Aging and Disability

Implications for the Housing Industry and Housing Policy in the United States

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Problem: The elderly population of the United States is large and growing rapidly. Since disability rates increase with age, population aging will bring substantial increases in the number of disabled persons and have a significant impact on the nation's housing needs.

Purpose: We demonstrate the impact of population growth and aging on the projected number of households with at least one disabled resident and estimate the probability that a newly built single-family detached unit will have at least one disabled resident during its expected lifetime.

Methods: We calculate disability rates using two alternative measures of disability and construct projections of the number of households with at least one disabled resident. We develop and apply a technique for estimating the probability that a newly built single-family detached unit will house at least one disabled resident using data on the average lifespan of those units, the average length of residence for households occupying those units, and the projected proportion of households with at least one disabled resident.

Results and conclusions: Under our medium assumptions, we project that 21% of households will have at least one disabled resident in 2050 using our first disability measure (physical limitation) and 7% using our second (self-care limitation). We estimate that there is a 60% probability that a newly built single-family detached unit will house at least one disabled resident during its expected lifetime using our first measure, and a 25% probability using our second measure. When disabled visitors are accounted for, the probabilities rise to 91% and 53%, respectively. Given the desire of most people

The elderly population of the United States is large and growing rapidly. In 2000, there were 35 million persons aged 65 and older, making up 12% of the total population. This population is projected to exceed 86 million by 2050, making up 21% of the total (U.S. Census Bureau, 2004). The oldest segment of the elderly population is growing particularly rapidly, with the population aged 85 and over projected to grow more than five-fold between 2000 and 2050, from 4 million to 21 million. Since disability rates rise with age, there is a strong likelihood that population aging will bring large increases in the number of disabled persons. This will have important implications for the housing industry and housing policy in the United States and will require the attention of federal, state, and local planners.

to live independently for as long as possible, these numbers reflect a large and growing need for housing units with features that make them accessible to disabled persons.

Takeaway for practice: The lack of accessible housing provides an opportunity for homebuilders to develop and market products that meet the needs of an aging population. In light of concerns about the civil rights of people with disabilities and the high public cost of nursing home care, housing accessibility is a critical issue for planners and policymakers as well. We believe planners should broaden their vision of the built environment to include the accessibility of the housing stock.

Keywords: aging, disability, housing accessibility, visitability, housing policy

Research support: None.

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It was estimated that 51 million Americans (18% of the total population) had some type of disability in 2002; among those aged 65 or older, more than 52% had a disability. Many of these disabilities reduced physical mobility. More than 9% of the population reported difficulty walking and 9% reported difficulty using stairs; among those aged 65 or older, 32% reported difficulty walking and 31% reported difficulty using stairs (Steinmetz, 2006). In the mid 1990s, almost seven million Americans living in noninstitutional settings were using assistive devices such as scooters, wheelchairs, canes, crutches, and walkers (Kaye, Kang, & LaPlante, 2000). Due to population growth and aging, this number is undoubtedly higher today.

People with mobility impairments often need features like zero-step entrances and wide interior doorways in order to reside safely and comfortably in their homes, but such features are generally missing in the U.S. housing stock. One study estimated that more than 90% of the housing units in the United States are inaccessible to people with disabilities (Steinfeld, Levine, & Shea, 1998); another estimated that the vast majority of newly built single-family homes have steps at all entrances and/or narrow interior doorways (Maisel, Steinfeld, & Smith, in press). This situation is not unique to the United States; Imrie (2003) cited a study of newly built private sector homes in the United Kingdom in which 98% of the units were inaccessible to wheelchair users.

Consequently, there is a substantial gap between the need for and the supply of accessible housing. Nishita, Liebig, Pynoos, Perelman, and Spegal (2007) reported that only 38% of U.S. households having at least one member with a permanent physical activity limitation had any type of home modification. Hammel (2005) reported that less than one-third of elderly homeowners with activity limitations had even the most common home modifications. Louie (1999) reported that fewer than half the households with disabled elderly residents who expressed a need for a ramp actually had one. Clearly, many people who would benefit from such features do not have them.

The lack of accessible housing has serious consequences for individuals and for society as a whole. Disabled people living in units lacking adequate accessibility features face a greater risk of injury due to falls than those living in units with adequate features (Close et al., 1999). Indeed, the fear of falling itself reduces the well-being of many older people (Gitlin et al., 2006). Disabled people living in units without adequate features are more likely to suffer from social isolation and loneliness (Hammel, 2005). This has a negative impact on life satisfaction, health, and self-esteem, three factors that are critical to successful aging (Maisel et al., in press). The lack of ade-

quate features also places a burden on caregivers, making it more difficult for them to provide assistance and reducing their own well-being (Saville-Smith, James, Fraser, Ruan, & Travaglia, 2007). Furthermore, many people who become disabled due to injury or disease are forced to move into nursing homes or other institutions because their homes lack adequate accessibility features (Maisel et al., in press). This imposes high emotional and financial costs on the individual, and most likely inflicts high economic costs on taxpayers as well.

Most disabled people want to live independently for as long as possible and strongly desire housing features that will allow them to do so. However, they are not the only ones interested in accessibility features. Many people who are not disabled would like to accommodate disabled friends or relatives when they come to visit (Bayer & Harper, 2000), and others have injuries or conditions that temporarily limit their mobility, even though they eventually return to full functionality (Crimmins, 2004). Perhaps more important, many recognize the possibility that they themselves may become disabled. A survey of Americans aged 45 and older found that nearly one-fourth of the respondents thought it likely that they or someone in their household would have difficulty getting around in their homes within the next five years (Bayer & Harper, 2000).

The vast majority of older people would like to continue living in their current homes as they age. Kochera, Straight, and Guterbock (2005) reported that 78% of persons aged 50 to 64, 91% of persons aged 65 to 74, and 95% of persons aged 75 and over expressed a desire to remain in their current homes for as long as possible. Other studies have reported similarly high proportions (Bayer & Harper, 2000; Kochera, 2002). Consequently, many have made structural modifications to their homes such as widening doorways and installing ramps. More than two-thirds of those who have made such modifications believe the changes will allow them or a member of their household to live in their residence longer than they could have otherwise (Bayer & Harper, 2000).

The demand for accessible housing is determined by market conditions, government policies, and a variety of personal and household characteristics. We believe this demand will increase in coming decades as the U.S. population grows and continues aging. To date, however, few studies have analyzed the determinants of this demand or projected how those determinants might change over time. In this article, we construct projections of one major determinant of the demand for accessible housing; namely, the number of households with a disabled resident. Recognizing that multiple households may occupy a given housing unit sequentially over time, we also develop estimates of the

probability that a newly built unit will house at least one disabled resident over its expected lifetime. We believe these estimates and projections will provide valuable information on the potential demand for accessible housing, and have important implications for homebuilders, planners, and policymakers.

We focus on long-lasting physical disabilities that impair a person's ability to enter, leave, or get around effectively at home. Thus, we use the term *disability* to refer solely to long-lasting mobility impairments. We do not consider short-term mobility impairments, vision or hearing impairments, or cognitive, emotional, or other disabling conditions.

We start by discussing a number of policy measures and initiatives that have been designed to raise the supply of accessible housing in the United States. Then, we describe several measures of disability and the data we use to construct disability rates. We discuss recent trends in disability rates and explain our approach to projecting future rates. Using projected disability rates and projections of the U.S. population by age and sex, we project the number of disabled persons from 2000 to 2050. We follow a similar approach to project the number of households with at least one disabled resident.

Population and household projections provide useful information on the potential demand for accessible housing, but do not tell the whole story because housing units typically last for many years and are occupied by a number of different households over time. To address this issue, we develop estimates of the probability that a single-family detached unit built in 2000 will have at least one disabled resident during its expected lifetime. We focus on single-family detached units because they constitute the majority of housing units in the United States and have been largely unaffected by federal accessibility legislation. We extend the analysis to consider *visitability*, or whether a housing unit can accommodate visits by disabled persons without undue difficulty. We close with an evaluation of our estimates and projections, a brief discussion of the cost of accessibility features, an overview of further research needs, and several recommendations for planners and policy makers regarding housing accessibility.

A number of studies have analyzed links between demographic characteristics and housing (Masnick, 2002; Myers, Pitkin, & Park, 2002; Myers & Ryu, 2008; Nelson, 2006). Several have focused specifically on the housing needs of disabled residents (Imrie, 2003, 2004; Milner & Madigan, 2004). To our knowledge, however, this is the first study to project the number of households with disabled residents and the first to consider the prevalence of disability within housing units rather than within the

population. Both of these innovations are essential for estimating the impacts of population aging and rising disability on the demand for housing and the formation of housing policy. Although our focus is on the United States, we believe our methods can be applied in other countries as well.

Policy Measures and Initiatives

What has been done to promote the construction of accessible housing in the United States? At the federal level, Section 504 of the Rehabilitation Act of 1973 required that at least 5% of multifamily housing units built or substantially rehabilitated using federal funds be accessible to people with mobility impairments (Kochera, 2002). The Fair Housing Amendments Act of 1988 prohibited housing discrimination on the basis of disability; required landlords to allow tenants to make reasonable modifications to accommodate disabilities; and expanded the coverage of federal accessibility standards to include most new multifamily buildings with more units. These standards include accessible entrances; wide interior doors; bathroom walls reinforced to accommodate grab bars; usable bathrooms and kitchens; and accessible light switches, electrical outlets, and environmental controls (Kochera, 2002). The Americans with Disabilities Act of 1990 focused primarily on access to public facilities, but reinforced the provisions of Section 504 of the Rehabilitation Act of 1973 (Maisel et al., in press).

To date, federal accessibility legislation has primarily affected nonresidential buildings and multifamily housing, with the only exception being the requirement that 5% of single-family units built using federal funds must be accessible to people with disabilities. However, this could be changing. The Inclusive Home Design Act, first introduced in 2003 by Representative Jan Schakowsky (D-IL), would require a zero-step entrance, 32 inches of clearance for interior doorways on the main floor, and a bathroom that can accommodate wheelchairs in all new single-family homes built using federal funds. As of November 2007, the bill had 16 cosponsors (Inclusive Home Design Act, 2007).

The Inclusive Home Design Act was inspired by the visitability movement that arose in Europe and the United States during the 1980s. A visitable home is one that is accessible to visitors with mobility impairments (Kaminski, Mazumdar, DeMento, & Geis, 2006). This movement is based on three fundamental principles: accessibility is a civil right that improves quality of life; accessibility for new housing units can be achieved at minimal cost if good

design practices are followed; and focusing on a limited number of features will speed their adoption. Although features such as accessible electrical controls and lever-style door handles are sometimes included, the three key visitability features are a zero-step entrance, a bathroom or half bath on the entry level, and interior doors with at least 32 inches of clearance (Maisel, 2006). These features not only make it easier for disabled people to visit the homes of others, but also make it more likely that people who are not disabled will be able to reside safely in their homes if they develop a disability.

The visitability movement was initiated in the United States by Concrete Change, a disability advocacy group in Atlanta, Georgia promoting the inclusion of the three key features in virtually all new housing units (Concrete Change, 2007a). The movement has been influential. In 1989, Concrete Change worked with the Atlanta affiliate of Habitat for Humanity to include the three key visitability features in virtually all their new houses; to date, more than 800 visitable Habitat homes have been built in Atlanta. In 1992, the City of Atlanta passed the first local ordinance requiring visitability features in private single-family homes built with any type of financial benefit disbursed by the city. Similar legislation has since been passed in other places, including San Antonio, Texas, Chicago, Illinois, Lafayette, Colorado, and the states of Georgia, Texas, and Kansas. Although most visitability legislation applies only to houses built with some degree of public funding, several local areas (e.g., Bolingbrook, Illinois and Tucson, Arizona) have passed legislation that applies to all new housing, including units built solely with private funds. In addition to mandatory requirements, several cities and states have worked with developers and homebuilders to establish voluntary programs. By the end of 2007, 57 state and local governments had mandatory or voluntary visitability programs in place (Maisel et al., in press).

Visitability legislation is controversial because it raises issues regarding the individual rights of property owners, the civil rights of disabled persons, and the proper role of government (Nishita et al., 2007). In the only lawsuit to date involving a visitability ordinance, the courts ruled in favor of the ordinance (*Washburn v. Pima County*, 2003). We return to these issues later in the article.

Visitability is part of a broader range of movements concerned with design that accommodates the needs of as many people as possible. These movements are described using terms like *universal design*, *inclusive design*, and *design for all*. The term *universal design* is the most widely used in the United States, and refers to the general principle that, to the greatest extent possible, manufactured products and the built environment should be designed to be usable by all people, regardless of their experience, knowledge, language skills, and physical abilities (Center for Universal Design, 1997). Universal design principles may be applied to a public park, a house, or an item as small as a vegetable peeler. The concept of visitability arose separately from that of universal design and focuses solely on houses, but the two movements are similar in that both aim to apply their principles universally rather than only in special circumstances. In recent years, proponents of the two movements have often worked together because many of their objectives overlap.

Another organization working on building design issues is the International Code Council (ICC), a private, nonprofit organization established in 1994 to develop comprehensive construction and safety codes for residential and commercial buildings (International Code Council, 2008). Its membership is drawn from federal, state, and local government agencies; the construction industry; advocacy groups; and other stakeholders. In 2006, the ICC instituted a task force to develop model code guidelines regarding visitability for housing types not covered by the Fair Housing Amendments Act of 1988 (i.e., new one-, two-, and three-family dwellings). Task force recommendations for a zero-step entrance, minimum interior door widths, one accessible bathroom, and several other features received preliminary approval in January 2008, and will be finalized after a period of public comment.

Housing accessibility movements are active not only in the United States, but also in Australia, Denmark, France, Greece, Italy, the Netherlands, Spain, Sweden, and several other countries (Alonso, 2002; Kochera, 2002; Maisel et al., in press). The United Kingdom has the most extensive mandate of any country, requiring all new housing units to have a zero-step entrance, wide halls and doorways, a bathroom on the entry level, and accessible electrical outlets and controls (Imrie, 2003). These requirements apply to single-family as well as multifamily units and to those built with private as well as public funding. As is true under most accessibility legislation in the United States, waivers in the United Kingdom may be granted based on the topography of the construction site.

A number of programs have been designed to assist in the modification of existing housing units (Duncan, 1998; Steinfeld et al., 1998). Many programs are targeted toward specific disability groups such as the elderly, veterans, or low-income households. Assistance may come in the form of grants, loans, equipment (such as lifts), or services (such as the provision of architectural plans). Funding is provided by federal agencies such as the Department of Housing and Urban Development, the Department of Energy, the Administration on Aging, the Social Security

Administration, and the Department of Veterans Affairs; a wide variety of state and local government agencies; and private organizations such as the Lions Club and Rotary International.

For those unable to pay for home modifications on their own, securing funds can be difficult due to the lack of a central information clearinghouse and the confusing array of programs, each with its own rules and eligibility requirements (Pynoos & Nishita, 2003). Furthermore, many programs do not have sufficient financial resources to meet the needs of all who request assistance. As a result, many disabled people are unable to make modifications and are forced either to remain in homes ill-equipped to meet their needs or to move prematurely into institutional housing (Maisel et al., in press).

Although public and private initiatives have had some success in promoting the construction of accessible housing and the renovation of existing units, the vast majority of housing in the United States remains inaccessible to people with disabilities. We turn next to estimating the potential need for accessibility features and projecting that need into the future.

Measures of Disability

A disability can be defined as "a physical or mental impairment that substantially limits one or more major life activities" (Steinmetz, 2006). Although the concept is clear, there is no single, standard way to measure the prevalence of disabilities within a population. Measures of significant disability are often based on whether individuals can accomplish Activities of Daily Living (ADLs), including bathing, dressing, eating, getting out of a chair or bed, walking across a room, and using the toilet (Freedman et al., 2004; Lakdawalla et al., 2003; Manton & Gu, 2001). Measures of less severe disabilities are often based on whether individuals can accomplish Instrumental Activities of Daily Living (IADLs), including doing housework, preparing meals, shopping for groceries, taking medications, managing money, and using the telephone (Crimmins & Saito, 2000; Spillman, 2004; Waidmann & Liu, 2000).

We use two such disability measures in this article, calculating each one for both individuals and households, using data from the 5% Public Use Microdata Sample (PUMS) files from Census 2000 (U.S. Census Bureau, 2003). Census data provide detailed geographic and demographic coverage and have been found to provide reliable disability estimates (Calsyn, Winter, & Yonker, 2001).

We define individuals with physical limitations (DIS-1) as those with long-lasting conditions that substantially limit one or more physical activities such as walking, climbing stairs, reaching, lifting, or carrying. We define individuals with self-care limitations (DIS-2) as persons with conditions lasting six months or more that make it difficult to dress, bathe, or get around inside the home. For both measures, we calculate disability rates for males and females in each age group by dividing the number of persons with a disability by the total number of persons in the group (see Table 1). These rates include persons living in institutions as well as those living in households.

Both measures show disability rates to increase with age. This pattern has been reported frequently in the literature (Bhattacharya et al., 2004; Kaye et al., 2000; Steinmetz, 2006). Both measures show slightly lower rates for females than males in the youngest group, but higher rates for females in all older groups, with the differences becoming larger as age increases. This pattern has also been noted before (Kaye et al., 2000; Steinmetz, 2006). Rates are substantially higher for DIS-1 than DIS-2, showing that the latter reflects more severe disabilities. Although it is not shown in Table 1, about 83% of persons with a self-care limitation (DIS-2) also have a physical limitation (DIS-1), but only 29% of those with a physical limitation also have a self-care limitation.

The rates obtained from these measures are consistent with those obtained from several other commonly used disability measures. Age- and sex-specific rates for DIS-1 and DIS-2 are roughly similar to rates measuring severe disabilities and needs for personal assistance, respectively, using data from the U.S. Census Bureau's Survey of Income and Program Participation (Steinmetz, 2006). Also, age-specific rates for DIS-2 are roughly similar to those reported for users of mobility devices such as wheelchairs, scooters, walkers, canes, or crutches (Kaye et al., 2000).

The first household measure, HHDIS-1, includes households in which any member has a long-lasting condition that substantially limits one or more physical activities such as walking, climbing stairs, reaching, lifting, or carrying. The second household measure, HHDIS-2, includes households in which any member has a condition lasting six months or more that makes it difficult to dress, bathe, or get around inside the home. For each measure, we calculate household disability rates by dividing the number of households with at least one disabled resident by the total number of households for each age group. Age groups are determined by the age of the householder, but the incidence of disability refers to anyone in the household, regardless of their age or sex. Disability rates for households are shown in Table 2. Because they are based solely on household data, these rates do not include persons living in institutions.

Table 1. Individual disability rates by age and sex, 2000.

Age	Male			Female		
	U.S. population	Persons with disability	%	U.S. population	Persons with disability	%
DIS-1						
<35	60,949,682	1,121,581	1.8	58,747,107	1,024,801	1.7
35–44	22,795,548	1,244,430	5.5	23,124,437	1,303,179	5.6
45–54	18,432,972	1,644,908	8.9	19,172,397	1,812,554	9.5
55–64	11,582,552	1,814,774	15.7	12,590,270	2,039,293	16.2
65–74	8,245,839	1,794,954	21.8	9,989,648	2,313,961	23.2
75–84	4,815,313	1,507,354	31.3	7,577,579	2,760,742	36.4
85+	1,306,660	618,657	47.3	3,045,737	1,852,722	60.8
Total	128,128,566	9,746,658	7.6	134,247,175	13,107,252	9.8
DIS-2						
<35	60,949,682	606,523	1.0	58,747,107	486,806	0.8
35–44	22,795,548	371,321	1.6	23,124,437	402,428	1.7
45–54	18,432,972	438,913	2.4	19,172,397	519,422	2.7
55–64	11,582,552	424,696	3.7	12,590,270	534,536	4.2
65–74	8,245,839	464,774	5.6	9,989,648	672,627	6.7
75–84	4,815,313	544,988	11.3	7,577,579	1,154,653	15.2
85+	1,306,660	322,841	24.7	3,045,737	1,147,017	37.7
Total	128,128,566	3,174,056	2.5	134,247,175	4,917,489	3.7

Note:

Data are for the population aged 5 and older.

Source: U.S. Census Bureau, 2003.

Whereas rates for DIS-1 and DIS-2 show the proportion of the population in each age-sex group with a disability, rates for HHDIS-1 and HHDIS-2 show the proportion of householders in each age group whose households contain at least one disabled resident. Overall, household disability rates are roughly twice as large as individual disability rates. This is not surprising because most households have two or more members. Again, these rates increase with age, and rates based on the first measure are substantially higher than rates based on the second.

These disability measures are based on a widely used methodology and use data from a well-recognized, reliable source. Rates based on individual data are similar to those reported in other studies. Perhaps most important, rates based on household data can be directly related to projections of households. We believe DIS-1 reflects the proportion of the population for whom accessibility features would be beneficial for residing safely and comfortably in their homes, and DIS-2 reflects the proportion for whom

such features are essential for doing so. HHDIS-1 and HHDIS-2 reflect the corresponding proportions for households. Although no measure can capture all dimensions of disability, we believe these measures provide a useful means for evaluating the links connecting aging, disability, and housing.

Trends in Disability Over Time

Before projecting how disability rates are likely to change in the future, we must consider how they have changed in the past. This task is difficult because disability is a social construct determined by an individual's physical, mental, and emotional condition and by a variety of social and environmental factors (Freedman et al., 2004). That is, disability rates are affected not only by a person's underlying capacity to perform certain tasks, but also by the availability of technological and human assistance and by

Table 2. Household disability rates by age of householder, 2000.

Age	U.S. households	HHDIS-1 (households with disabled resident)	%	HHDIS-2 (households with disabled resident)	%
<35	26,122,015	1,367,226	5.2	478,632	1.8
35–44	24,863,576	2,581,240	10.4	895,912	3.6
45–54	20,957,677	3,378,321	16.1	1,081,680	5.2
55–64	13,508,638	3,388,779	25.1	970,670	7.2
65–74	10,518,944	3,255,093	30.9	927,412	8.8
75–84	7,417,732	2,852,307	38.5	962,314	13.0
85+	2,247,362	1,205,028	53.6	559,272	24.9
Total	105,635,944	18,027,994	17.1	5,875,892	5.6

Source: U.S. Census Bureau, 2003.

changing perceptions of what constitutes a disability. Consequently, changes in disability rates reflect much more than changes in the underlying physical, mental, and emotional capacity of the population.

Numerous studies of disability trends have focused on the elderly population. Many have reported declines in disability rates for older persons during the 1980s and 1990s (Cai & Lubitz, 2007; Manton & Gu, 2001; Martin, Schoeni, Freedman, & Andreski, 2007; Spillman, 2004; Waidmann & Liu, 2000). These declines were often found to be relatively large (1–2% per year) and statistically significant.

Not all studies have reported declines, however. Crimmins and Saito (2000) found declines in disability rates for older women between 1984 and 1994, but not for older men. They also found statistically significant increases in the prevalence of a number of diseases over this time period (e.g., heart disease, cancer, diabetes, arthritis, and osteoporosis). Spillman (2004) noted that much of the decline in disability rates among the older population during the 1980s and 1990s was confined to less severe disabilities and that the evidence for more severe disabilities was mixed.

Furthermore, studies of the younger population have not reported consistently improving health or declining disability. Bhattacharya et al. (2004) and Lakdawalla, Bhattacharya, and Goldman (2004) found increases in disability rates among younger persons from the mid-1980s to the mid-1990s. Kaye, LaPlante, Carlson, and Wenger (1996) reported increasing disability rates for younger persons during the early 1990s. Martin et al. (2007) reported mixed results regarding trends in the health status of young adults between 1982 and 2003.

There are several reasons for this conflicting evidence. One is simply that different studies use different populations, data sets, and measures of disability; such differences are known to affect disability estimates and trends over time (Freedman et al., 2004; Wolf, Hunt, & Knickman, 2005). A second reason is more complex. Several analysts have reported disability rates that declined even as the prevalence of diseases increased (Crimmins & Saito, 2000; Freedman & Martin, 2000). This occurred because the relationship between disability and health has changed over time due to more effective diagnostic techniques, improvements in disease management, better assistive devices, and improvements in accessibility features. Furthermore, a condition or disease that was previously considered a disability may no longer be viewed as such. Consequently, declining disability rates do not necessarily reflect improving health.

Some analysts believe recent declines in disability rates for older persons will continue well into the future because of continuing advances in biomedical and epidemiological research, more aggressive public health programs, a growing awareness of the importance of regular exercise and good nutrition, and further increases in educational levels (Freedman & Martin, 2000; Singer & Manton, 1998; Waidmann & Liu, 2000). Such declines would have an important impact on overall disability rates because older people account for a disproportionately large share of the disabled population.

Others are less optimistic that rates will continue falling, either for the older population or for the population as a whole. They point out that disability rates have risen for younger adults, a group that constitutes a large proportion of the population and will become the older population of future decades (Bhattacharya et al., 2004; Lakdawalla et al.,

2004). They note that the prevalence of obesity, which is associated with elevated disability rates, has increased substantially among both older and younger adults (Arterburn, Crane, & Sullivan, 2004; Reynolds, Saito, & Crimmins, 2005). Furthermore, although rapid educational improvement contributed significantly to declining disability rates over the last several decades, the pace of that improvement is expected to slow in future decades (Freedman & Martin, 1999). Also, the largest racial and ethnic minority groups have relatively high disability rates (Schoeni, Martin, Andreski, & Freedman, 2005), and these groups are projected to grow more rapidly than the rest of the population (U.S. Census Bureau, 2004). Consequently, a number of analysts have questioned the likelihood that future disability rates will continue to fall (Bhattacharya et al., 2004; Spillman, 2004; Sturm, Ringel, & Andreyeva, 2004; Wang, Gu, & Yi, 2007; Wolf et al. 2005), and some have projected that rates will eventually rise (Lakdawalla, et al., 2003).

One can make plausible arguments for projecting either increasing or declining disability rates. We believe that when there is substantial uncertainty regarding the direction of future trends it is generally advisable to hold rates constant when making projections (Smith, Tayman, & Swanson, 2001). Consequently, we base our medium projections on rates that remain constant at 2000 levels. We also evaluate projections based on rates that rise or fall by 5% per decade between 2000 and 2050; we refer to these as our high and low scenarios, respectively. Given the trends in disability rates observed over the last several decades, we believe these scenarios provide a reasonable range of projections.

Projections

Our first objective is to project the number of disabled persons and the number of households with at least one disabled resident. We do this by applying the disability rates described above to a set of population and household projections. This is a standard and widely used approach for making projections of demographic and socioeconomic characteristics (Siegel, 2002).

We use population and household projections from the ProFamy projection model. We chose these projections because they incorporate recent population trends, extend through 2050, and provide data on households as well as population. In contrast, the most recent household projections from the U.S. Census Bureau were published in the mid-1990s and extended only through 2010. We believe the ProFamy projections provide a solid foundation for the empirical analysis. (See the Appendix for a description of the ProFamy model.)

Population

Table 3 shows projections of the total population and the number of disabled persons. Under the medium scenario, in which disability rates remain constant, the number of disabled persons for both disability measures more than doubles between 2000 and 2050, resulting in a growth rate substantially higher than for the population as a whole. The proportion of the population with a physical limitation (DIS-1) increases from 8.2% in 2000 to 11.6% in 2050, and the proportion with a self-care limitation (DIS-2) increases from 2.9% to 4.6%. Table 3 does not show this, but the number of disabled persons rises over time in each age group, with the largest increases occurring at the oldest ages.

Even under the low scenario, the number of disabled persons grows more rapidly than the population as a whole. For DIS-1, the number of disabled persons grows by 59% between 2000 and 2050; for DIS-2, it grows by 76%. Apparently, the aging of the population more than offsets the effect of declining disability rates.

Under the high scenario, the number of disabled persons grows by 163% between 2000 and 2050 for DIS-1 and by 190% for DIS-2. Clearly, when combined with population aging, rising disability rates lead to huge increases in the number of disabled persons.

Households

Projections of the number of households and the number of households with at least one disabled resident are shown in Table 4. Under the medium scenario, the number of households with a disabled resident almost doubles between 2000 and 2050 for HHDIS-1; for HHDIS-2, it more than doubles. Consequently, the proportion of households with at least one disabled resident increases substantially, from 16.5% to 21.2% for HHDIS-1 and from 5.4% to 7.2% for HHDIS-2. Although this is not shown in Table 4, the increases are considerably greater for households with older householders than for those with younger householders.

Under the low scenario, the number of households with a disabled resident as measured by HHDIS-1 grows more rapidly than the total number of households through 2030, but more slowly thereafter due to a slowdown in the rate of growth of the elderly population. This causes the proportion of households with a disabled resident to rise slightly between 2000 and 2030 but to decline slightly thereafter. For HHDIS-2, the proportion of households with a disabled resident increases slowly through 2040, but declines slightly by 2050.

Under the high scenario, the number of households with a disabled resident grows by approximately 150%

Table 3. Projections of total population and persons with disabilities, 2000–2050.

	2000	2010	2020	2030	2040	2050
Population	281,421,920	308,714,880	333,534,624	359,655,648	385,430,208	410,116,896
DIS-1						
Low	23,148,345	25,943,179	28,896,854	32,285,802	35,264,114	36,890,348
%	8.2	8.4	8.7	9.0	9.1	9.0
Medium	23,148,345	27,308,609	32,018,675	37,656,571	43,295,081	47,675,441
%	8.2	8.8	9.6	10.5	11.2	11.6
High	23,148,345	28,674,040	35,300,589	43,592,188	52,625,442	60,847,287
%	8.2	9.3	10.6	12.1	13.7	14.8
DIS-2						
Low	8,234,000	9,185,169	10,145,932	11,670,077	13,437,528	14,483,717
%	2.9	3.0	3.0	3.2	3.5	3.5
Medium	8,234,000	9,668,599	11,242,030	13,611,403	16,497,759	18,718,111
%	2.9	3.1	3.4	3.8	4.3	4.6
High	8,234,000	10,152,029	12,394,338	15,756,901	20,053,130	23,889,579
%	2.9	3.3	3.7	4.4	5.2	5.8

Source: ProFamy (unpublished data) and authors' calculations.

Table 4. Projections of households and households with at least one disabled resident, 2000–2050.

	2000	2010	2020	2030	2040	2050
Households	103,368,736	120,795,809	131,624,150	140,088,321	148,551,774	156,268,390
HHDIS-1						
Low	17,097,283	20,402,031	22,423,483	24,067,264	25,244,765	25,682,981
%	16.5	16.9	17.0	17.2	17.0	16.4
Medium	17,097,283	21,475,822	24,845,964	28,070,872	30,993,949	33,191,541
%	16.5	17.8	18.9	20.0	20.9	21.2
High	17,097,283	22,549,613	27,392,675	32,495,544	37,673,338	42,361,751
%	16.5	18.7	20.8	23.2	25.4	27.1
HHDIS-2						
Low	5,569,750	6,634,110	7,230,879	7,840,868	8,429,025	8,704,061
%	5.4	5.5	5.5	5.6	5.7	5.6
Medium	5,569,750	6,983,274	8,012,055	9,145,202	10,348,631	11,248,741
%	5.4	5.8	6.1	6.5	7.0	7.2
High	5,569,750	7,332,438	8,833,290	10,586,714	12,578,826	14,356,560
%	5.4	6.1	6.7	7.6	8.5	9.2

Note:

These numbers exclude disabled persons living in group quarters.

Source: ProFamy (unpublished data) and authors' calculations.

between 2000 and 2050 for both HHDIS-1 and HHDIS-2. As a result, the proportion of households with a disabled resident rises from 16.5% to 27.1% for HHDIS-1 and from 5.4% to 9.2% for HHDIS-2.

Estimated Probability That a Unit Will House a Disabled Resident

Our second objective is to estimate the probability that a newly built single-family detached unit will house at least one disabled resident during its expected lifetime. These estimates are intended to account for the likelihood that most housing units will be occupied by a number of different households over time, each with a different set of characteristics. For the sake of simplicity, we assume that all newly built single-family detached units have an equal probability of being occupied by a household with a disabled resident. We discuss the implications of relaxing this assumption later in this section. Although a small percentage of units are vacant or used seasonally at any given time, we believe our estimates are representative of all newly built single-family detached units. In 2005, 90% of single-family detached units were occupied, 7% were vacant, and 3% were used seasonally (U.S. Census Bureau, 2006).

We focus on single-family detached units for two reasons. First, they constitute the majority of housing units in the United States. In 2005, 63% of households and 68% of householders aged 65 and older lived in single-family detached units (U.S. Census Bureau, 2006). Second, multiunit structures are already subject to a number of federal, state, and local accessibility requirements; thus, future policy changes are likely to be directed toward single-family units. Similar analyses could be done for other types of housing units.

In order to estimate the probability that a newly built single-family detached unit will house at least one disabled resident during its expected lifetime, we must (a) project the proportion of households with at least one disabled resident for people living in single-family detached units, (b) estimate the average length of time households reside in such units, and (c) estimate the average lifespan of such units.

For the projected proportion of households living in single-family detached units with at least one disabled resident, we use the projected proportion of all households with at least one disabled resident (shown in Table 4). We believe this provides a reasonable proxy because disability rates for residents of single-family detached units are very similar to disability rates for all households (see Table 5).

We estimate the average length of residence in single-family detached units using data shown in Table 6. We note that length of residence increases dramatically with age, rising from 4.3 years for householders under age 35 to 30.2 for householders aged 85 or older. The average length of residence for all householders in 2000 was 13.7 years.

The lifespan of a housing unit (i.e., the period over which it provides dwelling services) is determined primarily by the quality of its design and construction, its exposure to hazards, and the extent of maintenance and renovation it receives. Theoretically, the lifespan could be extended almost indefinitely if sufficient resources were devoted to that end. In reality, that is seldom the case. Estimates of the average lifespan of single-family units in the United States generally range between 75 and 100 years (Baer, 1990). Estimates for Europe are substantially higher (Bradley & Kohler, 2007; Johnstone, 2001). We use a range of 75 to 100 years and an average of 87.5 in our calculations.

If length of residence and disability rates were unrelated to each other, we could estimate the probability that a newly built single-family detached unit will house at least one disabled resident during its lifetime as:

$$PROB = 1 - [(1-r)^x] \tag{1}$$

where r is the proportion of households with at least one disabled resident and x is the average number of households occupying a single-family detached unit over its expected lifetime (a measure of housing turnover).

We can illustrate the probability defined in Equation 1 using the medium projection scenario for HHDIS-1. The proportion of households with at least one disabled resident is 20.9% in 2040, which is approximately the midpoint in the average lifespan of a unit built in 2000 (see Table 4). If we divide the average lifespan (87.5 years) by the average length of residence (13.7 years), we obtain an estimate of 6.4 households occupying a single-family detached unit during its expected lifetime. The probability that a single-family detached unit built in 2000 will house at least one disabled resident can then be estimated as:

$$PROB = 1 - [(1-.209)^{6.4}] =$$
$$1 - .223 =$$
$$.777 \text{ or } 77.7\% \tag{2}$$

This estimate will not be valid, however, if disability rates and length of residence are related to each other. As shown in Tables 5 and 6, both disability rates and length of residence are strongly related to the age of the householder. Thus, Equation 2 overstates the probability that a single-family detached unit will house at least one disabled resident because it does not account for the fact that housing

Table 5. Household disability rates by age of householder and housing type, 2000.

Age	All housing types %	Single-family detached %	Single-family attached %	Multifamily %	Mobile homes %
HHDIS-1					
<35	5.2	5.4	5.3	4.4	8.4
35–44	10.4	9.3	10.2	11.4	17.6
45–54	16.1	14.6	14.6	18.4	28.1
55–64	25.1	23.3	21.0	28.4	37.5
65–74	30.9	29.6	26.8	33.8	38.9
75–84	38.5	37.6	34.3	40.2	43.2
85+	53.6	53.4	49.0	54.3	54.9
Total	17.1	16.9	15.0	16.0	24.0
HHDIS-2					
<35	1.8	1.9	2.1	1.6	2.7
35–44	3.6	3.2	3.9	4.1	5.6
45–54	5.2	4.6	5.1	6.1	8.4
55–64	7.2	6.6	6.3	8.5	10.0
65–74	8.8	8.4	7.8	10.0	10.1
75–84	13.0	12.8	11.4	13.8	13.3
85+	24.9	25.2	22.1	25.0	23.1
Total	5.6	5.5	5.1	5.5	7.1

Source: U.S. Census Bureau, 2003.

turnover is lowest in the age groups with the highest disability rates.

There is no perfect solution to this problem, but we can improve the estimate substantially by calculating an adjusted length of residence for each projection year, with the length of residence for each age group weighted by the age distribution of households with at least one disabled resident (using an average of the distributions for HHDIS-1 and HHDIS-2). This adjustment accounts for the fact that the age groups with the highest disability rates also have the lowest rates of housing turnover.

The results of the weighting process are shown in Table 7. The weighted average length of residence for 2000 is 17.6 years, which is considerably longer than the unweighted average of 13.7. Furthermore, the weighted average increases over time, reaching 21.2 years in 2050. The adjusted estimates are thus found to be larger than the unadjusted estimates and to increase over time; both of these results are consistent with the aging and disability trends noted previously.

We can now develop a more realistic estimate of the probability that a newly built single-family detached unit will house at least one disabled resident during its expected lifetime. The estimates shown in Table 7 imply that an average of four households will occupy a newly built single-family detached unit over roughly an 80-year period. Using 2000 as the construction date for newly built units, we take the proportion of households with at least one disabled resident from the medium projections for 2010, 2030, 2050, and, by linear extrapolation, 2070; these years are approximately the midpoints of the four time periods in the projection horizon. We then estimate the probabilities for our two disability measures as:

$$PROB\text{ (HHDIS-1)} =$$
$$1 - [(1-.178)(1-.200)(1-.212)(1-.224)] =$$
$$1-.402 =$$
$$.598 \text{ or } 59.8\% \tag{3}$$

$$PROB\text{ (HHDIS-2)} =$$
$$1 - [(1-.058)(1-.065)(1-.072)(1-.079)] =$$
$$1-.753 =$$
$$.247 \text{ or } 24.7\% \tag{4}$$

Table 6. Average length of residence by age of householder, single-family detached units, 2000.

Age	Average length of residence (years)
<35	4.3
35–44	8.0
45–54	12.8
55–64	19.0
65–74	24.7
75–84	28.0
85+	30.2
Total	13.7

Source: U.S. Census Bureau, 2003.

Table 7. Average length of residence for single-family detached units, weighted by the age distribution of households with a disabled resident.

Year	Average length of residence (years)
2000	17.6
2010	18.4
2020	19.1
2030	20.1
2040	20.8
2050	21.2

That is, we estimate there is a 60% probability that a single-family detached unit built in 2000 will house at least one disabled resident using our first disability measure (HHDIS-1) and a 25% probability it will do so using our second (HHDIS-2). Following the same procedure for the low and high projections, we estimate a range of probabilities from 51% to 69% for HHDIS-1 and from 20% to 30% for HHDIS-2. Clearly, the probability of housing a disabled resident is substantially greater when measured over the lifetime of a housing unit than when measured at a single point in time.

Again, we note that these estimates are based on the assumption that all single-family detached units have an equal probability of being occupied by a household with a disabled resident. They are intended to show the likelihood that a randomly selected single-family detached unit will house at least one disabled resident during its expected lifetime, given our assumptions regarding disability rates and occupancy characteristics. In reality, probabilities will not be the same for all units. We expect units with features that improve their accessibility to have a higher probability of housing a disabled resident than is shown here, and units lacking those features to have a lower probability.

Extension: Accommodating Disabled Visitors

Many people would like to accommodate disabled friends and relatives who come to visit them and many people with disabilities would like to participate in social activities in other people's homes. We can estimate the probability that a newly built single-family detached unit will have no disabled residents but will have at least one disabled visitor during its expected lifetime by making two additional assumptions. First, we assume that members of all age groups have an equal probability of having disabled visitors. Given the intergenerational nature of visits, we believe this is a reasonable assumption: Although older people have substantially higher disability rates than younger people, younger people often have older visitors (e.g., parents visiting adult children). Consequently, we use the average length of residence in single-family detached units for all persons (13.7 years) rather than weighting it according to the distribution of persons with disabilities. Dividing the average lifespan of a unit (87.5 years) by 13.7 implies that an average of 6.4 households will occupy a single-family detached unit over its expected lifetime.

Second, we assume that one disabled person from each household with a disabled resident will visit one household with no disabled residents during each 13.7 year occupancy period, and that no household will receive more than one disabled visitor during any period; this makes the proportion of households with a disabled visitor the same as the proportion with a disabled resident. To the extent that disabled people visit more than one household per period, the estimates would be higher than is shown here; to the extent that households with no disabled residents receive more than one disabled visitor per period, the estimates would be lower.

Using the medium projection of the proportion of households with a disabled resident in 2040 (approximately the midpoint in the average lifespan of a unit built in 2000), we estimate the probability that a newly built single-family detached unit will have at least one disabled visitor during its lifetime as:

$$PROB\,(HHDIS\text{-}1) =$$
$$1 - [(1-.209)^{6.4}] =$$
$$1 - .223$$
$$= .777 \text{ or } 77.7\% \tag{5}$$

$PROB$ (HHDIS-2) =
$1 - [(1-.070)^{6.4}] =$
$1 - .628 =$
$.372$ or 37.2% (6)

As these estimates show, the proportion of units with at least one disabled visitor is substantially higher than the proportion with at least one disabled resident.

We can combine estimates of the probability of having no disabled residents from Equations 3 and 4 with estimates of the probability of having no disabled visitors from Equations 5 and 6 to construct estimates of the probability that a newly built single-family detached unit will have no disabled residents *or* disabled visitors during its lifetime. Subtracting the combined estimates from 1 gives the probability that a unit will have at least one disabled resident or disabled visitor:

$PROB$ (HHDIS-1) =
$1 - [(.402)(.223)] =$
$1 - .090 =$
$.910$ or 91.0% (7)

$PROB$ (HHDIS-2) =
$1 - [(.753)(.628)] =$
$1 - .473 =$
$.527$ or 52.7% (8)

Using the first measure (HHDIS-1), there is a 91% probability that a newly built single-family detached unit will have at least one disabled resident or visitor during its expected lifetime. Even when disability is defined more restrictively (HHDIS-2), the probability is 53%.

These estimates are speculative, of course, and future research will help us refine our assumptions and techniques. On the average, how many friends and relatives does a disabled person have? How many might they visit if accessibility were not a problem? Should residents and visitors be weighted equally in calculating probabilities? If not, how should they be weighted? Some of these questions could be answered objectively by collecting the appropriate data, but others can be answered only subjectively. In spite of their shortcomings, the estimates shown here illustrate the large potential need for accessibility features when we consider both disabled visitors and disabled residents.

Discussion

Evaluating Estimates and Projections

Although several studies have developed projections of the disabled population (Singer & Manton, 1998; Waidmann & Liu, 2000; Wang et al., 2007), to our knowledge this is the first study to project the number of households with at least one disabled resident and the first to estimate the probability that a newly built housing unit will have at least one disabled resident during its expected lifetime. We believe such estimates and projections are essential for analyzing the links connecting aging, disability, and housing.

Under our medium assumptions, we project that in 2050 21% of U.S. households will have at least one resident with a physical limitation (our first disability measure) and 7% will have at least one resident with a self-care limitation (our second disability measure). We estimate that there is a 60% probability that a single-family detached unit built in 2000 will house at least one disabled resident during its expected lifetime using our first measure and a 25% probability using our second. When disabled visitors are accounted for, the probabilities rise to 91% and 53%, respectively. Given the desire of most older people to remain in their current homes for as long as possible, these numbers point to a large and growing need for housing units with accessibility features.

Although these numbers are large, they most likely understate the need for accessible housing because we made several conservative assumptions: 1) We calculated disability rates using disability status at a single point in time, thereby excluding the impact of persons who were previously disabled but had since recovered, and of persons who might become disabled in the future; 2) We calculated probabilities using household disability rates, thereby excluding the impact of nursing home residents who tend to have very high disability rates, and some of whom would have remained in their homes if adequate accessibility features had been present; 3) We used the lower rather than the upper end of the average lifespan range for single-family detached housing units, which resulted in four rather than five households occupying a unit over its expected lifetime; and 4) We assumed that each disabled person would visit the home of only one nondisabled person during each time period. Applying less conservative assumptions would have raised the estimates and projections shown here.

Changing the assumptions regarding disability rates, housing turnover, occupancy characteristics, population growth, and the lifespan of housing units would alter our estimates and projections, of course. Regardless of the specific assumptions used, however, two facts are beyond

dispute: 1) The proportion of households with at least one disabled resident is substantially higher than the proportion of persons with disabilities, and 2) Most housing units are occupied by several households over their lifetimes. Thus, analyses that are based on households and that consider housing turnover yield substantially larger, and in our view more realistic, estimates and projections of the prevalence of disability than analyses focusing solely on individuals.

Cost of Accessible Housing

The need for accessibility features will be transformed into effective demand only if the costs of those features are affordable. The cost of accessible housing depends on the specific features included and whether those features are incorporated in the construction of new units or added as modifications to existing units. When incorporated in the construction of new units, key accessibility features typically cost very little. If the unit is designed with at least a half bath on the entry level, adding a zero-step entrance and wide interior doorways usually costs less than $100 for homes built on a concrete slab and $300 to $600 for homes built over a basement (Concrete Change, 2007b). Additional features, such as universally designed kitchens and curbless showers, generally raise the cost of a new unit by a few thousand dollars. Costs are considerably higher when accessibility features are added to existing homes. Although installing a handrail may cost less than $100, major structural renovations often cost $50,000 or more (Duncan, 1998; Pynoos & Nishita, 2003). Features that are very inexpensive when included in new units can be much more expensive when added to existing units.

When evaluating costs, it is important to consider not only the cost of incorporating accessibility features in new units or as modifications to existing units, but also the cost of not doing so. As noted previously, disabled people living in units without adequate features face a greater risk of injury and are more likely to suffer from social isolation and loneliness than those living in units with adequate accessibility features. The lack of such features places a burden on caregivers and causes some people to enter nursing homes earlier than they would have otherwise, imposing high emotional and financial costs on the individual and, in many instances, high economic costs on society as a whole.

The cost of nursing home care is particularly important in an aging society. Cohen, Weinrobe, Miller, and Ingoldsby (2005) noted that, at current rates, 40–50% of people reaching age 65 will live in nursing homes at some point during their lifetimes. Total spending on nursing home care was $122 billion in 2005, with Medicaid accounting for 44% of those expenditures and Medicare for 16%

(U.S. Department of Health and Human Services, 2007). The average annual cost of nursing home care has been estimated at $74,000 for a private room and $64,000 for a semiprivate room (MetLife, 2005). Numerous studies have concluded that costs of nursing home care are substantially higher than the costs of home care even when the value of assistive home care services is included (Chappell, Havens, Hollander, Miller, & McWilliam, 2004; LaPlante, Kaye, & Harrington, 2007; Redfoot, 1993). Helping people avoid or delay the need for nursing home care may be an important benefit of raising the stock of accessible housing.

Further Research

This article presents a new perspective on aging, disability, and housing, but many issues require further research. Our analysis focused on the nation as a whole; similar analyses could be done for specific regions, states, or metropolitan areas. Our estimate of the probability that a newly built home will house a disabled resident focused on single-family detached units; estimates could also be made for single-family attached units, multifamily units, and other types of housing. Our study touched only briefly on the costs of accessibility features. More detailed analyses are needed, particularly as they relate to modifications to existing units. Perhaps most important, careful cost-benefit analyses are required before we can determine the extent to which investing in accessible housing might provide a cost-effective alternative to nursing home care.

Many other questions remain to be answered as well. What are the primary determinants of disability rates and how are they likely to change over time? What measures of disability are most closely related to the need for accessibility features? Are there better approaches than those used here to estimating the lifetime probability that a housing unit will be occupied by a disabled resident? How does the inclusion of disabled visitors affect this probability? Which accessibility features are most essential to people with disabilities? How much are new homebuyers and current homeowners willing to pay for accessibility features? What has been the experience of people who have asked homebuilders to incorporate accessibility features in the construction of new houses? To what extent does the lack of accessibility contribute to higher rates of institutionalization? Further research on these issues will have important implications for planning and the formation of public policy.

Conclusions and Recommendations

Population growth and aging will substantially raise the number of U.S. households with at least one disabled

resident over the next several decades, spurring the need for homes with accessibility features. People's desires to age in place and to accommodate disabled visitors will add to that need. Housing turnover will raise the probability that any given unit will house a person with disabilities over time. Viewing the issue from the perspective of households and housing units rather than individuals, we believe there is a large and growing need for homes with accessibility features.

Several studies have concluded that many people value accessibility features and are willing to pay for them (Alonso, 2002; Bayer & Harper, 2000; Kochera, 2002). Many homebuilders, however, have reported that relatively few homebuyers seem interested in those features (Lemmon, 2007), and some researchers have found that people with mobility impairments often seem reluctant to make modifications to their current homes (Gilderbloom & Markham, 1996). Given the millions of people with mobility impairments and the strong desire of most people to live independently for as long as possible, how can we explain these seemingly contradictory results? We believe there are several possible explanations.

Regarding the reported lack of interest in accessibility features among homebuyers, we note that disability rates increase with age, whereas the rate at which people move from one house to another declines with age; consequently, the people with the greatest immediate need for accessibility features are the ones least likely to buy a home. It is also likely that many homebuyers who are not disabled are unaware of the benefits of accessibility features, tend to over-estimate the cost of those features, or do not consider the possibility that they themselves might become disabled some day. The reluctance of people with mobility impairments to make modifications to their current homes may be due to their lack of knowledge, organizational skills, or financial resources, or to their determination to overcome barriers rather than alter their physical environment. In addition, some may be hesitant to add visible signs of disability such as a ramp because of negative societal messages regarding disabilities. People in both groups may be concerned about the aesthetics of an accessible home, believing that accessibility features make a house look unattractive or reduce its resale value. Dealing with these concerns will require a thoughtful and creative response from homebuilders and planners.

The vast majority of housing in the United States and many other countries is inaccessible to persons with disabilities. We believe the gap between the supply of accessible housing and the need for such housing presents a business opportunity to homebuilders. We urge them to pursue this opportunity by offering housing designs that are both accessible and attractive and to explore new ways to market homes based on those designs. There is a substantial market for the three key visitability features of a zero-step entrance, a bathroom or half bath on the entry level, and interior doors with at least 32 inches of clearance, and a smaller but growing market for upgrades such as curbless showers and universally designed cabinetry. We believe both markets can be profitably exploited.

Emphasizing the benefits of accessibility features for homebuyers who are not disabled may be a particularly savvy marketing strategy. Many are unaware of the advantages of features such as zero-step entrances and wider doorways for common tasks such as moving furniture, pushing baby strollers, storing bicycles, and carrying groceries in from the car. Others do not consider the likelihood of having disabled visitors or of sustaining a disabling condition themselves. Making homebuyers aware of the potential benefits of accessibility features will further expand the market for those features.

Koebel (2008) argued that planners should influence homebuilders to adopt innovative practices that make housing and communities more sustainable, durable, and affordable. We believe planners should influence homebuilders to make housing more accessible as well. We also believe planners should encourage social service agencies to inform elderly and/or disabled people about programs that could help them make modifications to their current homes. Such programs can improve the quality of life of disabled persons and raise the overall stock of accessible housing.

Myers and Ryu (2008) noted that population aging is likely to lead to a slowdown in housing sales and a decline in housing prices in many places because older people are net sellers rather than net buyers of homes. They suggested that planners should attempt to reduce the rate at which older people sell their homes by fostering community amenities such as senior activity centers, parks that are easy to access, dial-a-ride transportation, and mobile meals services. Our study suggests that programs that promote the construction of housing with accessibility features, and the addition of those features as modifications to the current housing stock, could also play a role in reducing the rate at which older people sell their homes.

Any discussion of accessibility policy must consider whether standards should be mandatory or voluntary. Clearly, there are trade-offs between developing new building standards and protecting the rights of property owners, but many safety, environmental, and aesthetic standards have already been implemented, establishing the precedent that housing construction is not solely a private matter. Furthermore, to the extent that accessibility features

help people avoid or delay the need for nursing home care, the costs of which are frequently borne by the public as a whole, an economic argument can be made for requiring that those features be incorporated in the construction of new units. We believe housing accessibility is not only an important personal and civil rights issue, but a critical fiscal issue as well. We urge planners and policymakers to explore the fiscal implications of increasing the stock of accessible housing.

With respect to visitability, mandatory requirements appear to be more successful than voluntary programs in raising the stock of accessible housing. An estimated 33 mandatory and 24 voluntary visitability programs have been established in the United States. To date, more than 30,000 visitable homes have been built in places with mandatory programs; in contrast, apart from age-restricted communities, fewer than 1,300 have been built in places with voluntary programs (Maisel et al., in press). Although reasonable people can disagree on this point, we believe successful visitability programs will generally require some type of legal requirement. Planners can look for models in the states and local areas mentioned earlier in this article that have already established such requirements. In many instances, requirements can be tied to existing programs without the need to pass new laws or offer new incentives. For example, housing-related grants and other financial benefits could be awarded based on the degree of compliance with accessibility standards.

The needs of an aging population, combined with concerns about the civil rights of people with disabilities and the high public cost of nursing home care, make the lack of accessible housing a critical issue for planners and policy makers. Although planners have traditionally focused their efforts on the built and natural environment outside the home, the time has come for them to look more closely at the environment inside the home as well. Efforts to improve a community's quality of life by promoting ameni-ties such as attractive public spaces, walkable destinations, and proximity to public transportation are highly desirable, but will be incomplete without efforts to improve housing accessibility. Given the slow pace at which changes in the housing stock occur, there is urgency to act now. Increasing the supply of accessible housing will benefit not only cur-rently disabled people, but also their families and friends, those who become disabled in the future, and society as a whole.

References

Alonso, F. (2002). The benefits of building barrier-free: A contingent valuation of accessibility as an attribute of housing. *European Journal of Housing Policy, 2*(1), 25–44.

Arterburn, D. E., Crane, P. K., & Sullivan, S. D. (2004). The coming epidemic of obesity in elderly Americans. *Journal of the American Geriatrics Society, 52*(11), 1907–1912.

Baer, W. C. (1990). Aging of the housing stock and components of inventory change. In D. Myers (Ed.), *Housing demography* (pp. 249–273). Madison: University of Wisconsin Press.

Bayer, A.-H., & Harper, L. (2000). *Fixing to stay: A national survey of housing and home modification issues.* Washington, DC: AARP Knowledge Management.

Bhattacharya, J., Cutler, D. M., Goldman, D. P., Hurd, M. D., Joyce, G. F., Lakdawalla, D. N., et al. (2004). Disability forecasts and future Medicare costs. *NBER Frontiers in Health Policy Research, 7*(1), 75–94.

Bradley, P. E., & Kohler, N. (2007). Methodology for the survival analysis of urban building stocks. *Building Research & Information, 35*(5), 529–542.

Cai, L., & Lubitz, J. (2007). Was there compression of disability for older Americans from 1992 to 2003? *Demography, 44*(3), 479–495.

Calsyn, R. J., Winter, J. P., & Yonker, R. D. (2001). Should disability items in the census be used for planning services for elders? *The Gerontologist, 41*(5), 583–588.

Center for Universal Design. (1997). *The principles of universal design.* Raleigh: North Carolina State University. Retrieved January 17, 2008, from http://www.design.ncsu.edu./cud/about_ud/udprinciplestext.htm

Chappell, N. L., Havens, B., Hollander, M. J., Miller, J. A., & McWilliam, C. (2004). Comparative costs of home care and residential care. *The Gerontologist, 44*(3), 389–400.

Close, J., Ellis, M., Hooper, R., Glucksman, E., Jackson, S., & Swift, C. (1999). Prevention of falls in the elderly trial (PROFET): A randomized controlled trial. *The Lancet, 353*(1), 93–97.

Cohen, M. A., Weinrobe, M., Miller, J., & Ingoldsby, A. (2005). *Becoming disabled after 65: The expected lifetime costs of independent living.* Washington, DC: AARP Public Policy Institute.

Concrete Change. (2007a). *Visitability defined.* Retrieved September 15, 2007, from http://www.concretechange.org/Definition_of_Visitability.htm.

Concrete Change. (2007b). *Myths and facts.* Retrieved September 15, 2007, from http://www.concretechange.org/myth.htm.

Crimmins, E. M. (2004). Trends in the health of the elderly. *Annual Review of Public Health, 25*(1), 79–98. Retrieved May 29, 2008, from http://www.demographic-research.org/Volumes/Vol3/9/3-9.pdf

Crimmins, E. M., & Saito, Y. (2000). Change in the prevalence of diseases among older Americans: 1984–1994. *Demographic Research, 3*(9).

Duncan, R. (1998). Funding, financing and other resources for home modifications. *Technology and Disability, 8*(1), 37–50.

Freedman, V. A., Crimmins, E., Schoeni, R. F., Spillman, B. C., Aykan, H., Kramarow, E., et al. (2004). Resolving inconsistencies in trends in old-age disability: Report from a technical working group. *Demography, 41*(3), 417–441.

Freedman, V. A., & Martin, L. G. (1999). The role of education in explaining and forecasting trends in functional limitations among older Americans. *Demography, 36*(4), 461–473.

Freedman, V. A., & Martin, L. G. (2000). Contribution of chronic conditions to aggregate changes in old-age functioning. *American Journal of Public Health, 90* (11), 1755–1760.

Gilderbloom, J. I. & Markham, J. P. (1996). Housing modification needs of the disabled elderly: What really matters? *Environment and Behavior, 28* (4), 512–535.

Gitlin, L. N., Winter, L., Dennis, M. P., Corcoran, M., Schinfeld, S., & Hauck, W. W. (2006). A randomized trial of a multicomponent home intervention to reduce functional difficulties in older adults. *Journal of the American Geriatrics Society, 54* (5), 809–816.

Hammel, J. (2005). *The impact of home modification services on community living and participation outcomes for people who are aging with disabilities: Final report* (RRF Grant 2001-328). Chicago: University of Illinois at Chicago.

Imrie, R. (2003). Housing quality and the provision of accessible homes. *Housing Studies, 18* (3), 387–408.

Imrie, R. (2004). The role of the building regulations in achieving housing quality. *Environment and Planning B: Planning and Design, 31* (3), 419–437.

Inclusive Home Design Act of 2007, H.R. 4204, 110th Congress. (2007). Retrieved February 11, 2008, from http://www.govtrack.us/congress/bill.xpd?bill=h110-4202

International Code Council. (2008). *About ICC: Introduction to the ICC.* Retrieved February 4, 2008, from http://www.iccsafe.org/news/about

Johnstone, I. M. (2001). Energy and mass flows of housing: Estimating mortality. *Building and Environment, 36* (1): 43–51.

Kaminski, S. E., Mazumdar, S., DeMento, J. F. C., & Geis, G. (2006). The viability of voluntary visitability: A case study of Irvine's approach. *Journal of Disability Policy Studies, 17* (1), 49–56.

Kaye, H. S., Kang, T., & LaPlante, M. P. (2000). *Mobility device use in the United States* (Disability Statistics Report 14). Washington, DC: National Institute on Disability and Rehabilitation Research.

Kaye, H. S., LaPlante, M. P., Carlson, D., & Wenger, B. L. (1996). *Trends in disability rates in the United States, 1970–1994* (Disability Statistics Abstract 17). Washington, DC: National Institute on Disability and Rehabilitation Research.

Kochera, A. (2002). *Accessibility and visitability features in single-family homes: A review of state and local activity.* Washington, DC: AARP Public Policy Institute.

Kochera, A., Straight, A., & Guterbock, T. (2005). *Beyond 50.05: A report to the nation on livable communities.* Washington, DC: AARP Public Policy Institute.

Koebel, C. T. (2008). Innovation in homebuilding and the future of housing. *Journal of the American Planning Association, 74* (1), 45–58.

Lakdawalla, D. N., Bhattacharya, J., & Goldman, D. P. (2004). Are the young becoming more disabled? *Health Affairs, 23* (1), 168–176.

Lakdawalla, D. N., Goldman, D. P., Bhattacharya, J., Hurd, M. D., Joyce, G. F., & Panis, C. W. (2003). Forecasting the nursing home population. *Medical Care, 41* (1), 8–20.

LaPlante, M. P., Kaye, H. S., & Harrington, C. (2007). Estimating the expense of a mandatory home- and community-based personal assistance services benefit under Medicaid. *Journal of Aging & Social Policy, 19* (3), 47–64.

Lemmon, W. (2007). Reality check from the homebuilder's sales floor. *Planning Commissioners Journal*, Planners Web, April 19. Retrieved February 5, 2008 from http://pcj.typepad.com/planning_commissioners_jo/2007/04/reality_check_f.html

Louie, J. (1999). *The housing modifications for disabled elderly households* (Joint Center for Housing Studies Publication W99-8). Cambridge, MA: Harvard University.

Maisel, J. L. (2006). Toward inclusive housing and neighborhood design: A look at visitability. *Community Development, 37* (3), 26–34.

Maisel, J. L., Steinfeld, E., & Smith, E. (in press). *Visitability: A report for AARP.* Washington, DC: AARP.

Manton, K. G., & Gu, X. (2001). Changes in the prevalence of chronic disability in the United States black and nonblack population above age 65 from 1982–1999. *Proceedings of the National Academy of Sciences, 98* (11), 6354–6359.

Martin, L. G., Schoeni, R. F., Freedman, V. A., & Andreski, P. (2007). Feeling better? Trends in general health status. *Journal of Gerontology: Social Sciences, 62B* (1), S11–S21.

Masnick, G. S. (2002). The new demographics of housing. *Housing Policy Debate, 13* (2), 275–321.

MetLife. (2005). *The MetLife market survey of nursing home & home care costs.* Westport, CT: MetLife Mature Market Institute.

Milner, J., & Madigan, R. (2004). Regulation and innovation: Re-thinking "inclusive" housing design. *Housing Studies, 19* (5), 727–744.

Myers, D., Pitkin, J., & Park, J. (2002). Estimation of housing needs amid population growth and change. *Housing Policy Debate, 13* (3), 567–596.

Myers, D., & Ryu, S. (2008). Aging baby boomers and the generational housing bubble: Foresight and the mitigation of an epic transition. *Journal of the American Planning Association, 74* (1), 17–33.

Nelson, A. C. (2006). Leadership in a new era. *Journal of the American Planning Association, 72* (4), 393–409.

Nishita, C. M., Liebig, P. S., Pynoos, J., Perelman, L., & Spegal, K. (2007). Promoting basic accessibility in the home. *Journal of Disability Policy Studies, 18* (1), 2–13.

Pynoos, J., & Nishita, C. M. (2003). The cost of financing of home modifications in the United States. *Journal of Disability Policy Studies 14* (2), 68–73.

Redfoot, D. L. (1993). Long-term care reform and the role of housing finance. *Housing Policy Debate, 4* (4), 497–537.

Reynolds, S. L., Saito, Y., & Crimmins, E. M. (2005). The impact of obesity on active life expectancy in older American men and women. *The Gerontologist, 45* (4), 438–444.

Saville-Smith, K., James, B., Fraser, R., Ruan, B., & Travaglia, S. (2007). *Housing and disability: Future proofing New Zealand's housing stock for an inclusive society.* Aotearoa, New Zealand: Centre for Housing Research.

Schoeni, R. F., Martin, L. G., Andreski, P. M., & Freedman, V. A. (2005). Persistent and growing socioeconomic disparities in disability among the elderly: 1982–2002. *American Journal of Public Health, 95* (11), 2065–2070.

Siegel, J. S. (2002). *Applied demography.* San Diego, CA: Academic Press.

Singer, B. H., & Manton, K. G. (1998). The effects of health changes on projections of health service needs for the elderly population of the United States. *Proceedings of the National Academy of Sciences, 95* (26): 15618–15622.

Smith, S. K., Tayman, J., & Swanson, D. A. (2001). *State and local population projections: Methodology and analysis.* New York: Kluwer Academic/Plenum.

Spillman, B. C. (2004). Changes in elderly disability rates and the implications for health care utilization and cost. *The Milbank Quarterly, 82* (1), 157–194.

Steinfeld, E., Levine, D. R., & Shea, S. M. (1998). Home modifications and the fair housing law. *Technology and Disability, 8* (1), 15–35.

Steinmetz, E. (2006). *Americans with disabilities: 2002* (Current Population Reports, P70-107). Washington, DC: U.S. Census Bureau.

Sturm, R., Ringel, J. S., & Andreyeva, T. (2004). Increasing obesity rates and disability trends. *Health Affairs, 23* (2), 199–205.

U.S. Census Bureau. (2003). *2000 census of population and housing.* Washington, DC: Author. [Public use microdata sample files available on DVD from http://www.census.gov/mp/www/cat/decennial_census _2000/005955.html]

U.S. Census Bureau. (2004). *U.S. interim projections by age, sex, race, and Hispanic origin.* Retrieved October 10, 2004, from http://www. census.gov/ipc/www/usinterimproj/

U.S. Census Bureau. (2006). *American housing survey for the United States: 2005* (Current Housing Reports, Series H150/05). Washington, DC: Author.

U.S. Department of Health and Human Services. (2007). *National health expenditures by type of service and source of funds.* Centers for Medicare and Medicaid Services. Retrieved September 14, 2007, from http://www.cms.hhs.gov/NationalHealthExpendData/02_ NationalHealthAccountsHistorical.asp.

Waidmann, T. A., & Liu, K. (2000). Disability trends among elderly persons and implications for the future. *Journal of Gerontology: Social Sciences, 55B*(5), S298–S307.

Wang, Z., Gu, D., & Yi, Z. (2007, March). *Projections of elderly disability, care needs, and care costs for the states of California, Florida, Minnesota, and North Carolina: A pilot study.* Paper presented at the annual meeting of the Population Association of America, New York.

Washburn v. Pima County, #2 CA-CV 2003-0107 (2003).

Wolf, D. A., Hunt, K., & Knickman, J. (2005). Perspectives on the recent decline in disability at older ages. *The Milbank Quarterly, 83*(5), 365–395.

Yi, Z., Vaupel, J. W., & Wang, Z. (1998). Household projection using conventional demographic data. *Population and Development Review, 24*(Suppl.), 59–87.

Appendix: ProFamy Household Projection Model

The most widely used approach to making household projections is the headship-rate model, but it has been criticized because it defines the household head arbitrarily, it does not allow for linking headship rates to demographic rates, it lumps all household members other than the head into a single category, and it projects only a limited number of household types and sizes. The ProFamy model was developed as an alternative to the headship-rate model. Its defining feature is the use of individuals as the basic unit, which permits the application of demographic rates that affect household structure.

In the ProFamy model, demographic rates are calculated from standard data sources such as the decennial census and applied to individuals. The model projects households differentiated by age, sex, race, marital status, number of coresiding children, and coresidence with parents. Household type and size are calculated with respect to the characteristics of the reference person; this is usually a female adult, but can be a male adult when there are no female adults in the household.

The basic structure of the model consists of a number of demographic accounting equations that calculate the number of persons age $x+1$ with status i at time $t+1$, based on the number of persons age x with status i at time t. Status characteristics include factors such as marriage and divorce, cohabitation, number of children, living with children, and living with parents. Events causing changes in status include births, deaths, migration, marriage, divorce, and leaving or returning to a parental home. Fertility assumptions depend on age, number of children, and marital status. Assumptions regarding mortality, first marriage, widowhood, divorce, and remarriage depend on age, sex, and marital status. Projections are made in one-year intervals for all the years in the projection horizon. A detailed description of the ProFamy model can be found in Yi, Vaupel, and Wang (1998).

The major advantages of the ProFamy model for our purposes are that it is based on a sound methodology, it incorporates recent population data, it provides detailed projections of households as well as population, and it covers a long projection horizon. The ProFamy projections used in the present analysis were produced in 2007 and extended through 2050, whereas the most recent household projections produced by the U.S. Census Bureau were published in 1996 and extended only through 2010. Furthermore, the short-range ProFamy household projections are in line with recent data from the Current Population Survey and the long-range ProFamy population projections are consistent with those produced by the Census Bureau. For 2050, for example, the ProFamy U.S. population projection of 410,116,896 falls midway between the two most recent sets of Census Bureau projections: 403,687,000 for the set released in 2000 and 419,854,000 for the set released in 2004.

Evaluating the ProFamy household projection for 2050 is difficult because no comparative benchmark is available. One can look, however, at the average number of persons per household (PPH), which is a measure linking population and household data. PPH has changed little since 1990 and there are no clear indications that it will change significantly in the future; this high degree of stability is consistent with the assumptions used in the ProFamy model. We believe the ProFamy model provides a sound underpinning for the disability projections discussed in the present article.