home modifications are incorporated into the home (Anderson & Wiener, 2015, p. 430; Hoenig, Taylor, & Sloan, 2003; Hong, 2010, p. 96; Wolff, Agree, & Kasper, 2005, p. 1140, 1148).

Perhaps not surprisingly, the adoption rate of newer "smart" technologies is low in comparison to traditional assistive devices (Lee, 2014, p. 14). There are several potential explanations for this observation, including the relative affordability of basic assistive devices (Garcon et al., 2016; Schulz, Wahl, et al., 2015; Wolff et al., 2005), awareness among caregivers and receivers of such devices, ease of use (Kramer, 2014), perceived use value, and their coverage by health insurance. Chapter 2, "Promoting Technology Adoption and Engagement in Aging," explores these topics with the ultimate goal of improved care at a lower cost.

Second Challenge: Increased Caregiver Burden

As noted earlier, the proportional numbers of individuals available to provide care, both formally and informally, is projected to decrease (Anderson & Wiener, 2015, p. 429; Institute of Medicine, Committee on the Future Health Care Workforce for Older Americans, 2008; Redfoot et al., 2013; Stone & Harahan, 2010). The continued decline of the dependency ratio increases the burden of care carried by fewer individuals. Earlier, we outlined the application of technology for keeping seniors independent in the home and reducing the need for care; another important application of technology is to help reduce the burden of care that the provider experiences. Caregivers are a relatively neglected market for the development of technologies that will assist in care (Schulz, Beach, et al., 2015), while caregivers may even be a more receptive market for purchasing assistive technologies than older adult end users (Schulz, Beach, et al., 2015). To that point, job-related injuries among caregivers are high, especially back injuries, as direct care workers help disabled

seniors in and out of beds and chairs, for example (Brannon, Barry, Kemper, Schreiner, & Vasey, 2007; Kemper et al., 2008). Institutional-based caregivers have emotionally taxing and physically demanding jobs. These issues are particularly problematic for home nurses who are noted to work more hours than nurses in nearly any other setting (U.S. Department of Health and Human Services, Health Resources and Services Administration, 2010). Importantly, it has been shown that improved managerial support of nursing practice and better relations with physicians, can translate to improved morale and patient outcomes (Flynn, Dickson, & Moles, 2007; Lake & Friese, 2006). Therefore, technological communication and collaboration tools that bridge these gaps may also provide alternate or additional paths to improved patient care.

Informal caregivers are typically untrained and unpaid family or friends of the patient. Unfortunately, this group is more likely than the general population to experience mental health and financial issues because of the demands of caregiving (Hughes, Giobbie-Hurder, Weaver, Kubal, & Henderson, 1999, p. 534). More specifically, for those caring for someone with dementia, caregiver burden is linked to higher rates of depression (Hughes et al., 2004; Sugihara, Sugisawa, Nakatani, & Hougham, 2004). These issues may, in part, be compounded by a lack of training among informal caregivers, the often personal and intensive nature of care, and a lack of supporting care infrastructure for the challenging tasks they are burdened with (Yates, Tennstedt, & Chang, 1999). It is important to acknowledge and account for the specific needs of informal caregivers who may benefit from technological solutions that are configured to their level of understanding and ability.

Appropriately designed and implemented technology can extend the reach of caregivers, ultimately offsetting the cost of care and need for skilled labor. Examples of such technologies include remote patient–monitoring technologies such as wearable devices and teleconferencing, which have been discussed earlier. Another related, and sometimes overlapping, technology is the *relational agent*. Relational or companion devices have been popularly referred to by several names, such as *carebots*, *robot caregivers*, and *social robots*, but their intent is the same—they are designed to build a care relationship with a patient or to perform care duties in order to promote quality health care at a lower cost. Some of the more popularly known products in this category include PARO the robot seal, Robobear, and Polly the talking parrot, all of which are companion devices intended to interact with the recipient. Preliminary research among seniors with dementia who interact with these robots has demonstrated an objective reduction in stress hormones, as seen by decreased cortisol levels. Other fundamental benefits of relational agents include companionship for lonely and/or socially isolated

seniors (Bursack, 2016), as well as an alternative interface for remote care interaction, health education, encouragement, and monitoring. Chapter 11 provides an in-depth review of the different types of relational agents as well as their application and value.

Typical relational agents available today are only able to mechanically support themselves with their internal architecture and machinery. However, more robust robotics are under development to assist in the movement of patients or objects in the environment. For example, Robina is a recent robotic caregiver developed by Toyota that is intended to provide direct medical and nursing care and perform other physical activities such as housework (Toyota, n.d.). There are also mechanical exoskeletons in development that can be worn by physically impaired individuals to promote mobility, or be worn by caregivers to assist in physically demanding tasks. Examples include Toyota's Walk Assist Robot (Toyota, 2011, Care Assist Robot Technical Presentation) and Cyberdyne's HAL (Cyberdyne, n.d.). However, these futuristic solutions are projected to be cost intensive (Schulz, Beach, et al., 2015). It may be difficult to justify replacing more standard but less glamorous assistive devices such as electronic lifts and chairs, which are typically used to move bedridden or disabled patients.

In the future, technologically enabled senior care is likely to progress in the direction of a "global, immersive, ambient computing environment with advanced connectivity between devices, systems and services that will alter everyday life for individuals of all ages" (Schulz, Wahl, et al., 2015, pp. 728–729). This medical sensor and Internet of Things (IoT)-enabled vision for health care brings with it challenges and opportunities that are further discussed in Chapter 10. Artificial intelligence and electronic medication management strategies will also play an important role in the future development and design of these solutions to improve the delivery of care for both provider and patients. Chapter 12 provides an extended discussion of the many developing applications of artificial intelligence in health care, and Chapter 8 provides information about the latest advances in medication management and compliance innovations. Finally, with increased time pressures on caregivers, there is a critical need to provide educational resources in a more efficient way. Chapter 13 provides an overview of some of the exciting technological advances in education that are available or currently under development.

Third Challenge: Health Promotion and Prevention

The third challenge is to efficiently and effectively provide health promotion and prevention measures to our older population. The following section

provides an overview of how these concepts are relevant to older adults, followed by specific examples.

As outlined earlier, our older population is growing, and research has shown most age-related illnesses are known to develop after the age of 75 years (Shinkai, 2013). The most rapid growth of our older population is occurring in the oldest age groups. In other words, population aging is becoming "deeper" with preferential accumulation of particularly old and frail people who are prone to additional disability. Of particular concern in the United States is the accelerated growth of the population aged 85 years and over, which will occur after 2030 owing to the large size of the Baby Boomer generation (U.S. Census Bureau, 2014; Figures 1.2 and 1.3). Because the prevalence of disability and chronic diseases increases and accelerates with age, there is an imperative to use cost-effective measures to promote health in this group now in order to prevent illness and disability later. This type of intervention may take several forms, but typically involves tailored, population-specific, prevention and health promotion programs. Research has demonstrated that health promotion and lifestyle intervention is effective in compressing morbidity—that is, reducing the time spent in one's life suffering from age-related diseases or disability—and the prevention of some diseases (Fried, 2016; WHO, 2015). Various forms of technology hold great potential for application in prevention and health promotion, helping to personalize treatment to individual older adult's lifestyle and needs. Two common examples of age-related conditions that respond positively to health promotion and prevention with technological applications in this area are discussed in the following paragraphs.

Frailty is a multidimensional medical condition typically marked by a loss of muscle mass and bone density. One's susceptibility increases with age, and research has demonstrated a correlation between a decline in physical activity and an increased risk of developing frailty (Shinkai, 2013). Seniors are among the least physically active of all age groups, and relatively simple steps can be taken to prevent and even reverse the development of frailty. Common examples include musculoskeletal strength and dexterity training and dietary changes. Some examples of technologies currently being applied to encourage physical activity and better nutrition among older adults include consumer health technologies such as the FitBit, Apple watch, and other devices and smartphone applications that track and monitor health. These tools are particularly empowering and powerful because they have the potential to provide immediate feedback and a sense of control over one's own health (Chapter 10 continues

the discussion about personal health and wearables, providing an in-depth review of the available options).

The use of mechanical exoskeletons to reduce some of the physical burden of care was discussed earlier. However, these same technologies can also be applied to empower seniors with physical limitations. Even simple mobility assistance devices such as a walkers and canes are examples of technologies that encourage seniors to be active, thereby strengthening their musculoskeletal system so that they may more easily navigate standard living environments and return to a former level of relative physical activity (Chapter 6 offers specific discussion of frailty).

However, there is an important balance to be made in the use of these technologies; assistive devices that oversupport mobility may become too convenient or helpful, leading to the erosion of skills and abilities through their continued use, undermining the very goal of health promotion and prevention (Schulz, Wahl, et al., 2015, p. 732). This underlines the need for appropriate assessment, application, and monitoring of these types of technology.

Increased physical activity has also been linked to the improvement of a variety of other health conditions in old age, including lowered risk for developing chronic diseases, improved psychological status, improved reported well-being, and improved social engagement (U.S. Department of Health and Human Services, 2008). Depression is common among older adults, and research has shown that active seniors who regularly socialize are less likely to develop depression (Shinkai, 2013). Simply encouraging older adults to leave their homes and participate in some form of social engagement, including running errands, can help reduce their risk of developing depression (Shinkai, 2013). In addition to mobility assistance devices that help seniors safely leave their houses, within-the-home information and communication technology can also help facilitate socialization by providing opportunities for talking with friends and family, access to continued education, and stimulate new hobbies and interests, thereby elevating mood and overall psychological well-being (Schulz, Wahl, et al., 2015, p. 725). The discussion in Chapter 11 about relational agents offers further insight into potential technological solutions to mitigate loneliness and isolation.

Finally, home telehealth services offer a virtual extension of a caregiver into a senior's home. This not only provides a way to receive care with a decreased risk of nosocomial infections, but also provides a convenient forum to consume preventive health education as well as health maintenance monitoring. Dedicated discussion about the many facets of home telehealth can be found in Chapter 4.

Fourth Challenge: Develop Service Delivery System Inclusive of Assistive Technologies

The fourth major challenge of an aging society is to effectively deliver advanced assistive technologies to those who need them. Meeting this challenge will involve a fundamental change in how health care is viewed, as well as how patients, caregivers, and health care insurers interact. The following section highlights some of the major challenges and opportunities for successful integration of advanced health care technologies.

Although most older adults and their caregivers feel that assistive technologies should be comprehensively covered by health insurance or paid for by the government, such a responsive health insurance system has yet to be enacted in the United States (Schulz, Beach, et al., 2015, p. 11). Medicare-approved assistive technology is limited to durable medical equipment (DME), which includes medical supplies, medical devices, and assistive devices, but limits it to those that are "reusable, medically necessary, and ordered by a physician for use in the client's home. This definition excludes assistive technology that are obtained without medical authorization, designed for use outside of the home (e.g., portable wheelchairs), and environmental modifications used mainly to enhance functioning or safety" (Kitchener, Ng, Yuol Lee, & Harrington, 2008, p. 182). Recently, the Food and Drug Administration Safety and Innovation Act (FDASIA) endeavored to broaden the scope, especially as it relates to devices that may have health IT functionality (U.S. Food and Drug Administration, 2014). Currently, Medicaid (which provides medical coverage for low-income individuals of all age groups) provides payment for some assistive technologies through its waiver program. However, to complicate matters, what is offered under Medicaid varies from state to state. More evidence of the cost saving and improved care potential of advanced assistive technologies, such as telehealth and robotic caregivers, will be needed before the Centers for Medicare & Medicaid Services will consider paying for them (Schulz, Beach, et al., 2015, p. 12; Schulz, Wahl, et al., 2015, p. 732). There is some hope, however, as already industrialized countries, with more comprehensive service delivery programs, already have policies that offer incentives and subsidies to increase adoption of assistive technologies by insurance providers (Lee, 2014, p. 16).

Despite the challenges of reimbursement and coverage policy, evidence supports the need for a comprehensive health care system that provides coverage for the purchase of assistive medical technology in aging populations. For example, standard assistive device use climbs from 20% at age 70 years to a staggering 90% by age 90 years (Ivanoff & Sonn, 2005 in Garcon et al., 2016, p. S293). Furthermore, advanced medical technologies

offer opportunities to lower cost, improve the standard of care, and, in some cases, prevent or even reverse debilitating conditions (Illes, de Grey, & Rae, 2007). Therefore, there is an imperative to build a supportive environment for the innovation and application of assistive technologies and medical devices. An important element of developing a service delivery system inclusive and supportive of assistive technology is to increase the accessibility, affordability, and availability of safe and effective assistive technology and medical devices (WHO, 2014a, p. vi). One proposed strategy to meet these aims can be broken down into four primary initiatives: (a) providing funding mechanisms for the research and development of assistive and medical devices; (b) raising public awareness and building market capacity for assistive technologies and medical devices; (c) putting policy supportive of assistive technology into practice; and (d) fostering service networks and suppliers to bring these technologies into the hands and homes of the older adults and caregivers who need them (Garcon et al., 2016, p. S300) and ensure that they are properly maintained (Coughlin, 2014). Assistive health technologies and medical devices hold the potential of cost-effective care for both individuals and health care systems (Kitchener et al., 2008; Lee, 2014, p. 14). Creating the kinds of technologies that demonstrate value requires both investment as well as the collaborative insight of multiple different types of expertise. For example, technology developers and entrepreneurs need the insight of both caregivers and patients to deliver relevant products to improve health quality, efficiency, and safety. Without dedicated attention to these key elements, health technology and/or the implementation of technology will not be embraced. Chapter 2 provides an in-depth review of these concepts, as well as specific considerations for successful technology design and adoption.

CONCLUSION

While population aging represents a success story of human progress, it also presents profound challenges for health care as well as for society as a whole. Fortunately, the acceleration in technological advances holds the promise of providing improved care more equitably and efficiently. It is important to keep in mind that technology by itself is not the solution, but rather another tool to enhance the quality and delivery of care and the abilities and reach of caregivers. Bringing about successful technology development and deployment requires the collaboration of a variety of different participants including, but not limited to, clinicians, engineers, statisticians, computer scientists, social scientists, political scientists, policy makers, and patients themselves. Insightful leadership and management will need to understand

the requirements and perspectives of these stakeholders to meet the growing demands of our rapidly aging population. The chapters in this book present some of the most exciting solutions available to not only adapt, but also lead new paradigms in the effective delivery of high value health care.

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