Grand Challenges of Our Aging Society: Workshop Summary

ISBN
978-0-309-15010-1

88 pages
6 x 9
PAPERBACK (2010)

Amy Smith, Rapporteur, Center for Economic, Governance, and International Studies, National Research Council

Grand Challenges of Our Aging Society

Workshop Summary

Amy Smith, *Rapporteur*

Center for Economic, Governance, and International Studies

Division of Behavioral and Social Sciences and Education

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE NATIONAL ACADEMIES PRESS
Washington, D.C.
www.nap.edu

THE NATIONAL ACADEMIES PRESS 500 Fifth Street, N.W. Washington, DC 20001

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the Steering Committee for the workshop were chosen for their special competences and with regard for appropriate balance.

This study was supported with internal funds from the National Academy of Sciences. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the organizations or agencies that provided support for the project.

International Standard Book Number-13: 978-0-309-15010-1
International Standard Book Number-10: 0-309-15010-8

Additional copies of this report are available from the National Academies Press, 500 Fifth Street, N.W., Lockbox 285, Washington, DC 20055; (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area); Internet, http://www.nap.edu.

Printed in the United States of America

Suggested citation: National Research Council. (2010). *Grand Challenges of Our Aging Society: Workshop Summary.* Amy Smith, Rapporteur. Center for Economic, Governance, and International Studies, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Charles M. Vest is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. Charles M. Vest are chair and vice chair, respectively, of the National Research Council.

www.national-academies.org

PLANNING COMMITTEE FOR THE ACADEMIES-WIDE INITIATIVE ON THE GRAND CHALLENGES OF OUR AGING SOCIETY

RONALD LEE (*Chair*), Center for the Demography and Economics of Aging, University of California, Berkeley
ROBERT H. BINSTOCK, School of Medicine, Case Western Reserve University
ROBERT N. BUTLER, International Longevity Center, New York
JUDITH CAMPISI, E.O. Lawrence Berkeley National Laboratory, Berkeley, California
LAURA L. CARSTENSEN, Department of Psychology, Stanford University
JOSEPH F. COUGHLIN, Engineering Systems Division, Massachusetts Institute of Technology
EILEEN M. CRIMMINS, Davis School of Gerontology, University of Southern California
ROBERT M. HAUSER, Center for Demography of Health and Aging, University of Wisconsin–Madison
JAMES S. JACKSON, Institute for Social Research, University of Michigan
CHARLES M. LUCAS, Osprey Point Consulting, Deer Isle, Maine
DAVID B. REUBEN, Multicampus Program in Geriatric Medicine and Gerontology, University of California, Los Angeles
DAVID R. WEIR, Institute for Social Research, University of Michigan

JANE L. ROSS, *Study Director*
TRACY HARRIS, *Senior Program Officer*
CONNIE CITRO, *Center Director*
BARNEY COHEN, *Board Director*
ROGER HERDMAN, *Board Director*
SUSAN VAN HEMEL, *Senior Program Officer*
BARBARA WANCHISEN, *Board Director*
SCOTT WEIDMAN, *Board Director*
GOOLOO WUNDERLICH, *Senior Program Officer*
BARBARA BOYD, *Administrative Coordinator*
KATHLEEN SASLAW, *Assistant Director, Finance*

Acknowledgments

This report summarizes the proceedings of a workshop that focused on the development of high-priority topics in aging research. Over a year ago the presidents of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine launched an initiative focused on the challenge of shaping policies and programs that exploit the benefits of increased longevity and enhanced health for individuals and for society. The intent of the initiative was to develop a broad portfolio of studies and related activities that would contribute to an evidence-based dialogue on population aging. The initiative was also designed to contribute to the development of sound program and policy options related to an aging society. The two-day workshop on which these proceedings are based included presentations by experts in many aspects of aging and discussion with a broad range of invited guests. The substance of the workshop was developed by the Planning Committee for the Academies-Wide Initiative on the Grand Challenges of Our Aging Society. The workshop was supported by the Presidents' Fund.

This workshop summary was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the Report Review Committee of the National Research Council (NRC). The purpose of this independent review is to provide candid and critical comments that assist the institution in making its report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness

to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

The panel thanks the following individuals for their review of this report: Andrea Louise Campbell, Department of Political Science, Massachusetts Institute of Technology; Laura L. Carstensen, Department of Psychology, Stanford Center on Longevity, Stanford University; Joshua R. Goldstein, Office of the Executive Director, Max Planck Institute for Demographic Research, Rostock, Germany; and Barbara Boyle Torrey, Population Reference Bureau.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the content of the report, nor did they see the final draft of the report before its release. The review of this report was overseen by Beth J. Soldo, Population Aging Research Center, University of Pennsylvania. Appointed by the NRC, she was responsible for making certain that the independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of the report rests entirely with the author and the NRC.

Contents

1

Introduction

Aging populations are generating both challenges and opportunities for societies around the globe. Increases in longevity and improvements in health raise many questions. What steps can be taken to optimize physical and cognitive health and productivity across the life span? How will older people finance their retirement and health care? What will be the macroeconomic implications of an aging population? How will communities be shaped by the shift in age structure? What global interconnections will affect how each society handles the aging of its population?

GRAND CHALLENGES OF OUR AGING SOCIETY

To address these questions, the National Academies organized a symposium called "The Grand Challenges of Our Aging Society," held in Washington, DC, on May 28-29, 2009. Presentations in the fields of biology, public health, medicine, informatics, macroeconomics, finance, urban planning, and engineering approached the challenges of aging from many different angles. The presenters reviewed the current state of knowledge in their respective fields, identifying areas of consensus and controversy and delineating the priority questions for further research and policy development. The overall goal of the symposium, as Judy Salerno of the Institute of Medicine described in her welcoming remarks, was to help the National Academies determine how best to use its resources so as to contribute to an evidence-based dialogue on population aging that

will "shape policies and programs that make the most of the benefits of enhanced longevity into late life for both individuals and society."

The symposium consisted of six panels. The first panel addressed scientific research on the biology of aging and frailty, with further attention to health care at the end of life. The second panel concerned the steps that individuals and society can take to enhance healthy aging, ranging from healthy behaviors to new technologies. The next two panels addressed economic issues, including macroeconomic effects of aging populations and concerns about income security and health care financing. The final two panels turned to issues of social institutions and policies as well as the response of communities to aging populations. In the final group discussion, several participants offered their perspectives. Appendix A is the symposium agenda. Appendix B is a list of recent National Academies publications bearing on the topics touched on here. Appendix C provides biographical sketches of the planning committee members and presenters.

This report is a summary of the presentations and discussions that took place at the symposium. As such, it is limited to the views presented and discussed during the workshop. The broader scope of issues pertaining to this subject area is recognized but could not be addressed in this summary. In addition, as a summary, this document is not a transcript of each panelist's presentation, but rather a distillation of the themes of their presentations. All statements and opinions in this summary are directly attributable to the workshop speakers.

A variety of research opportunities and priorities were identified across the two days of the event. All aim to respond to grand challenges so that an aging society can be good for all members of that society, improving the economic, social, and physical well-being of the aging population while strengthening economies and societies. As speaker Linda Fried affirmed, "If we can redesign societal approaches so that they are both great for people as they get older and great for society because they help bring wisdom and experience of an aging population to bear on unmet social needs, then we could have a new kind of social compact."

INTRODUCTORY REMARKS

Ronald Lee
Center for the Demography and Economics of Aging
University of California, Berkeley

Aging may be considered from three different perspectives: (1) individual aging, (2) population aging, and the (3) global age profile. An individual's aging has many components, including biological, emotional, and cogni-

tive changes as well as different patterns in behavior, productivity, and consumption. Life expectancy has increased, and both health and functional status have improved. Individuals are now functionally younger at a given chronological age than older adults were in previous generations. Technological advances have also altered the experience and quality of aging.

Population aging in the aggregate—the increasing proportion of elderly in the population—is occurring in industrialized nations as both mortality and fertility decline. As aged individuals in industrialized nations are consuming more goods and services and producing less than midlife adults, the increasing ratio of older adults in the population places a greater burden on the working-age population. This rising dependency challenges the fiscal stability of government programs and also has other macroeconomic consequences.

Population aging is occurring throughout the industrialized world. Indeed, most industrialized countries will see a doubling or tripling of their old-age dependency ratios (the number of older adults divided by the number of working-age adults) in this century. The momentous effects this will have on societies and economies can be anticipated, but not entirely known. Institutional and policy responses are also not determined. As Lee observed, "We're not there yet. We don't know what it looks like. We can extrapolate from current circumstances, but we don't have a firm basis of knowing what life will be like, what the macroeconomy will be like, how well the welfare state will work, and all of these things in a population that is actually old."

Data from the National Transfer Accounts Project (see http://www.ntaccounts.org) may be used to compare rich countries (using data from the United States, Japan, Sweden, and Finland) and poor countries (with data from India, Indonesia, Kenya, and the Philippines) regarding the age profile of labor income and consumption. Data indicate that entry into the labor force occurs later in rich countries than in poor countries, as more early years are spent in education. Earnings also peak later in rich countries, presumably reflecting returns to experience for workers with more human capital. The drop in labor income is far more precipitous as people retire in rich countries, while labor income continues at older ages in poor countries. Retirement also occurs earlier in rich countries.

In the United States, the median age at retirement dropped by 11 years during the 20th century from age 74 to age 63. This trend in retirement age is now reversing, but the recent change is small compared with the earlier larger declines. Thus, at a time when the life span was increasing and disability rates were falling, the length of the work life was shrinking.

Rich and poor countries can also be compared in their patterns of consumption relative to earnings across the life span. In poor countries,

the age pattern of consumption is flat from young adulthood through advanced old age. In rich countries, childhood is one phase of greater consumption, because of investment in education. The other is old age, because of the costs of health care and long-term care. In the United States, several components contribute to consumption expenditures. Data from 2003 indicate that until about age 65, rising consumption is fueled by increasing private expenditure in both private health care and private durable goods. In the United States, after age 65, private health expenditures drop as public health expenditures expand. The overall pattern of consumption continues upward, with the cost of long-term care causing a sharp rise in consumption at advanced ages. Overall consumption at older ages in other industrial countries also rises.

Trends of aging populations, such as increased old-age dependency ratios, longer life spans and health spans but shorter work lives, and increased consumption despite lower labor income among older persons, are not necessarily troublesome. Yet Lee commented, "It's hard to avoid worrying that we may just be stumbling into these patterns rather than making informed decisions about how to organize allocation of resources across age." Public allocations for pensions, health care, and long-term care may be influenced by institutions and programs that were created and shaped in very different historical periods, with very different age profiles, median retirement ages, and consumption patterns. The incentives those institutions and programs now generate may be distortional under the new circumstances.

Lee closed by proposing six questions for the symposium to consider:

1. Are institutions channeling people's behavioral responses to longer life and lower fertility in suboptimal ways (e.g., earlier retirement or too little saving)?
2. Will the increase in the old-age dependency ratio be a serious burden on the future economy and society?
3. Are U.S. households saving enough for old age?
4. Will aging populations generate increased capital intensity, and will this raise labor productivity and offset the higher dependency burden? Will the savings rate fall?
5. How will rapid population aging in the industrial world affect international trade, financial markets, and migration patterns?
6. What can societies do to maintain or extend healthy and active life in relation to rising life expectancy?

2

Biological Research, Medical Advances, and Ethical Considerations

The first session of the symposium examined links between scientific advances in biology and medicine and healthy aging. How can the healthy life span be increased, either by a longer life span that is healthy or by an existing life span made healthier? What advances have been made in understanding the underlying biology of aging? What are the challenges to caring for people as they become more frail? And at the end of life, what is the appropriate amount of health care? What ethical dilemmas arise when trying to determine the amount of health care that society should provide?

EXTENDING THE LIFE SPAN

Richard A. Miller
Geriatrics Center
University of Michigan

Richard Miller addressed biological research on the life span by proposing to ask a hypothetical 50-year-old: Would you rather spend the next 30 years turning into an 80-year-old, or would you like to stay 50 years old for 30 years, and only then resume aging? Miller is convinced that remaining 50 is not only preferable but also possible.

In some laboratory animals, including animals that function as humans do, the life span can be extended by 40 percent. The animals whose aging has been slowed are healthy, vigorous, and cognitively intact, with strong

immune systems at ages that would be the equivalent of 80 to 130 years in humans. They are not disease-ridden. Indeed, at death, the incidence of most diseases in these animals is below the norm.

The possibility of extending longevity and delaying late-life diseases as a group has tremendous implications not only for a longer healthy life span but also for research budgets. Years would be added to an average person's life span as the result of finding cures for cancer, heart disease, stroke, and diabetes. However, none of these hypothetical cures separately, and not even all of them together, would generate the increase in life span that would result from slowing the aging process. Concentrating resources on research on slowing the aging process would yield much greater dividends than dispersing the resources among different diseases.

Furthermore, while cures for these various late-life diseases remain hypothetical, increasing the life span of animals is already routinely accomplished in laboratories, via at least two diets (including radical caloric restriction) and five gene mutations. The next step is to devise more palatable pharmacological methods to achieve these results. An intermediary research agenda involves the study of worms and flies that use the same gene to extend their life span, the study of cells from bats and birds that live on average three times longer than mammals of the same size, and comparisons of people to shorter lived marmosets. Research should also take advantage of what biologists have discovered regarding stress resistance pathways, developmental "switches," and long-lived mouse mutants. Such research could lead to the development of antiaging drugs, a reasonable therapeutic means for human beings to slow the aging process.

Nonetheless, basic research on the biology of longevity and the aging process receives very little funding. For example, the National Institutes of Health now directs 0.06 percent of its funds to this topic. Why is that the case? Obstacles to this research are largely political rather than scientific. Popular pseudoscience on extending longevity has damaged the public image of serious work in the field. In addition, aging is generally viewed as inalterable, so researching how to change it is seen as futile. Furthermore, each of the late-life diseases has a separate lobby to build social awareness, gain media attention, raise money, and pursue research funds.

The market is another arena of difficulty. Although current research is promising, drugs that will actually slow aging cannot be tested in time, Miller noted, "to show a profit within a chief executive officer's lifetime." Also, drugs that purport to slow aging are already on the market and, although ineffectual, are profitable. Politically, "Add life to years" is an acceptable slogan, while slowing aging is not. Finally, in terms of science

as a profession, most scientists depend on funding, and there is very little funding for research on the biology of aging. And while young scientists are attracted to the latest technological advances, little of that is involved in this research. Standing apart from these cultural, social, economic, political, and professional obstacles is the considerable scientific challenge of curing aging. "To be honest," Miller admitted, "it's not that easy to cure."

What are the key questions to be addressed in the biology of aging and extending the healthy life span? Miller put two research questions at the forefront:

1. Why do some species live longer than others?
2. How can important cells be made stress resistant with drugs?

To characterize the scientific consensus, controversy, and ignorance on the biology of aging, a parallel may be drawn from the history of infectious disease. The study of how to slow the aging process is at about the same stage as the study of infectious disease after Edward Jenner pioneered a vaccine against smallpox, but before Louis Pasteur, John Snow, and Robert Koch documented why the vaccine worked and developed the germ theory of disease. That is, in efforts to slow the aging process, scientists can already intervene, but they do not know how that intervention works, if it is safe, or how to make it as safe and efficacious as possible. "In general," Miller summarized, "we have a lot of controversy, a growing consensus, and too much ignorance at this stage."

A further puzzle is how to reframe the possibility of slowing the aging process as an acceptable, endorsable, and respectable endeavor. Acknowledging that this remains a distant goal, Miller coined a term for the general prejudice in this area: "gerontologiphobia." This prejudice includes the fear of what antiaging medicines (if they were ever invented) might do to society, despite the evidence that a pharmacologically extended life span would add healthy, active, disease-free years to life.

THE BIOLOGY OF FRAILTY

Linda P. Fried
Mailman School of Public Health
Columbia University

Much new research exists on the underlying biology of frailty. Clinical components of frailty include declines in mobility, strength, balance, motor processing, cognition, nutrition, endurance, and physical activity. A core feature is loss of muscle mass or sarcopenia. There is mounting

evidence of a multisystem physiological dysregulation in frailty, including not only sarcopenia but also inflammation, decreased heart rate variability, altered clotting processes, altered insulin resistance, anemia, and altered neuroendocrine axis. People who manifest frailty have disruptions of multiple systems at the physiological level and perhaps at much deeper molecular and genetic levels. Many of these systems affect each other, creating a biological safety net that provides reserves and resilience. In frailty, multisystem dysregulation and interactions may result in loss of physiological networking and mutual regulation, loss of reserves, and decreased homeostatic regulation. A spiral of deterioration is established as decreased physiological reserves and resilience lead to functional decline, culminating in disability or death.

The understanding of frailty has changed significantly over the past 20 years. Fried identified six points of a new consensus: (1) frailty is an aging-associated phenomenon, (2) frailty carries a high risk of adverse outcomes for the individual (e.g., mortality), (3) the risk is evidenced under conditions of stress (e.g., hospitalization), (4) frailty may have to do with an underlying vulnerable physiological state, (5) the severity of frailty occurs along a continuum with implications for the opportunities for prevention, and (6) frailty may be associated with multisystem reduction in reserve capacity[1] (even to the threshold of clinical failure).

The consensus view is that frailty is better understood as background vulnerability rather than a foreground presenting disease, and it has a physiological or biological basis. There is also some divergence among researchers working on frailty. Some see it as the vulnerability or loss of reserves that results from the sum of all the health problems an individual may have, including coexisting impairments, symptoms, and diseases, not necessarily related to each other. Others view frailty as its own medical syndrome with an identifiable clinical presentation. In this perspective, which Fried shares, frailty results from physiological impairments. Frailty is an independent, distinct, clinically recognizable condition. It is not a single disease, nor is it associated with just one disease. It is neither comorbidity nor multimorbidity. It predicts disability but is not a disability. Frailty may have a primary relationship to the biology of aging and also seems to be associated with a number of specific diseases that have inflammation as a component (e.g., HIV, congestive heart failure, chronic obstructive pulmonary disease, diabetes, obesity).

Understanding frailty is essential because it appears to be a chronic

[1]Reserve capacity refers to the ability of a physiological system (e.g., cardiac, respiratory) to maintain vital functions in the face of external stresses. Frailty is a likely result of aggregate loss of reserves in multiple systems.

progressive process in 90 percent of older adults. Prevention, particularly in the early stages, is therefore a great concern. There are a variety of ways to screen for early vulnerability to frailty at four levels: (1) phenotype, (2) preventing attendant risk, (3) physiological dysregulation, and (4) molecular and genetic causes. Because frailty is a multisystem phenomenon, key risk factors will probably affect multiple systems. Effective interventions are also likely to affect many systems simultaneously. Intervening on only one level (phenotype, physiological, or molecular) may not be a meaningful alteration. As Fried observed, "We've done lots of single-strand silver-bullet type interventions over the years, which actually didn't yield results."

Three categories of interventions are under evaluation. Interventions at the first level, phenotype, include ways to increase physical activity and social engagement by redesigning community opportunities and environment. Maintaining physical activity ensures functioning on many levels, from muscle mass and strength to regulating mitochondrial function and energy production. Intervention to encourage and facilitate physical activity could be very cost-effective. Social engagement is also essential. Building a sense of meaning and usefulness and countering isolation is likely to play a role in preventing frailty and disability. Experience Corps, which puts older volunteers into public elementary schools, is a form of social engagement in which both physical and cognitive activities are embedded.

A second category of interventions under evaluation addresses moments of risk. Careful attention is warranted to redesigning hospitals and rethinking hospitalization, as hospitals are virtual stress tests for frail individuals. Screening procedures, for example before surgery or certain therapies or treatments, are also relevant. Current research indicates that screening for frailty is a much more specific predictor of poor postoperative outcome than any other screening measure.

The third category of interventions under evaluation work on the physical characteristics of frailty. These include nutritional supplementation, such as with protein enhancement or selenium. In a pilot study, the hormone ghrelin appears to significantly increase both body weight and the level of growth hormones in frail older women. Anti-inflammatories may also be an effective intervention. All of these affect multiple systems.

Many research questions remain. Fried identified four areas of research in frailty science with great potential to enhance healthy aging:

1. Understand frailty as a key risk factor for disability and loss of independence. This would include establishing standardized meth-

ods for screening and devising strategies for prevention of frailty at early stages.
2. Explore primary and secondary frailty, particularly seeking underlying processes that are intermediate, in common (e.g., inflammatories), or final common pathways. A related area of study is whether prevention of chronic diseases and obesity would also prevent frailty.
3. Undertake deeper study of the biology of vulnerability, including systems biology of homeostasis and reserves.
4. Pursue clinical implications, including redesigning care to be more effective and less costly, with attention to reducing risks in the built environment and the provision of palliative care.

It is important to think about public health for an aging society. In frailty prevention, public health approaches are likely to be the most effective. Housing and neighborhoods could be redesigned to minimize isolation and optimize access. Programs such as Experience Corps can also have large impacts, as older adults maintain physical and cognitive activity, make meaningful and valued contributions, and extend their productivity. Large-scale public health interventions of this sort would affect physiology at many different levels and would furthermore be sustainable in ways that laboratory interventions are not. They are sustainable because they are meaningful, they make a difference, and they are fun. Therefore people sign up and stay—which is not the case for many physical exercise interventions. They also bring in people at high risk and are cost-effective. A final advantage of large-scale public health interventions is that they confer social benefit on everyone. As Fried concluded, "If we can redesign societal approaches so that they are both great for people as they get older and great for society because they help bring the wisdom and experience of an aging population to bear on unmet social needs, then we could have a new kind of social compact."

ALLOCATING SCARCE HEALTH CARE RESOURCES

David B. Reuben
Multicampus Program in Geriatric Medicine and Gerontology
University of California, Los Angeles

The provision of health care services in the United States falls into three categories: (1) what we can do, (2) what we do indeed do, and (3) what we should do.

The category of "can do" is driven by technology and science and is characterized by the perspective that more is always better. Large invest-

ments have yielded large returns, including improved control of disease, prevention of some disease, and lengthened life expectancy. These large returns have come at a high price. Providing dialysis, for example, which became a defined Medicare benefit in 1973, costs $23 billion per year for the current 422,000 beneficiaries. Implantable cardiac defibrillators, a defined Medicare benefit since 2005, cost $28,000 for each of the approximately 500,000 eligible individuals, for a total of $13.5 billion. Many more such costly procedures are to come, especially for the older adults who are becoming a larger proportion of the population.

The second category, the "do indeed do," refers to health care as it is generally practiced. It is driven by providers and patients and shaped by such factors as availability, access, insurance, practice patterns, and patient/provider choices. While the procedures and tests of conventional health care do not carry price tags comparable to those of dialysis or defibrillators, taken as a whole they sum to very large expenditures. However, despite substantial expenditures, the U.S. health care system exhibits poor performance on quality measures. People in America also have a poorer health status compared with those in other nations.

The third category is the "should do." What should be done in health care is a matter of personal, societal, and ethical values. Little money is invested in determining the proper limits of health care because of the difficulty of the task, the lack of ownership of this challenge, and the potential for public backlash. Because the issue of determining the proper limits of health care is avoided, people are left with a system in which what they can do eventually becomes what they do indeed do.

The refusal to address the proper limits of health care raises questions of distributive justice and the fair allocation of resources across society. In general, the guiding principle in the United States has been that resources are spent to benefit the most people. Nonetheless, costly sophisticated care is often provided to individuals while the needs of many are neglected. For example, the cost of a bed in an intensive care unit for a week ($16,800) can be compared with the annual cost of health insurance for a family of four ($12,700). This is similar to the case of a trapped miner for whom immense resources are spent on rescue, when society is not willing to invest in making the mineshaft safer in the first place. If the country continues in this manner, health care costs will become completely unaffordable.

Garrett Hardin's well-known 1968 essay, "The Tragedy of the Commons," describes the dilemma of multiple individuals acting independently in their own self-interest and thereby destroying a shared limited resource, through no intent of their own and against their own long-term interest. Hardin's metaphor is the common pastureland on which each herder sends an additional cow, resulting in overgrazing. It is in the inter-

est of each herder to put as many cows as possible on the land, even to the point of damaging it, since the herder receives all the benefit of the additional cows. The damage, however, is shared by the whole group. There are many parallels with individual overuse of common health care resources.

According to Hardin's earlier analysis, problems characterized by the tragedy of the commons (such as overpopulation) have no technical solutions. Hardin argued that appeals to individual conscience or altruism will also not be effective and that some sort of coercion is required. Coercion can take the form not of force, but of laws and standards, a new and clear shared understanding, in Reuben's view, "of what is permissible and what is not permissible." In health care, this would consist of some form of reallocation of health care resources.

What might this look like? In terms of Reuben's three categories, restricting what we can do is not a feasible step. The impressive and costly interventions in this category have strong public support and have provided large benefits to improving health. Furthermore, they offer the promise of hope to individuals and their families and are therefore difficult to withdraw. And systemically, they are the livelihood of many scientists and physicians who have a vested interest in providing them. Thus, restricting what we can do is not apt to happen.

Defining the limits of what we should do is imperative but also unlikely. This task is inherently messy, involving cultures and religions, and often putting individual interests counter to societal interests. Defining the limits of what we should do in health care requires courage and leadership, and neither is coming, either from government or from health care providers.

Therefore, focus might best be put on what we do indeed do. Government, medical experts, and ethicists can use their moral authority to establish a system of allocating health care resources. Doing so will involve some degree of moral hazard. If health care services are too readily available, they may be overused. But if access to health care services is excessively restricted, then failure to access early preventive care will result in more costly health problems later.

A well-designed regime for allocating health care resources would move society off the path toward bankruptcy and ensure distributive justice in health care. It would be a welcome means to deny unrestrained use of health care in futile situations. Providing an illustration from his own practice, Reuben mentioned the case of an elderly individual with severe dementia and metastatic breast cancer being kept in an intensive care unit for 130 days at the insistence of her family. In another similar instance involving a patient in intensive care for many weeks, Reuben sought to convince the family to allow the patient to be transferred. His efforts to

discuss prognosis and palliative care options were cut short, however, by a statement of the patient's relative: "Our family believes in miracles." Such individual situations, in a larger context that permits and pays for whatever interventions can be done, makes for a health care system that violates distributive justice and generates unsustainable costs.

Responding to questions, Reuben acknowledged that the overuse of medical care and technology is not only patient-driven. In the current system, with payment based on procedures performed rather than health outcomes achieved, doctors have incentives to do too much. There may be an overuse of costly tests and technology, but an underuse of more cost-effective interventions. Different approaches will be needed to address patient-driven and physician-driven overuse of health care. One type of solution is needed when a patient's family demands a ventilator for the last 90 days of life, whereas a different solution is needed when physicians who are making a profit doing procedures continue to order costly tests and interventions. A defined system for allocating health care resources would address only direct costs of health care, and not the substantial indirect economic impact of lost productivity of patients and their informal caregivers. Reuben closed with a three-part research agenda:

1. What methods are most effective in communicating choices at the individual patient/provider level?
2. How can technical solutions reduce the need for tough societal decisions (e.g., present the case to a panel without having the patient or patient's representative in the room)?
3. How can science inform decision making about resource allocation?

3

Enhancing Healthy Aging

As life span increases, individual behavior will have important ramifications for healthy aging, both physically and cognitively. Technological innovations and new approaches to health care can also facilitate healthy aging across a diverse society.

STRATEGIES FOR HEALTH PROMOTION

Robert N. Butler
International Longevity Center, New York

Despite all the advances in medicine and public health, life expectancy in the United States may decline from such factors as obesity, diabetes, smoking, and alcohol abuse as well as poor health care coverage. Noting that the United States has fallen from 11th to 42nd in world rankings of life expectancy in recent years, Butler cautioned, "We may reach a point where our grandchildren have lower life expectancy than we have."

Butler called for a broad strategy of health promotion. The essential elements are already well known. The grand challenge is getting people to do them. As no more than 25 percent of health and longevity depends on genes, the other 75 percent is up to people themselves. Butler identified seven steps in a public health campaign to promote healthy aging. The first four concern physical health, encouraging people to (1) remain physically active, (2) change their diets by reducing caloric intake and adding fruits and vegetables, (3) moderate their use of alcohol, and (4) cease

tobacco use. The other steps foster cognitive health: (5) building and maintaining support systems and close friendships, (6) managing stress, and (7) continuing to seek meaning and maintain a sense of purpose. With greater longevity and improvements in both physical and cognitive health, people can and should work longer. This will have a positive impact on individuals' health and will reduce Social Security costs. Older persons can also volunteer, providing services to others.

What else can be done? Butler mentioned several public policy strategies: tax soda, tax alcohol, and further regulate tobacco. He also advocated universal health insurance and a national walking movement, established through joint efforts of government, private foundations, corporations, and lobby groups to encourage people to walk together, using pedometers to monitor performance and get feedback. A movement that establishes walking as a fun, frequent, and shared practice could have an immense impact on healthy aging.

Butler closed his remarks with an emphasis on the value of taking a life-course perspective to health promotion. Considering a range of healthy behaviors, preventive care, and physical and cognitive exercise, Butler declared, "It is never too late to start and always too soon to stop."

OBESITY AMONG OLDER PEOPLE

Gordon L. Jensen
Department of Nutritional Sciences
Pennsylvania State University

One specific risk to healthy aging is the recent rise in obesity among older people. In the United States, there has been a tremendous increase in the prevalence of obesity among people in their 60s and 70s. In this age range, a third or more of both men and women are now obese, meeting the threshold definition of a body mass index of 30 or greater.

While some excess weight in older people may be positive, providing a metabolic reserve, obesity to this extent has adverse consequences. It is often accompanied by the gamut of serious medical comorbidities. It also has profound functional implications, particularly for mobility. In addition to loss of mobility, obesity is also a predictor of many other forms of functional decline: joint disease, chronic disease, chronic proinflammatory state, decline in muscle mass, sedentary lifestyle, homebound status, and restrictions in activities of daily living. These build on each other, as the physical inactivity of a sedentary lifestyle leads to more substantial loss of muscle mass, further restricting mobility.

Obesity in older people thus has a tremendous impact on their quality of life, capacity to live independently, and psychosocial health. It also has a great economic impact on the health care system, as body mass that is either very high or very low is associated with increased health care expenditures. An obese Medicare recipient costs approximately $1,500 more per year than one of healthy weight. That figure does not cover indirect costs of lost productivity.

A study of diet quality among community-dwelling older adults generated several observations. Nutrient deficiencies are relatively common among older obese people. Due to poor diet quality, they are overnourished and undernourished at the same time. Obese older women are less likely than men to meet nutrient requirements and to have healthy eating habits. Women living alone were most apt to have a high body mass index and poor diet quality.

Strategies for prevention and treatment of obesity among older people are needed. However, research on which interventions are relevant for older obese people in particular is lacking. Pilot studies involving prudent diet, behavior modification, physical activity, and pedometers are showing positive results. It is not clear whether they will translate into long-term sustained benefits. More aggressive bariatric surgery (surgical modification of the gastrointestinal tract to promote weight loss and maintenance of a more healthy weight) is now being offered to the "young old." As this is a potentially life-threatening surgical intervention, the need to develop other interventions and to intervene earlier is clearly very great. Devising effective interventions for obese individuals in childhood and midadulthood has also proved difficult.

Jensen identified these priorities for research on obesity and aging:

- What is the significance of sarcopenic obesity (obesity with associated muscle loss), especially for functional decline?
- What should weight recommendations for older people be?
- What warrants intervention and what should those interventions be?
- What are the proper protocols for caring for older people with obesity in transitional care, chronic care, and community-based settings?
- How should poor diet quality and micronutrient deficiencies be handled?

EXERCISE AND COGNITION

Arthur Kramer
Biomedical Imaging Center
University of Illinois at Urbana-Champaign

Exercise encompasses not only physical activity but also intellectual engagement, social interaction, and aspects of diet. In cognitive health and in physical health, exercising more is the route to healthy aging.

These issues have been informed by molecular and cellular studies of nonhuman animals, prospective observational epidemiological studies, and human randomized clinical trials. Much is known about the molecular and cellular underpinning of exercise. Positive impacts of exercise include increases in neurotrophins, enhanced synaptogenesis (formation of new synapses), enhanced angiogenesis (formation of new blood vessels), increased production of various neurotransmitters, reduced meta amyloid protein, and enhanced learning and memory. More work needs to be done, particularly regarding the interaction of different factors that act as moderators and mediators.

Exercise to build and maintain cognitive health is important across the life span. The increase in the numbers of sedentary children is of grave concern for their well-being now and in the future. Sedentary older adults should not consider themselves too old to start. According to current research, there is no point of no return with regard to the benefits of exercise for cognition and brain health. Even older persons with Parkinson's disease, multiple sclerosis, and early Alzheimer's disease benefit from exercise.

Genetic moderators also play a role in the relationship between exercise and cognition. More research is needed on the interaction of different alleles that are linked to different aspects of cognition. Various genes can also affect the dopamine system, influencing a person's experience of and pleasure from exercise.

Another area of research concerns the interaction of exercise and other lifestyle choices on cognition and the brain. Multimodal interventions appear most promising. These incorporate physical activity, intellectual engagement, emotional control, social interaction, and meaning. The interaction of exercise and diet on cognitive health is also beginning to be studied.

From a public health perspective, how can exercise be encouraged so as to stimulate and maintain cognitive health? Exercise can be built into all environments for living, working, and playing. Exercise can be an element in the design of transportation, workplaces, schools, parks, recreational facilities, urban environments, and so forth. "There is more to be known, certainly," Kramer concluded, "but we know enough to suggest

that exercise and physical activity have positive effects both on reduction of disease in the long term and on memory, cognition, decision making, intentional processes, and brain health even in the short term and even independent of disease reduction—of course, also in concert with disease reduction. But if we cannot get people to do what we know is good for them, it is kind of a moot point from a public health perspective."

RACIAL DISPARITIES AND COMMUNICATION

M. Chris Gibbons
Urban Health Institute and Schools of Medicine and Public Health
Johns Hopkins University

Consumers increasingly are using information technology to acquire the necessary tools and information in order to promote their own healthy aging. In addition, the rising desire to age in place generates a growing home health care sector. If there is also a rising prevalence of chronic diseases, then care for such diseases will increasingly be provided by family members, community members, and other types of health care workers outside a hospital or health care setting. In such situations, nonmedical factors will have greater importance. Sociobehavioral factors are increasingly recognized as important determinants of healthy aging and health care outcomes.

The line between biological and sociobehavioral factors is not sharp. Disease causation in general and health disparities in particular result from the complex interaction of many factors that simultaneously and often cooperatively act across more than one level. Thus it is not possible to characterize health, disease, aging, or disparity at only one level of analysis, and interventions, too, should act on many levels. Transdisciplinary research that truly integrates sociobehavioral, environmental, and biomolecular research on health, aging, disparities, and intervention is necessary.

Currently, more research is being performed and a higher level of consensus exists among researchers regarding prevalence of chronic disease, increasing longevity, and rising health care costs. Regarding intractable health care disparities, more research is being performed and a higher level of consensus exists at the epidemiological level. However, regarding what to do about these health care disparities, less research is being performed and a lower level of consensus exists among researchers.

A promising initiative for intervening in health care disparities will come from information and communication technologies. Just as advances in these technologies helped propel a revolution in molecular biology and clinical sciences, the same revolution is needed in the behavioral and

population sciences. Health care interventions based on information technology will provide a more robust and comprehensive characterization of the process of healthy aging and the pathogenesis of disparities. These approaches also offer significant promise for the promotion of healthy aging and the reduction of disparities. In discussions of health care and information technology, what generally comes to mind is electronic medical records, e-consultations, telemedicine, remote monitoring, intelligent devices, and sensor technology. These tend to be designed for and used by physicians and other health care professionals. However, this represents only a very limited part of the spectrum. The use of technologies by consumers has the potential for even greater impact than those used by professionals. These include a range of platforms, including cell phones, Web 2.0/3.0, health gaming, population health technologies, consumer health informatics, and programmed evidence-based processes.

Technologies used by consumers will need careful attention to design so that patients and caregivers are empowered to do what is necessary toward the goal of improving clinical outcomes. Reducing health care disparities requires not just increasing access to technology, but rather redesigning it. The underserved and minorities do not use information technologies in the same way as the general population. Without attention to design, information technology could even increase health care disparities. Gibbons advocated user-centered design to attend to the needs, wants, and limitations of the end-users. Human-computer interaction and usability testing should also be addressed in the development of information technologies. Culturally informed design that attends to the needs of minorities, immigrants, or low-literacy groups is also an essential part of the process.

The relevant end-users of these information technologies are not only patients but also a range of caregivers, including family members, friends, neighbors, home health care workers, and community health workers. Consumer use includes a variety of tasks, such as calendaring (e.g., keeping track of appointments, scheduling tasks), decision support, open and distance learning, and radio frequency identification devices for tracking and constant monitoring. With well-designed information technologies, health risks can be managed before they become diseases, and patients can receive an intervention without going to the hospital. Intervention delivery can occur via a variety of formats (e.g., Web, game console, television, cell phone, personal digital assistant). Interventions can be delivered when and where they are needed. Connections can be maintained regardless of location, facilitating aging in place, ongoing social networks and personal independence.

Information and communication technologies have great potential to improve outcomes across the continuum of health care. Possible areas of

impact include harm reduction, prevention/wellness, screening, diagnosis, medical treatment, self-care, and survivorship. By making information accessible in the form in which it is needed, information technologies can help make health care proactive rather than reactive. The efficacy of traditional interventions could also be enhanced via technological adjuncts to treatment or care.

The current challenge, Gibbons concluded, is not just what doctors and hospitals need in order to do a better job, but what patients and caregivers need "in order to do the things we want them to do better over time to improve clinical outcomes." And the best approach is information technologies that are used and owned by patients or immediate caregivers and that do not depend on a physician or practitioner.

Gibbons posed three critical questions:

1. What is the role of human factors (how humans behave physically and psychologically in relation to environments, products, and services) on the use of information and communication technologies among seniors?
2. What is the role and impact of designs that take account of the characteristics of the end-users on seniors' use of technology?
3. What is the role and impact of using computer science in combination with health information among seniors?

4

Macroeconomic and Financial Impacts

Aging populations have enormous implications for the economic underpinnings of their societies. Different countries will face these challenges differently and affect each other in the global system.

GENERAL MACROECONOMIC OVERVIEW

Axel H. Börsch-Supan
Mannheim Research Institute for the Economics of Aging and University of Mannheim

Basic economic inputs—volume of labor, productivity of labor, and capital supply—are affected by an aging society. The general view is that the volume of labor declines in an aging society. The pool of workers shrinks relative to the ranks of the retired; society has the same number of consumers but fewer workers. The general view has also been that productivity declines in an aging society, as older workers are less productive. Finally, the common expectation has been that savings decline, as older people spend down their savings and the smaller working population cannot save enough to make up the loss of elder saving. The financial base of an aging population thus appears to be a shrinking pie.

But, Börsch-Supan asked, is the pie really shrinking? Does it have to? Increases in longevity have added 30 years to life, and these are healthy, active years characterized by slower aging. The financial base of an aging

population shrinks, he argued, only if current retirement age is maintained, if productivity declines, and if people fail to save after age 50. None of these need be the case. The challenge is to devise and undertake policy action that will generate different outcomes.

The story in each country will vary somewhat. The fertility rate in the United States, higher than in many industrialized countries, will mitigate the dependency of the aged on workers. Global flows of capital and labor could also diffuse the effects of population aging in many countries. Differences in demography and the extent of globalization could result in significant differences across countries. No country will experience population aging in isolation, and all will be affected by it.

What are the areas of agreement and controversy regarding the macroeconomic impacts of aging? There is substantial agreement that an aging population could pose serious challenges to any country's financial base. In terms of basic economic inputs, the supply of labor is key to the size and sustainability of the economic pie. The years added to life as longevity increases must be active years with continued participation in the labor force on the part of the older population. Börsch-Supan declared himself optimistic that current unused capacity in the labor force could be mobilized. New laws and public policies are essential. Speaking from a European context, he mentioned changing the retirement age so that people remain in the workforce longer, making schools more efficient so that workers enter the labor force earlier, and providing child care so that women who are mothers can rejoin the workforce more quickly. Migration could also help the labor supply, but the volume provided by migration will not be sufficient. The number of new workers required to balance the aging of the population is far too large to be met by immigration.

Maintaining the quality of labor is also essential. The health and human capital of aging workers are critical to their productivity. Investments in health should be made across the life course. Human capital at advanced ages should be sustained and renewed through lifelong learning, continued training, and utilization of experience, but age profiles of productivity are controversial. Some studies indicate that productivity declines after age 40. However, Börsch-Supan stated that the evidence for this is not solid. In his view, the best evidence indicates that productivity is flat, indeed, "astoundingly flat." Proper management is the key factor in determining ongoing productivity of labor. Later, in responding to a question regarding globalization and the loss of jobs offshore, Börsch-Supan offered his view that jobs requiring experience will not be transferred to offshore locations. He speculated on a multitier system and a new international division of labor in which production might be offshore in developing countries while design and innovation remain in developed countries. While innovations appear to be the province of younger people,

he argued that actually turning these innovations into marketable products generally requires the experience of older people.

The third issue regarding the macroeconomic impacts of aging is capital or savings. Again, there is some controversy. Many analysts, particularly in the United States, see old age as a period of dissaving, that is, spending accumulated savings or going into debt. Definitive evidence of this in the United States is lacking, however, and dissaving is clearly not the pattern in Europe. More research would be useful, particularly to address the interaction between policy and savings behavior. The effect of the global flow of capital also requires further research. Capital supply is not apt to be severely affected by an aging population. In terms of demography, capital supply is simply not as great a concern as labor supply.

Börsch-Supan closed with ideas for a three-part research agenda:

1. Age and productivity, with attention to maintaining health and human capital in workers and changing laws and policies regarding retirement age.
2. Age and saving, with attention to the buffer effect that savings could provide at both the macroeconomic and microeconomic levels.
3. International spillovers, particularly the effects of reforms in Europe and growth in China and India.

MACROECONOMIC AND FINANCIAL IMPACTS OF AGING

Robin Brooks
Brevan Howard Asset Management, LLP

The U.S. economy has three sectors making decisions regarding aging: households, companies, and government. Aging individuals in households are making decisions on savings and consumption. Companies are responding to the expectations of an aging workforce or anticipated trends in the availability of capital. The government also considers the aging of the population as it develops projections of revenues and expenditures.

For households, savings decisions are paramount. However, savings behavior is not well understood. China has a growing economy and strong growth prospects with relatively low income today and higher income expected in the future. Such a profile is not generally associated with high savings rates, yet the Chinese are perennial high savers. The United States is aging and people should be saving more, yet 2005-2007 saw a record low personal savings rate. Consumption behavior and portfolio decisions are also poorly understood. There should be a shift to safer assets over the life cycle. As human capital is depleted over the course

of a lifetime, capital assets should be placed in safer investments. This is not always the observed behavior. Indeed, Brooks noted, savings and consumption decisions often appear "completely irrational" and are not captured by economic models that assume rational actors.

Population aging affects the decisions made by companies. An aging workforce may influence company decisions on where to invest so as to make use of a youthful labor supply. Companies may also choose to invest away from aging populations so as to be closer to a younger consumer base. Financing decisions may be affected by the aging of the population, as companies consider paying higher dividends in anticipation of an elderly population desirous of more fixed income.

As the population ages, government must consider unfunded liabilities. Entitlement reform becomes an issue, as does the possibility of a shrinking tax base and diminished revenues.

Historically, households are a net provider of savings, whereas corporations and governments use savings. The overall current account deficit has resulted in the United States attracting funds from overseas because domestic savings are insufficient. Some patterns are changing now. The personal household savings rate is rising quickly. The government is borrowing more in an effort to prevent a complete stall of the economy.

Four other considerations should be taken into account regarding the macro and financial impacts of aging. First, generational patterns in behavior are important. Risk aversion is acquired through experience. For example, those who experienced the Great Depression save. In the current economic downturn, Brooks noted, the savings rate is responding. A second consideration is financial education. Longevity and an extended retirement are new. We do not have an accumulated popular wisdom about how to prepare financially for retirement. Financial education about how to manage resources is seriously lagging. Geopolitics and global imbalances are a third consideration. Will the rest of world be willing to finance the U.S. standard of living? What will be the reserve currency status of the U.S. dollar? As standards of living rise around the world, how will that affect competition for resources and commodities? A fourth consideration is the global demographic imbalance. While there is high population growth in some parts of the world, populations are shrinking elsewhere.

AN INTERNATIONAL PERSPECTIVE

David Canning
Program on the Global Demography of Aging
Harvard School of Public Health

Three fundamental issues need to be addressed regarding macroeconomic impacts of aging at the international level: (1) the impact of demographic change on income levels, (2) the experience of developing countries that will become old before they become rich, and (3) the role of international linkages in mitigating or exacerbating the macroeconomic effects of aging.

A central question to these concerns is whether improvements in health and longevity will raise or lower income levels. Yet high income levels are not the goal of civilization. Canning stated, "Life itself is quite valuable. People like living a long time rather than a short time." Similarly, while continuing to be active in the labor force so as to maintain income is important, leisure time "is one of the great advances of civilization. Retirement is something people enjoy."

Population aging is a new phase in the demographic transition, and therefore much is unknown. What is known is that health and longevity are both beneficial to an economy. Healthier workers are more productive. Long-run effects on worker productivity follow from early childhood investments in health, including both physical and cognitive development. Investments in health during childhood also have an impact on later educational outcomes. Over the course of a longer and healthier life, an individual earns returns to education, so investments in education can be exploited for an extended period. Health in youth is also linked to health in age. Looking across the life course (not just at older age) is thus very important.

While improved health and increased longevity are good for the economy, population aging does raise some concerns. One is having too many people in the world. This may not be a big problem, but it is a potential problem. In terms of economic impacts, there is a shift in consumption over the life cycle. The young and the old consume more than they earn, while those in their middle years save. Allocating resources across the entire life cycle can be a challenge. A third concern is the age structure of the population and the impact of a large number of old people relative to a small working-age population.

In many ways these are institutional rather than real problems, Canning said. "We have institutions which are unsuited to population aging and so the problem is to change those institutions." In his view, institutions need to change, for example, in order to address the challenge of shifting resources across the life cycle, whether that is done through

public or private transfers or private savings. However, people are often reluctant to change institutions, and the politics of changing the institutions is difficult.

International comparisons can be made regarding the ratio of the working-age to the nonworking-age population. Around the world, as populations age, old-age dependency ratios are increasing. Yet there is also considerable variation. Compared with the rest of the world, the problem of aging in the United States is not that substantial, in part because of higher fertility rates. Low fertility is a particular problem in Europe. China will age quite fast because of its very low fertility. South-Central Asia will not begin significant aging for decades. The fertility transition is only beginning in Africa. Overall, it is important to recall that population aging is as much an outcome of lowered fertility as it is of increased life expectancy. Both factors exacerbate high ratios of dependency on the working-age population. Thus, far lower fertility rates have resulted in a demographic dividend, with fewer children dependent on workers. However, if fertility rates fall below replacement levels and the population ages, the result will be increasing dependency on the working-age population.

The impact of population aging in developing countries raises distinct questions. Countries that get old before they get rich will face a different set of problems than developed countries. They also wrestle with the dual burden of infectious disease and rising chronic disease, as well as weak or nonexistent public transfer systems. The future of family support for the aged is unclear, because of urbanization and changes in dependency ratios. Developing countries have one major advantage: they are not locked into inappropriate institutions. Indeed, Canning said, they "can design their institutions with aging in mind."

International linkages may either mitigate or exacerbate the economic effects of aging populations. International connections occur through trade, capital flows, and migration, as well as through externalities, technology, and idea flows. Regarding the latter, Canning emphasized that he meant not only inventions but also institutions. "There is a lot to be learned by looking at how different countries organize their institutions to deal with aging, and we can learn a lot by looking at different countries."

The fact that not all countries are aging at the same time or rate suggests that a global reservoir could absorb some of the impact of population aging. Excess savings or dissavings could flow abroad, thus having less impact on national interest rates. Similarly, countries with younger populations might have trade surpluses, while older countries would import. Savings and trade surpluses during dividend phases would balance the decrease in surplus by aging populations.

Migration could also limit the problems caused by a changing age structure. However, as immigrants age, this is not as large an effect as might be expected. One very compelling problem in the area of migration is the importation of health care workers to care for aging populations. Health care workers trained at public expense in developing countries then migrate to developed countries to meet the demand for care of older people. This amounts to a subsidy provided by developing countries to developed countries. It is very difficult for a developing country to invest in its health sector or pursue a policy of expanding its health workforce when doctors and nurses have high rates of migration. This requires far better management to benefit both the developing and developed countries.

5

Income Security and Health Care Financing Programs

The financing of retirement and of health care for an aging population presents immense challenges. These are being met with different strategies around the world.

INCOME SECURITY FOR AN AGING POPULATION

Alicia Munnell
Carroll School of Management
Boston College

The U.S. population is aging, longevity is increasing, and the need for retirement income is growing. Yet at the same time that the need for retirement income is increasing, the retirement income system is contracting. Retirement income may be thought of as a three-legged stool consisting of public government funds (Social Security), employer-sponsored retirement plans (defined benefit or defined contribution plans), and personal savings. All three legs of this stool are wobbly.

The cost of Social Security is increasing. With a pay-as-you-go system, more retirees, and fewer workers, the cost rate goes up—this is well known. Social Security will replace less of an individual's preretirement income in the future. Under current law, a decline in the replacement rate from 39 percent in 2002 to 28 percent in 2030 is anticipated. Thus, the first leg of the retirement income stool is not so secure.

The second leg, employer-sponsored retirement, is also not solid. In

the private-sector workforce, fewer than half the people working have any type of employer-sponsored retirement plan. This figure has changed little over the past 30 years. The plans themselves, however, have changed substantially from defined benefit plans to defined contribution plans. Defined benefit plans promise a specific monthly benefit upon retirement; defined contribution plans—such as 401(k) plans—are characterized by contributions from the employer or employee (or both), and the balance of the account is available to the employee upon retirement. In the early 1980s, 62 percent of those with pension coverage had a defined-benefit-only plan. By 2007, 63 percent of those with pension coverage had a defined-contribution-only plan. Such plans shift all responsibilities to the individual. With a 401(k) plan, the individual must decide whether to join the plan, how much to contribute, how to invest those contributions, and how to change the portfolio over time. And as Munnell observed, "people make mistakes every step of the way." About 20 percent of people who are eligible fail to participate in 401(k) plans. Of those who do, only 8 percent contribute the maximum; 92 percent do not. Decisions regarding investment are also faulty, with 42 percent of people failing to diversify and putting all their funds into stocks or all into bonds. Furthermore, people do not change the investments as they age. When the stock market fell, people age 55 to 65 held two-thirds of their assets in equities and did not roll over their investments. In sum, people do not have much money in their 401(k) plans. In 2007, the average 401(k) plan had $60,000 in the account, considerably below the potential.

The final support of the three-legged stool is personal savings, which is currently completely inadequate for retirement needs. And with the booming housing market of the 1990s, as many people borrowed on their homes and spent beyond their incomes, the savings rate went negative.

The solution to the retirement income challenge is straightforward and similarly threefold: people should remain in the workforce longer, make better use of retirement assets, and save more.

Working longer, Munnell argued, "is really the most powerful thing people can do to have a secure old age." An individual retiring at age 62 receives 75 percent of the Social Security benefits that would come at the full retirement age which is moving toward 67, while an individual who continues working until age 70 gets 132 percent. Social Security benefits, in Munnell's view, are "backbone income": they are lifelong, adjusted for inflation, and unavailable in the private sector. Working longer also gives the assets in a 401(k) plan more time to grow. Finally, working longer shifts the ratio between working years and years in which support will be required.

There are several obstacles to working longer. Employers' perceptions of older workers are a problem. In survey responses, employers say they

value experience but are less positive about older workers' ability to learn new tasks and less sure of their physical health, stamina, and continued presence in the job. Such perceptions make employers disinclined to train or promote older workers.

Furthermore, clearly not everyone can work at advanced ages. Estimates of disability-free life expectancies indicate that people in the bottom income quartile at age 50 can expect 14 years of disability-free life. It would hardly be possible to recommend to such individuals that they continue working for another 17 years. In response to later questions on this topic, Munnell proposed that one approach might be setting different ages for full retirement based on life experience, perhaps using a person's average indexed monthly wage. She acknowledged that the disability issue is very hard and requires very careful management. Nonetheless, she remarked, "We are taking over General Motors. We are taking over banks. We could figure this out. This is not impossible to solve and to try to make changes that are helpful for the bulk of the population and also protect the vulnerable population."

Turning to the use of retirement assets, people need to use the assets they have more effectively. When people get to retirement, Munnell noted, "it is hard to tell them they should have eaten better and exercised more and saved more. They are what they are, so we need to make sure they use what they have effectively." One important challenge is annuitization: people need an orderly way to decumulate retirement balances. Annuitization yields the highest income for life, yet people dislike it. Munnell suggested that ways be devised to "coax, cajole, default, or mandate" that some portion of people's financial assets be annuitized. Tapping housing equity efficiently is another challenge. For many people, their house is their major asset; leaving it to heirs is a luxury that very few can afford. There needs to be some financial innovation so that people can access their housing equity.

The third component of improving retirement income is to increase savings, and Munnell has a simple imperative—"We need more." Without increased personal savings, standards of living in retirement will deteriorate. Munnell's research suggests that 43 percent of current households will not be able to maintain their preretirement living standards when they reach age 65.

In terms of the three legs of the existing retirement income stool, the situation is particularly acute for those who depend on Social Security. Can benefits be cut? If the population is divided into income terciles, Social Security payments are crucial at the bottom, really important in the middle, and significant even for the top. Thus to suggest that shortfalls in the Social Security system be fixed partly by tax increases and partly by benefit cuts is not realistic. "When I look at the retirement income

landscape," Munnell observed, "I think that we cannot afford to cut back on benefits at all."

Even if people work longer and Social Security benefits are not diminished, private retirement plans will be inadequate. When 401(k) plans were first devised, they were intended to be supplementary to Social Security and defined benefit plans. "They were never intended for this job," Munnell said, yet they have become many people's sole form of private retirement income.

A whole new tier of savings for retirement is necessary. For people with or without a 401(k) plan, it would provide 15 or 20 percent of replacement income. It would be contributory by either employee or employer, and it should be mandatory, with no access until retirement. This new tier of savings would be invested in something very low cost, and the portfolio would change as people age. It would be paid out as an annuity. Munnell acknowledged that although she has many ideas, she does not have a plan. Nevertheless, she asserted that the imperative is to increase savings by whatever means.

The solution to income insecurity for an aging population, then, is threefold: work longer, use assets more effectively, and save more. With that agenda, Munnell proposed the following key questions:

- Are people healthy enough to work longer? Are there large components of the population for whom working longer is not the right answer? What can be done about them? How can a system be devised that gets most people who can work to work and yet protects those who cannot? Is there adequate employer demand for older workers? What are the actual levels of productivity of older workers?
- What new financial instruments would help people make more effective use of their retirement assets?
- How can savings be increased?

HEALTH CARE FINANCING

Kenneth M. Langa
Department of Internal Medicine
University of Michigan

There are three basic questions regarding health care financing for an aging population: (1) What is happening to the prevalence and onset of disability?, (2) How should older adults be cared for generally and at the end of life?, and (3) Who will care for the growing number of older

adults? Langa reviewed the areas of consensus, controversy, and ignorance regarding these questions.

Disability is measured in terms of the capacity to perform activities of daily living (ADLs) and instrumental activities of daily living (IADLs) independently. The risk of disability increases with age, and the United States has an aging population. What are the trends in disability prevalence? There is a general consensus that the prevalence in disability among the aged has declined over the past 20 years. There is also some evidence of significant declines in cognitive impairment, although longitudinal data are more limited. These declines are probably the result of increases in education, through multiple direct and indirect causal pathways. Decreases in cardiovascular disease have also contributed to decreases in disability prevalence, as have improvements in health care (such as cataract surgery, joint replacement, and treatment for hypertension and cholesterol). Healthy behaviors are also helping to compress disability, so that onset of disability is later when it does occur. Disability rates will be higher for those in the bottom income quartile. This may be due, in part, to differences in early education, which has long-term consequences including influence on the choice of jobs, ways of using the brain, environments, and social interactions. Better education earlier in life for those in the bottom quartile could be an important component of addressing disparities in health and disability later in life. A final factor regarding trends in disability is the impact of rising obesity and diabetes, including among children. The large increase in the prevalence of obesity and diabetes may reverse some of the disability declines that have occurred over the past 20 years.

Trends in disability are important to study, because they have large implications for both costs of long-term care and for the ability of older workers to remain in the labor force. Tracking trends in disability also helps to identify healthy behaviors and other risks and protective factors in the environment.

Regarding the right amount of care for older people and those at the end of life, there is particular evidence of regional variations in Medicare expenditures. Per capita Medicare expenditures vary widely across regions. Growth in Medicare expenditures has also exhibited striking differences. In Miami, for example, Medicare expenditures are far higher and growing faster than in Oregon. The data are properly adjusted for characteristics of the population, and thus the results reflect actual differences in utilization rates, not differences in the people or the burden of disease in these regions. The patients in the high-use regions are not sicker, nor do they prefer more intensive care in general or at the end of life. Furthermore, they do not have better health outcomes in many ways that can be measured. Rather, physicians' behavior in high-use areas is

key. Physicians in high Medicare expenditure regions make more referrals to subspecialists, more frequently hospitalize older patients at the end of life, more frequently use intensive care units for older patients, and less frequently discuss palliative care with patients and families.

Why is determining the right amount of care for older adults important? First, given the size of the Medicare budget, even small changes in per capita growth in Medicare expenditures will have major implications for the program's future solvency. Second, the so-called gray areas of decision making—determining whether and how much to intervene—is where health care money goes. As Langa observed, "I would argue that geriatrics is almost entirely defined by gray areas of decision making." Good geriatricians need to handle ambiguity and complexity. In treating older patients, he suggested, there is a "huge potential, especially with full insurance coverage, for things to expand if we don't figure out what should be done rather than just being able to do everything we can."

The tremendous regional variation in Medicare expenditures suggests that the decisions made in these discretionary gray areas vary widely and that further refinement is needed, for example, in the guidelines for appropriate care for frail adults with multiple coexisting chronic diseases. The guidelines for treating a 50-year-old in this situation might be very different from those for an 80-year-old. Further attention should also be given to determining the appropriate goals of chronic disease care in terms of independence or length of life, for example. More work is needed to define and measure outcomes. Another essential challenge is to figure out how to organize and pay for services in a way that will reward more conservative practice. The current system of compensation for procedures performed rather than for actual health outcomes generates perverse incentives. Finally, better tools for prognosis and for encouraging communication between doctors and patients and their families are essential. This is true not just at end of life. End-of-life care and costs should be thought about from an earlier age, prior to crisis or any kind of impairment.

The next question is who will provide the care for an aging population. The pool of informal nonprofessional caregivers in the United States is shrinking. The population over age 65 is increasing, and the population of 44- to 55-year-olds—the potential caregivers—remains essentially flat. Looking at informal caregiving costs for various chronic diseases, the largest costs were for dementia, amounting to 29 percent of costs in 2000. When other aspects of brain ill health, such as depression and strokes, are added, this accounts for 54 percent of informal caregiving costs. In informal settings, caring for someone with dementia can be literally a full-time job. Thus, brain health will be key in terms of the costs and hours involved in informal caregiving.

In the formal sector, there are coming shortages in geriatricians and

direct care workers. The United States currently has 7,000 geriatricians, and trends suggest that number will decline by 2030, when projected need will rise to 30,000 geriatricians. Current shortages in direct care workers for home care services and nursing home care are also significant and expected to grow.

Considering the future supply of informal and formal care is important because it focuses attention on potential interventions to increase supply. It also highlights the importance of making the most of what is available, particularly improving the performance of geriatricians and other care providers in the gray areas of decision making regarding care for older patients. Improved training, clearer guidelines, and different pay incentives could both improve outcomes and lower costs. There is also a great potential to coordinate the formal and informal care systems, especially through such technology as telemedicine and e-consultations. This would extend the caregiving network and could improve outcomes while decreasing costs. Research is also now being conducted to understand the determinants of the well-being of informal caregivers and ways to intervene to maintain it. Supporting informal caregivers with new technologies could make them more effective and efficient. The training of geriatricians and other caregivers also needs further study to increase recruitment and retention and improve decision making.

Langa grouped the research agenda into three questions:

1. What are the trends in the prevalence of disability, and will disability be more compressed toward the end of life as the society ages?
2. What is the right amount of care for older patients in general, and older patients near the end of life in particular?
3. What caregiving resources, both paid and unpaid, will be available for older adults with disability and chronic disease?

AN INTERNATIONAL PERSPECTIVE

Andrew Mason
Department of Economics
University of Hawaii at Manoa

Different societies provide for the economic needs of the elderly via a mix of public resources, private assets, and family transfers. Relying on data from the National Transfer Accounts Project, Mason traced patterns in health consumption and its finance, the labor income of older individuals, and the funding of the life-cycle deficit—that is, the gap between consumption and labor income.

Japan, which has the oldest population in the world and is among the most rapidly aging, may be used to illustrate trends that are also occurring elsewhere. Consumption, which rises at the end of life, is a trend that is accelerating. The increase comes from spending on health care. These trends raise two questions: What steps can be taken to provide for and control health care spending at the end of life? And can policies raise the labor income of the elderly by increasing the age of retirement and increasing the productivity of older workers?

Turning to the composition of health care spending, data on publicly and privately funded health consumption from age 55 to over age 90 in several countries can be compared. Public spending on health in the industrialized countries is high and steeply increasing with age. In this, the United States is similar to Germany and Japan, but the United States stands out from other industrialized nations in its large private spending on health. In this, it more closely parallels some developing countries, such as Uruguay, Chile, and Brazil. Other industrial nations, such as Austria or Finland, have less private spending on health than the United States.

The same data sets yield information on labor income as a percentage of consumption for elderly people in several countries. On average, for those age 65 and older, 17 percent of their consumption is funded by their labor income. Countries with a higher average are the Philippines (38.9 percent) China (35.5 percent), and Kenya (34.2 percent). However, given the multiple differences between these societies and the United States, these patterns do not provide much guidance for the nation.

By contrast, among high-income industrial economies, a far smaller portion of consumption by older people is funded by their labor income. In Austria, the figure is 1.8 percent of consumption, in Germany it is 3.2 percent, and in the United States it is 15 percent. While this is far better than Austria or Germany, Mason observed, the developing countries are "starting from a very bad position, and it is going to take a revolution in employment amongst older workers and what they are paid in order to make much headway about the gap between what they consume and what they produce."

Thus, for the foreseeable future, closing the life-cycle deficit with labor income will not be feasible. It will be covered instead by three types of reallocations. One is asset-based reallocations, in the form of either asset income or dissaving. In actuality, Mason said, this is almost entirely asset income; dissaving is rarely observed. Another form of reallocation is net public transfers, in the form of goods and services provided through the public sector, cash transfers such as pensions, and lower taxes for the elderly. Finally, there are private transfers, either net interhousehold or net intrahousehold transfers.

Mason then discussed the share of the life-cycle deficit over age 65 that is funded by private assets, public transfers, and private transfers in a number of countries. Taiwan is the sole economy that comes close to funding the life-cycle deficit equally from the three sources. No country relies solely on family transfers, although they are a relevant component of funding the life-cycle deficit in Asian countries. Most countries depend primarily on a mix of personal assets and public transfers. Those that rely most on public transfers include Austria, Finland, and Germany, as well as Japan and Costa Rica. The United States is unique among highly industrialized countries in relying more on private assets and less on public transfers. This is a result of its employment-based pension system. Developing countries rely far more on private assets to fund the life-cycle deficit. The Philippines is particularly notable for its reliance on private assets, but this may not be supporting a very high level of consumption.

This support system also changes as people age further. In general, asset-based reallocations decline and transfers increase with age. Public transfers tend to increase in Austria, Germany, and the United States, whereas family transfers increase in Costa Rica, Japan, Mexico, South Korea, and Thailand.

Mason proposed three questions regarding the funding of the life-cycle deficit via asset-based reallocations, public transfers, and private transfers:

1. Which of these reallocation systems work? Which are sustainable? What incentives and disincentives does each system create for the timing of retirement, the quantity of saving, and investment in human capital?
2. Do the reallocation systems vary in their risk-sharing features?
3. Which reallocation systems are least able to adapt to population aging?

6

Social Institutions and Policies

The impressive improvement in health and increases in longevity suggest a need to rethink the timing of major life events, such as education, raising a family, career and retirement. This will entail changes and flexibility in institutions, policies, and social norms and expectations.

WILL INSTITUTIONS AND POLICIES PERMIT SUFFICIENT FLEXIBILITY?

Phyllis Moen
Department of Sociology
University of Minnesota

Phyllis Moen explored flexibility (e.g., alternative work arrangements), structural lags (e.g., outdated institutions), and structural leads (e.g., innovative social policies). From the perspective of individuals and families, flexibility can mean more options and greater control over the life course, including the pathways of education, career, retirement, and civic engagement. From the perspective of businesses, however, flexibility or "flexibilization" can include contract work, temporary work, unpaid furloughs, layoffs, and forced retirements. This type of flexibilization, coupled with technological and global economic change, can result in rising demands on time, increased productivity expectations, and increased job and economic insecurity for workers and families.

Will social institutions help people meet these challenges and adjust their major life activities as longevity increases? Moen expressed several criticisms of outdated institutions and age-graded policies that perpetuate age stratifications and limit flexibility regarding work hours and life trajectories.

Addressing issues of aging and increased longevity, she questioned whether existing lagging policies and outdated institutions push people into retirement; limit their life planning; preclude encore activities in education, paid work, or civic engagement; and increase insecurity and uncertainty as well as health, isolation, and poverty risks. She further questioned whether the impacts of a global information economy combined with the new flexibilization of work will open or limit options for workers. She also speculated on whether and how current standard age schema precipitate transitions and limit options in the second half of the adult life course.

Several policies and institutions reify social patterns despite new emerging social goals. People need to work longer, yet rigid and outdated policies and practices continue to keep everyone on a lockstep path rather than enabling them to define flexible paths to retirement. Such flexible paths might include part-time work, encore careers, or productive civic engagement. Similarly, despite much attention to lifelong learning as a means to improve labor productivity, education continues to be presented as appropriate to earlier years, with college brochures featuring people in their 20s. Insisting on a standard 40-hour work week is another institutional rigidity. Part-time work is possible, but those who engage in it pay a price in lower wages, less training, and fewer promotions.

Social flux presents many challenges. In Moen's view, "we are living on a moving platform of change and structural lag so that what we know may or may not still be relevant." There are several elements of the moving platform of change. The current population includes the first generation with married women retiring in significant numbers. Models and expectations developed for men may not be predictive of women's behavior. There is also greater variation in the timing and completeness of exit from the labor force. What used to be considered a normal retirement—that is, full retirement after a single full-time continuous career—is no longer as common, although alternative paths are not yet clearly defined. Moen wondered how such change is affecting the self-concept, preferences, and decision making of older workers and retirees at different ages and stages. Existing evidence on prior trends in age-related activities may not be relevant to emerging trends. Furthermore, consideration is needed of how the concepts, categories, data, and models of a previous period should be updated.

Although institutions and policies lag, baby boomers are making adap-

tations to social change and changes in their career paths and work lives. They often do not plan adequately, and couples tend to accommodate to the husband's rather than the wife's transition plans, for example, regarding the timing of retirement. Baby boomers also pursue self-employment and part-time work. They maintain engagement in meaningful paid and unpaid work. And they reduce the intensity of job demands by shifting the relative amounts of time in these different activities.

Structural leads, rather than structural lags, will help people adapt to the moving platform of change. Moen posed two questions regarding structural leads: What organizations and agencies are introducing transformative flexible innovations in career paths, retirement options, education and training opportunities, and civic engagement? And what innovative policies regarding work time, retirement age, health care, education, and incomes would promote alternative and flexible paths and thus promote a better fit to changing life courses?

Characterizing the current moment as a perfect opportunity rather than a perfect storm, Moen offered three possible avenues for change: reframe the standard duration of work days, work weeks and work lives; develop new standards or norms regarding work sabbaticals at all life stages; and facilitate possibilities for second, third, or fourth acts in schooling, civic engagement, and employment for people of all ages. Across the spectrum, she sees a need for social insurance and skill upgrades to respond to the risks and transitions in the world labor market.

Moen identified three research questions addressing institutional flexibility and an aging population:

1. What are the impacts of a global information economy combined with the new flexibilization of work?
2. How is the deinstitutionalization of normal retirement affecting the self-concept, expectations, preferences, and decision making of older workers and retirees at different ages and stages?
3. What policy innovations regarding work time, retirement age, health care, education, and income can promote a good fit over the changing life course and the pursuit of alternative, flexible paths?

THE GROWING IMPERATIVE FOR STRUCTURAL CHANGE

Richard V. Burkhauser
Department of Policy Analysis and Management
Cornell University

The disjuncture between outdated institutions and current reality may be traced to a different source. Social Security was established to protect

people from a specific risk: that they would live too long. The structures created to deal with that risk are fine. The problem, rather, is that society is no longer abiding by the implicit contract. People are living too long. The simple solution, he joked, is that people all agree to die at the same age as their parents. "If we did that, we wouldn't have to change our systems at all. They would be really perfect and we could go on in equilibrium." However, people are living longer than their parents. They are more educated, in better health, and capable of productivity at later ages. Thus, attempting to save Social Security as we know it is not the right goal, because we are not the same people for whom that institution was built. It is time to change Social Security and other outdated institutions and policies.

Matilda White Riley defined structural lag as "the inertial tendency of social structures to persist rather than respond to the changing needs and characteristics of individuals, creating a continuing tension between people and the structures in which their lives are embedded." Considering structural lag as it concerns institutions and population aging, Burkhauser posed four questions: (1) Can society afford to grow old without changing current institutions and policies? (2) Are institutions and policies changing? (3) Are people responding to these changes? (4) Has society reached equilibrium, or is more change necessary?

The country cannot afford to grow old with its existing institutions. The burden on workers is growing as the number of beneficiaries per worker increases. Demographic changes mean that the United States has gone from four workers per beneficiary in 1965 to a projected two workers per beneficiary in 2030. Social Security payments face a shortfall in the future, and when Medicare and Medicaid are added, the picture will be "unimaginably bad."

The good news is that this scenario need not occur. Echoing other presenters, Burkhauser said the solution is for people to work longer over their increasing lifetimes. And indeed, people are already changing their behavior. The participation of men over age 65 in the labor force had been declining in the latter half of the 20th century. That trend has stabilized, and the labor force participation of men over age 65 has begun to increase. Women's labor force participation has also seen a tremendous increase, including among women over age 65.

What explains labor force exits at relatively young ages? Although there are several possible answers, one very important reason may be disability policies that create perverse incentives. Noting a "gradual but profound decline in the employment of those people who have disabilities," Burkhauser suggested there are valuable lessons to be learned from policy change in the Netherlands. When policy reforms made it more

possible to receive disability payments, the Netherlands saw a dramatic rise in the number of individuals claiming disability.

A similar story unfolded in the United States following welfare reform in 1993, in which states gained responsibility for welfare. States can get people off their rolls in two ways. One is to invest in them, train them, and help them join the workforce. The other is to classify them as disabled and shift them onto federal disability rolls. States have an interest in expanding the rolls of persons with disabilities so as to shift the burden to the federal government. Burkhauser argued that these rises in disability rates resulted from bad policies that create perverse incentives to claim disability, not increases in actual disability rates.

In another example, in the 1980s, Medicare was switched from being the first provider of insurance at older ages to second provider. That is, if an individual was employed after age 65 and had private employer-sponsored health benefits, then Medicare paid only the residual after those benefits were used. People over age 65 have higher health costs. For a firm that provides health insurance, it is much more expensive to hire an older than a younger person. Fewer jobs are therefore available to older workers in such firms.

Burkhauser offered these as examples of "the unintended consequences of changing policies that we need to think more carefully about." He added, "when we set up our systems, when we think about our institutions, we have to think about incentives that those institutions set up for contracts between employers and employees."

In identifying the most important questions in this area, Burkhauser asked:

- What are the behavioral and distributional consequences of raising the Social Security early retirement age?
- What are the behavioral and distributional consequences of shifting to more prowork strategies for working-age people with disabilities?
- What are the behavioral and distributional consequences of changing the way health insurance is purchased and provided?

7

Community Responses

The physical and social aspects of communities will be very relevant to the experience of aging individuals and will be affected by these individuals' needs, limitations, and resources. Transportation, housing, technology, and social services all need to adapt to the changes that will accompany an aging population.

TRANSPORTATION

Sandra Rosenbloom
University of Arizona

The realities of the transportation sector can be examined by first exposing a few widespread myths. The first one is that older people who do not drive take public transportation—this is not the case. Older people who can drive do so, and those who cannot drive ride with others as passengers or they walk. Even people with disabilities rely on the car as either a driver or a passenger. Older people are not major users of public transit. In 2001, public transit accounted for less than 1 percent of all the trips taken by drivers over age 65 and about 10 percent of trips by nondrivers over age 65. The car, by contrast, was the mode of transportation in over 90 percent of trips for drivers over age 65 and about 65 percent of trips for nondrivers over age 65. Walking was the mode of travel for 7 percent of trips among drivers and about 25 percent among nondrivers over age 65. Older people currently account for nearly 15 percent of all drivers in the

United States, and this will increase to about 25 percent in 2030. That figure will be even greater in states with a higher percentage of older people. The importance of these observations is that policy needs to focus on the right issues. If people remain committed to the myth that older people rely on public transit, policies will not address reality.

A second myth is that travel differences between genders are narrowing—this also is not so. Women take fewer trips, travel fewer miles, and drive less than men. These gaps are widening. When they do travel in cars, women are in the passenger seat. This has significant implications for the mobility of aging women and for their safety as drivers. What makes older drivers dangerous is that they drive less. The more one drives, the safer a driver one is. Women report such reasons as anxiety, not medical causes, for giving up driving. Women stop driving earlier and for less specific reasons than men; by contrast, the precipitating event for a man to give up driving is the third stroke or heart attack. Women at all ages are safer drivers and have lower crash rates than men, but they are more likely to be killed in comparable crashes. This is because vehicles have been designed for men. The anthropomorphic dummies used in safety tests were based on male bodies, with implications for torso size and strength. Cars are not designed for women, although they could be, with the aims of reducing anxiety and increasing physical safety. Women respond to traffic safety messages differently and are less comfortable in vehicles and more often need vehicle adjustments. The significance of toppling this myth is that if vehicles and roadways continue to be designed for only a portion of the driving population, that design will not be improving the mobility and safety of all.

A third myth is that older people live in or will move back to central cities—also is false. Currently, 75 percent of older people live in low-density or rural areas, and the trend is increasing. When older people move, they tend to move outward, to lower density suburbs. Retirement communities are being built on the outskirts of metropolitan areas, in locations without ready access to public transit.

A fourth myth is that older drivers are dangerous and have more crashes and that older women drivers are even worse. None of this reflects reality. Per capita, until about age 80 or 85, older people have fewer accidents. And indeed, older drivers are never worse than teenagers. Older people do, however, have higher fatality rates in crashes due to their overall greater fragility. Older people are more likely to die in crashes of comparable severity than younger people, and older women are much more likely to die in crashes of comparable severity than men.

All of these myths need to be dispelled so that sound policies are based on reality. When it comes to transportation practices and the safety of older men and women, customary assumptions are often false. Design-

ing for people as they are requires new research, policies, and design. Because older people drive, it is important to direct efforts at making driving safe for them. Since walking rather than public transit is the actual alternative to driving, pedestrian facilities also need to be improved with older people in mind. Rosenbloom proposed several questions warranting further investigation, including:

- What vehicle and roadway characteristics would keep older people driving safer longer?
- What pedestrian facilities would be genuinely helpful to older people?

Research on vehicle and roadway characteristics includes attention to every aspect of driving, including drivers, vehicles, roadways, signage, and the like. Many of these will differ by sex, because women need different characteristics in the car and roadway than men in order to be safe, confident, and comfortable drivers. Efforts are needed to improve ease and comfort in driving, prevent crashes, and improve crash outcomes.

Regarding pedestrian facilities, it has been presumed that people will consistently engage in walking only if it is purposeful (for example, to a grocery store). Thus if people do not live in communities where they can do purposeful walking, engineering for walking is considered a waste of time. However, recent studies suggest that people who walk for leisure are actually doing it more than people who walk for purpose. People living in adult retirement communities, for example, walk more than people living in central cities. More research is needed on why older people who walk are doing so. Safety and security are key issues: older people drive to malls to walk because malls provide safety and security. Proper research questions, then, would address their safety and security concerns. This might include enforcement of existing traffic laws. The provision of a physical environment that facilitates walking in suburbs where people are aging in place is another priority. This includes sidewalks and lowered curbs. For crossing streets, crosswalks with islands in the middle or the means to extend the walk signal (which are usually timed for how long it takes an 18- to 24-year-old to cross) can make a significant difference for older pedestrians. Separating bicyclists and skaters from pedestrians is also important, as these can also be hazards for older people.

"As long as we're not dealing with these kinds of micro-issues in the pedestrian environment and the auto environment," Rosenbloom concluded, "we're dooming a lot of older people to immobility. And we need to deal with the real issues and not the issues that we think are the problem."

TECHNOLOGY, AGING, AND INNOVATION

Joseph F. Coughlin
AgeLab
Massachusetts Institute of Technology

How can communities monitor, manage, and motivate older people? New technologies will play a role, but much of the technological innovation is already accomplished or in process. Lags in organizational capacity and national policy are far more worrisome. Coughlin presented three areas of inquiry:

1. Do current public and private aging service providers have the organizational capacity to meet new aging demands and utilize new technologies and processes? Are the caring professions getting the relevant training, and are service providers developing innovative business models to deliver the new services?
2. How might national policy facilitate innovation in aging products and services (e.g., user-centered design, technology development, engineering, creative delivery systems)?
3. How do societies and individuals address policy lag and the difference between what technology can do versus what people want done?

With these questions in mind, increased longevity may be viewed as a systems success. The increase in longevity has been achieved due to multiple public systems, including clean water delivery, sanitation, delivery of health care services, and medical technology. A similar systems approach can be applied to the challenges of global population aging. Society needs to think about multiple integrated systems that will allow people to live well across the entire life span.

Currently, systems are fragmented. Even when the needs of an aging population are anticipated, they are not being acted on. For example, an ongoing survey of metropolitan planning organizations reveals that professional planners are well aware that the aging population will need a different transportation system. Nonetheless, they confirm that their regions are not adequately funding changes in infrastructure, vehicles, or services to meet those needs.

An integrated systems approach would match technological innovations to needs across the life span, including quality aging. Older adults have a pyramid of needs that might be addressed by appropriate technological innovations. At the bottom tier are health needs, which could be matched by telemedicine and a range of aids that assist patients in making decisions about their health care. At the next tier, the need for safety is

matched by smart housing, personal emergency response systems, and ubiquitous health monitoring. Proceeding up the pyramid, the need for connectivity addresses people's desire to lead meaningful lives and connect with others. Relevant innovations at this tier include communication technologies, transportation alternatives, and livable communities. The need to make a contribution—perhaps by working, whether full- or part-time; volunteering and civic engagement; or caring for grandchildren—occupies the penultimate tier of the pyramid. Education technologies and methods of cognitive enhancement would help meet this need. At the pinnacle of the pyramid is the need to leave a legacy. Cross-generation learning and creative media models will facilitate this.

Technology-enabled innovations and intelligent devices will also affect people's lives as they age. Many of these are already available and in use. They include shirts with sensors that can perform an electrocardiogram, implantable sensors that monitor blood pressure, and devices in cars that monitor the physiological functions of the driver. Spoons have been developed that can measure the viscosity of fat content and send the calorie count via the Internet to a doctor, family member, or other caregiver. Smart toilets evaluate stool and urine for glucose count and fiber content, uploading that information via the Internet. Specially equipped stuffed animals can monitor blood pressure and provide reminders to take medications. Smart grocery carts take personal diet and health data and provide information relevant to deciding on purchases by scanning products and evaluating them in light of an individual's health history. "The idea," according to Coughlin, "is the right information at the right time to make the right choice."

This technology goes nowhere without an equally smart business model. For example, stuffed animals that monitor blood pressure are provided free by Panasonic to customers of Tokyo Electric Power who are part of a program to monitor congestive heart failure. The device connects 60,000 households in the metropolitan Tokyo area to Tokyo University Hospital for monitoring. The household pays a service fee for the health monitoring. As this kind of monitoring becomes ubiquitous in homes, retail sites, and transportation, the biggest asset of the private sector, its supply chain and logistic platforms, needs to be fully used. Coughlin urged, "Wal-Mart, Rite Aid, CVS, these places have supply chains and presence and trust in places we can't even begin to dream of."

These technologies have had various rates of penetration. For example, a fast-growing segment of social networking via the Internet involves baby boomers looking for information and advice on health, caregiving, and financial management. Virtual communities addressing health are on the rise. Televisions and cell phones also facilitate penetration. Using these, an individual can get a consultation with a dietitian, or measure

blood pressure and glucose level, or send health information to caregivers. Platforms to collect and report key bio-vital data are multiplying. Their widespread distribution will enable individuals to get useful consultations with professionals as needed and allow absent caregivers to monitor their elderly charges.

Several nations are investing in such technological innovation and the organizational capacity to deliver it. The United Kingdom is a top investor in organizational capacity (e.g., the processes, procedures, and information technology to improve delivery systems), whereas Singapore invests heavily in technology (e.g., the development of new devices to improve the health and well-being of older adults). For example, the United Kingdom initiated a multibillion-pound sterling investment in a new information technology infrastructure to improve efficiencies in the National Health Service for scheduling, movement of test results, etc. One of the most noted symbols of this investment is the provision of a personal computer to every primary care physician. Although it looks like a technology investment, it is actually an investment in the current capacity to deliver care. Japan is high on investments in both technology and organizational capacity; the United States remains low on both. The United States needs to invest far more robustly in both technological innovations and in the training of how to use them.

Professional caregivers, including doctors, nurses, and social workers, should be trained in the use of technologies relevant to the care of older people. The educational structure in the health professions needs to be restructured, Coughlin argued, to incorporate attention to technology. "If we don't stop calling telemedicine 'telemedicine,' until we call it medicine, it's always going to be something different and out of the ordinary."

Technological innovations will also figure in ethical debates about individual and public health. If people make poor health choices or engage in poor health behaviors, despite the assistance of technology to provide full and correct information at the point of decision or to facilitate healthier behaviors, then what is the responsibility of society to that individual? How will the social contract around longevity be rewritten? With technologies that can monitor behavior, such as food purchases or driving practices or basic mobility, Coughlin cautioned, "Be careful what you ask for, we may actually deliver it."

Coughlin closed with four questions for research and public policy regarding aging and technological innovation.

1. Acceptability: Does society want to make use of these new technologies? Some of them raise issues of desirability, such as privacy, independence, and dignity.

2. Availability: What are the best ways to make new technologies widely available?
3. Adequacy: How ready are public and private institutions to integrate new technologies, for example in education, clinical management, and service delivery?
4. Affordability: How does one ensure that new technologies are equitably distributed for the broadest social benefit, across income brackets, cultures, and education levels?

In subsequent discussion, Coughlin responded to a geriatrician who expressed reservations about the flood of extraneous data provided by the new monitoring technologies. As a provider, this speaker remarked, these technologies are "in a sense, my worst nightmare." Coughlin concurred that the situation can become "data, data everywhere and not a drop of knowledge," noting that technology often solves one problem and creates two more. Data visualization and translation are the next challenges. He sees a need for a new level of professional dedicated to translating data into knowledge. The distillation of information at different levels will be imperative so that it can be of greatest use to the physician, the intermediary caregiver, and the patient.

In responding to a question about end-users and the distribution of these new technologies, Coughlin noted that the consumer is often not the older adult, but rather his or her caregiver. The technologies thus have implications for the labor force participation of caregivers. Adult children or other informal caregivers will be able to remain uninterrupted at work while monitoring an aged parent or other older adult.

8

Summary Discussion

REACTION OF DISCUSSANTS

Five discussants offered perspectives on the grand challenges of an aging society. They were followed by a final general discussion among all panelists and members of the audience.

Robert Binstock of Case Western Reserve University criticized the "merchants of doom" who predict intergenerational conflict as old and young compete for scarce resources. He takes a different view. Because elderly people are embedded in their families, communities, and society, he argued, old-age policies are in effect family policies, affecting the whole social fabric. Social Security benefits and other retirement income allow seniors to care for grandchildren; proper health care for older people affects not only these individuals but also their families and communities in many ways. Binstock concluded, "Most of us, of all ages, have a stake in old-age policies. Social Security, Medicare, and Medicaid are not luxurious government benefits for a group of Americans who are presently depicted in public rhetoric as if they were a separate selfish tribe of the elderly. Reframing our understanding of the social contract in these terms, I think, is a major challenge for our aging society." Binstock suggested that a relevant research initiative would be to document the extent to which so-called old-age benefits actually benefit all generations.

Robert Butler, reflecting on what he'd heard over the course of the symposium, noted that longevity is a real human achievement, and the years gained are healthy ones. Nonetheless, many of the topics discussed point to grave problems. The financial grounding of baby boomers is

inadequate; the labor market is not accommodating to older workers; obesity and lack of exercise continue to be problems; the training of doctors—whether in the gray areas of decision making, new technologies, or palliative care—is lacking; and communities are not up to providing the transportation and other services that older people need. Thus, Butler summarized, the baby boomers are not prepared for aging, and society is not prepared for them. Addressing this lack of preparedness is the immediate challenge. Butler also recommended further research on the interrelationship of health and wealth. His final suggestion was much greater attention to and funding for longitudinal studies so as to ground a life-course perspective on many issues of physical and cognitive health, income and productivity, meaning and engagement, and community involvement over the entire life span.

James Jackson of the University of Michigan offered several observations and insights. He noted that many of the symposium presentations had addressed averages, with insufficient attention to the profound heterogeneity of the aging population. He also remarked that the age grading of society will change because of both increased longevity and declining fertility. Thus, not only will people live longer, but they will live in a radically different society—a situation that merits further appreciation. Jackson's third emphasis was on the myriad connections and mutual influences of global flows in trade, capital, and migration as well as intergenerational linkages. He then underscored the importance of a life-course perspective and consideration of cohort and period events that occur to different groups as they age over a particular point. Jackson also discussed the inadequacy of models that assume people behave rationally. In practice, individuals and families make decisions without full information or without using the information they do have well. That will affect how they handle the problems and challenges of an aging society. Jackson also asserted that as society has "essentialized" certain ages (such as 62 for early retirement, 65 for full retirement), this has precluded thinking in new ways about retirement and other issues. Similarly, he suggested a rethinking of retirement as a status. If only people who are economically productive are valued, where does that leave retirees? Jackson suggested further thinking about the different reasons for exiting retirement, ranging from economic necessity to self-actualization, since these would result in very different experiences. Finally, Jackson urged that synchrony be improved at all levels—between policies and programs, between state and federal programs, between diverse policies targeting any one age group, or between policies addressing different age groups. It is important to think about how these all go together and "impact people as they traverse their life courses, as families traverse their life courses, and indeed, as institutions change as we become an aging society."

Barbara Torrey of the Population Reference Bureau mentioned several possible theoretical avenues of policy action and research suggested by symposium presentations. Some of the suggestions would influence behavior without technology, through information and incentives. For example, noting that people generally fail to consider or prepare end-of-life directives, Torrey speculated that this could be a requirement for getting a driver's license. Or perhaps the annual mailing from the Social Security Administration estimating an individual's benefits at different retirement ages could also offer varying estimates of life expectancy for that individual reflecting different health behaviors, such as excessive weight gain or tobacco use. Overuse of health care at the end of life might be addressed by requiring some reimbursement from the deceased's estate for the final six months of care. Such a controversial policy might change family attitudes toward miracles, she suggested. Torrey identified several areas meriting further research, including housing as a vital asset for the elderly and how to tap it, obesity and future disability rates, and the responses of the elderly around the world to economic upheaval. She also drew attention to the imperative of addressing the immigration of health care workers who have been trained in the developing world. Their services are essential; their countries of origin should be compensated for training.

Axel Börsch-Supan also offered closing perspectives, underscoring in part the research agenda he had earlier outlined. These include the study of age and productivity: Is it economically profitable to work to age 75? What happens at age 30 or 40 to make people more productive at older ages? What is the gap between productivity and payment at older ages? What is the actual impact of part-time work on productivity, particularly at older ages? The topic of age and saving is also a major one, including how to develop more accurate models of savings behavior and how to translate those models into policies. Global aging merits attention, from modeling the effects of international spillovers to making international comparisons regarding natural demographics or institutional change. Börsch-Supan raised two further points. He highlighted the need for much greater study of aging and inequality, encompassing both how inequalities in income, health, and education interact over the individual life course and the implication of inequality for macroeconomic growth.

A final essential issue, Börsch-Supan acknowledged, is the structural lag of institutions and the inability to reform them as well as the structural lag in behavior. While human beings learn some things very quickly, others things require generations to learn. Thus, "if we have three trials and then finally get it right, 100 years have passed." This may be acceptable in some areas, but not, for example, in Social Security or health care. With population aging as with climate change, the process is occurring faster

than people's learning process. To meet the dramatic challenges posed by an aging society, Börsch-Supan observed, people are going to have to learn faster.

GENERAL AUDIENCE DISCUSSION

The general audience discussion that followed returned to many of the themes that had been raised over the two days of the symposium. One theme was social change, particularly the frustrations around institutional lag and the mysteries of promoting individual change across society. In discussion, presenters and participants alike drew attention to the delay in institutions in adapting to changes in social reality. Institutional lags are seen as hampering efforts to define or implement new policy. They perpetuate incentives that are no longer appropriate under conditions that have changed substantially from when the institutions were established. They limit and rigidify options for human behavior and choice. Furthermore, lagging institutions become a distraction to change, as efforts are misdirected toward preserving inherited institutions rather than creating new ones to address current challenges.

Promoting change in individual behavior can be equally challenging. Despite substantial knowledge regarding what constitutes healthy behavior or wise economic choices, and despite carefully designed interventions and programs, people often do not act rationally, do not make the necessary changes, or do not maintain positive changes once they are achieved. In the final discussion, one participant referred to this recurring theme and thought a cross-disciplinary study of behavior change, incorporating work from psychology, economics, medicine, engineering, and other fields, would be useful. The need for more longitudinal studies was also affirmed.

Another theme was a concern with heterogeneity and inequality. This included diversity across culture, citizenship status, health, income, education, gender, technology use, transportation use, and many other factors. Many symposium participants expressed a sense that neither current research nor current policies are giving adequate attention to heterogeneity and inequality, particularly how inequalities can be exacerbated across a life course. Many of the challenges of aging will be amplified for those with fewer means, worse health, less education, or weaker social networks. Policies to deal with health care financing or labor force participation, medical approaches to disabilities, even the design of communication technologies will need to take social inequalities into account. Enduring inequalities also have macroeconomic and social implications for aging populations.

A final theme was the importance of taking a life-course perspective.

Investments in health and education in early and middle age have a continuing profound effect on later life span, productivity, and physical and cognitive health. Access to health care at earlier ages influences the need for health intervention at later ages. Healthy behaviors are necessary and effective over the entire life span. Policies to promote healthy and productive aging should address individuals at all points in their lives. In the final discussion, a life-course perspective was also urged as an antidote to concern over potential intergenerational conflict. When the possibility was raised that scarce resources might become the subject of a zero-sum struggle between older and younger generations, several participants and panelists advocated greater attention to the intergenerational spillover effects that result from programs and resources designed to benefit older persons. They cited broad data that intergenerational conflict over budget resources are not occurring, as well as the results of specific programs in which, for example, resources provided to grandmothers generate improved outcomes for grandchildren. In effect, these speakers advocated taking a life-course perspective to families, communities, and societies as well as to aging individuals.

Appendix A

Agenda

THE GRAND CHALLENGES OF OUR AGING SOCIETY: A SYMPOSIUM

THURSDAY, MAY 28

8:30–9:00 a.m. **Welcome and Background**
Ronald Lee, University of California, Berkeley, Chair of Symposium Planning Committee

9:00–10:45 a.m. **How can biological research, medical advances, and ethical considerations inform health care decisions?**

Health span and life span—*Richard Miller,* University of Michigan
Frailty—*Linda Fried,* Columbia University
Judicious use of resources—*David Reuben*, University of California, Los Angeles

Discussion/Q&A

10:45–11:00 a.m. **Break**

11:00 a.m.–12:30 p.m. **What steps can individuals and society undertake to enhance healthy aging?**

An introduction to health promotion—*Robert Butler*, International Longevity Center

Exercise and cognition—*Arthur Kramer,* University of Illinois at Urbana-Champaign
Racial disparities and communication—*M. Chris Gibbons*, Johns Hopkins University
Obesity in older persons—*Gordon L. Jensen*, Pennsylvania State University

Discussion/Q&A

12:30–1:15 p.m. **Lunch**

1:15–3:00 p.m. **What will be the macroeconomic and financial impacts of an aging society?**

General macroeconomic impact—*Axel Börsch-Supan,* Mannheim Research Institute for the Economics of Aging
Financial impact—*Robin Brooks,* Brevan Howard Asset Management, LLP
International perspective—*David Canning*, Harvard University

Discussion/Q&A

3:00–3:15 p.m. **Break**

3:15–5:00 p.m. **How will income security and health care financing programs be affected by the aging of the population, and how should they be changed?**

Income security—*Alicia Munnell,* Boston College
Health and long-term care—*Kenneth Langa,* University of Michigan
International perspective—*Andrew Mason,* University of Hawaii at Manoa

Discussion/Q&A

5:00–6:00 p.m. **Reception—The Great Hall**

FRIDAY, MAY 29

8:30–8:45 a.m. **Welcome and Overview of Day**
Ronald Lee, University of California, Berkeley, Chair of Symposium Planning Committee

8:45–10:30 a.m. **Will our institutions and policies permit sufficient flexibility in the timing of major life activities as life span increases?**

Social perspective—*Phyllis Moen*, University of Minnesota
Economic perspective—*Richard Burkhauser*, Cornell University

Discussion/Q&A

10:30–10:45 a.m. **Break**

10:45 a.m.–12:15 p.m. **In what ways will our communities be affected by an aging society and how should they respond?**

Social perspective—*Sandra Rosenbloom,* University of Arizona
Physical perspective—*Joseph Coughlin*, Massachusetts Institute of Technology

Discussion/Q&A

12:15–1:00 p.m. **Lunch**

1:00–2:30 p.m. **Summary Discussion: What topics would benefit from studies conducted by the National Academies?**

- *Robert Binstock,* Case Western Reserve University
- *Robert Butler,* International Longevity Center
- *James Jackson,* University of Michigan
- *Barbara Torrey,* Population Reference Bureau
- *Axel Börsch-Supan,* Mannheim Research Institute for the Economics of Aging

2:30 p.m. **Adjourn**

Appendix B

Selected Recent National Academies Publications on Aging Issues

America's Uninsured Crisis: Consequences for Health and Health Care (2009)
http://www.nap.edu/catalog.php?record_id=12511

Differences Between Older Female and Male Drivers in Response to Safety Interventions (2009)
http://pubsindex.trb.org/view.aspx?id=882444

Evaluation of Urban Travel Training for Older Adults (2009)
http://pubsindex.trb.org/view.aspx?id=881950

From Molecules to Minds: Challenges for the 21st Century: Workshop Summary (2008)
http://www.nap.edu/catalog.php?record_id=12220

The National Academies Keck Futures Initiative: The Future of Human Healthspan: Demography, Evolution, Medicine, and Bioengineering, Task Group Summaries (2008)
http://www.nap.edu/catalog.php?record_id=12084

Retooling for an Aging America: Building the Health Care Workforce (2008)
http://www.nap.edu/catalog.php?record_id=12089

Simulation Framework for Analysis of Elderly Mobility Policies (2008)
http://pubsindex.trb.org/view.aspx?id=847768

Biosocial Surveys (2007)
http://www.nap.edu/catalog.php?record_id=11939

Cancer in Elderly People: Workshop Proceedings (2007)
http://www.nap.edu/catalog.php?record_id=11869

The Future of Disability in America (2007)
http://www.nap.edu/catalog.php?record_id=11898

Aging in Sub-Saharan Africa: Recommendations for Furthering Research (2006)
http://www.nap.edu/catalog.php?record_id=11708

Increasing Elderly Mobility by 2025: Using National Household Travel Survey to Increase Mobility of Elderly Nondrivers (2006)
http://pubsindex.trb.org/view.aspx?id=776774

A Strategy for Assessing Science: Behavioral and Social Research on Aging (2006)
http://www.nap.edu/catalog.php?record_id=11788

When I'm 64 (2006)
http://books.nap.edu/catalog.php?record_id=11474

Safe Mobility for Older Americans (2005)
http://onlinepubs.trb.org/onlinepubs/conf/CPW2.pdf

Age-Related Disease, Mobility, and Driving (2004)
http://pubsindex.trb.org/view.aspx?id=702073

Critical Perspectives on Racial and Ethnic Differences in Health in Late Life (2004)
http://www.nap.edu/catalog.php?record_id=11086

Health and Safety Needs of Older Workers (2004)
http://www.nap.edu/catalog.php?record_id=10884

Hearing Loss: Determining Eligibility for Social Security Benefits (2004)
http://www.nap.edu/catalog.php?record_id=11099

Technology for Adaptive Aging (2004)
http://www.nap.edu/catalog.php?record_id=10857

Testosterone and Aging: Clinical Research Directions (2004)
http://www.nap.edu/catalog.php?record_id=10852

Transportation in An Aging Society: A Decade of Experience: Technical Papers and Reports from a Conference (2004)
http://pubsindex.trb.org/view.aspx?id=702068

Understanding Racial and Ethnic Differences in Health in Late Life: A Research Agenda (2004)
http://www.nap.edu/catalog.php?record_id=11036

Elder Mistreatment: Abuse, Neglect, and Exploitation in an Aging America (2003)
http://www.nap.edu/catalog.php?record_id=10406

Care Without Coverage: Too Little, Too Late (2002)
http://www.nap.edu/catalog.php?record_id=10367

Cells and Surveys: Should Biological Measures Be Included in Social Science Research? (2001)
http://www.nap.edu/catalog.php?record_id=9995

Improving the Quality of Long-Term Care (2001)
http://www.nap.edu/catalog.php?record_id=9611

New Horizons in Health: An Integrative Approach (2001)
http://www.nap.edu/catalog.php?record_id=10002

Preparing for an Aging World: The Case for Cross-National Research (2001)
http://www.nap.edu/catalog.php?record_id=10120

The Aging Mind: Opportunities in Cognitive Research (2000)
http://www.nap.edu/catalog.php?record_id=9783

Extending Medicare Coverage for Preventive and Other Services (2000)
http://www.nap.edu/catalog.php?record_id=9740

Improving Access to and Confidentiality of Research Data: Report of a Workshop (2000)
http://www.nap.edu/catalog.php?record_id=9958

The Role of Nutrition in Maintaining Health in the Nation's Elderly: Evaluating Coverage of Nutrition Services for the Medicare Population (2000)
http://www.nap.edu/catalog.php?record_id=9741

Intelligent Transportation Systems: A Two-Edged Sword for Older Drivers? (1999)
http://pubsindex.trb.org/view.aspx?id=512025

Appendix C

Biographical Sketches of Planning Committee Members and Presenters

Robert H. Binstock (*Planning Committee Member/Presenter*) is professor of aging, health, and society at Case Western Reserve University. His primary appointment is in the Department of Epidemiology and Biostatistics in the School of Medicine; he holds secondary appointments in the departments of Bioethics, Medicine, Political Science, and Sociology and in the School of Nursing. He has served as president of the Gerontological Society of America, director of a White House Task Force on Older Americans, and chairman and member of a number of advisory panels to federal, state, and local governments and foundations. He has published numerous articles, book chapters, monographs, and books, most of them dealing with politics and policies affecting aging. He has A.B. and Ph.D. degrees in political science from Harvard University.

Axel H. Börsch-Supan (*Presenter*) is the founding director of the Mannheim Research Institute for the Economics of Aging and professor of macroeconomics and public policy at the University of Mannheim. Previously he was assistant professor in the John F. Kennedy School of Government at Harvard University, then taught at both Dortmund and Dresden University in Germany before joining Mannheim. He has published widely on topics of applied econometrics, household saving, housing demand, retirement decisions, and the economic implications of aging. He is a member of the German National Academy of Sciences Leopoldina and the Academy of Sciences in Berlin-Brandenburg. He has a diploma in mathematics from the University of Bonn and a Ph.D. in economics from the Massachusetts Institute of Technology.

Robin Brooks (*Presenter*) is an economist and foreign exchange strategist at Brevan Howard Asset Management, LLP, a macro hedge fund. Previously he was a Brookings Institution research fellow. Before joining the International Monetary Fund as an economist, he worked in the Research Department, specializing in exchange rate misalignments, and in the Asia Pacific Department, where he worked on the countries of Philippines and Singapore. Earlier he was a vice president with Goldman Sachs Asset Management in New York. He has an undergraduate degree in monetary economics from the London School of Economics and a Ph.D. in economics from Yale University.

Richard V. Burkhauser (*Presenter*) is the Sarah Gibson Blanding professor of policy analysis in the Department of Policy Analysis and Management and professor of economics at Cornell University. He has published widely on the behavioral and distributional consequences of public policies targeted on vulnerable populations. He is the 2009 president-elect of the Association for Public Policy Analysis and Management. He has a Ph.D. in economics from the University of Chicago.

Robert N. Butler (*Planning Committee Member/Presenter*) is president and chief executive officer of the International Longevity Center and professor of geriatrics and adult development in the Brookdale Department of Geriatrics and Adult Development at Mount Sinai Medical Center. As a physician, gerontologist, psychiatrist, public servant, and Pulitzer Prize–winning author, he has long been involved in a broad array of social and health issues. He is an advocate for the medical and social needs and rights of the elderly and conducts research on healthy aging and the dementias. He has a B.A. from Columbia College and an M.D. from the College of Physicians and Surgeons of Columbia University.

Judith Campisi (*Planning Committee Member*) is a senior staff scientist in the Cell and Molecular Biology Department of the Lawrence Berkeley National Laboratory. Previously she was assistant and associate professor in biochemistry at the Boston University Medical School. Bridging the fields of cancer and aging, her work includes contributions to understanding the evolution and mechanisms of tumor suppression, the cellular damage responses of senescence and apoptosis, DNA repair mechanisms, telomere biology, and the role of genome maintenance systems in postponing aging and cancer. She has published numerous scholarly papers and has received several awards for her research. She has a Ph.D. from the State University of New York and did postdoctoral training at the Dana Farber Cancer Institute.

David Canning (*Presenter*) is deputy director of the Program on the Global Demography of Aging and heads the economics track of the doctoral program in population and international health in the Harvard School of Public Health. His research focuses on the role of demographic change and health improvements in economic development. Specifically, his research on demographic change focuses on the effect of changes in age structure on aggregate economic activity, as well as the effect of changes in longevity on economic behavior. In terms of health, his research focuses on health as a form of human capital and its effect on worker productivity. He has a B.A. in economics and mathematics from Queen's University Belfast and a Ph.D. in economics from Cambridge University.

Laura Carstensen (*Planning Committee Member*) is a licensed clinical psychologist and professor of psychology at Stanford University. Her research focuses on motivational and emotional changes in adulthood. Most recently, she has published research showing the ways in which motivational changes influence cognitive processing in older adults. In collaboration with Alan Garber, she is studying motivational influences on medical decision making. She is chair of the External Scientific Advisory Committee for the Max Planck Institute for Human Development in Berlin and, at the National Research Council, chaired the Committee on Aging Frontiers in Social Psychology, Personality, and Adult Developmental Psychology. In 2003, she was selected as a Guggenheim fellow. She has a B.S. from the University of Rochester and M.A. and Ph.D. degrees from West Virginia University.

Joseph F. Coughlin (*Planning Committee Member/Presenter*) is founder and director of the Massachusetts Institute of Technology AgeLab. It is the first multidisciplinary research program created to understand the behavior of the population over age 45, the role of technology, and the opportunity for innovations to improve the quality of life of older adults and their families. His own research focuses on how the convergence of baby boomer expectations and technology will shape the future of public policy and drive innovation across global industries—including the financial services, insurance, health, information technology, telecommunications, automobile, and retail sectors. In February 2008, the *Wall Street Journal* named him one of America's 12 pioneers inventing the future of retirement and aging. He has a Ph.D. from Boston University, an A.M. from Brown University, and a B.A. from the State University of New York.

Eileen Crimmins (*Planning Committee Member*) is associate dean of the Davis School of Gerontology and the Edna M. Jones professor of gerontology and sociology at the University of Southern California. Her

research interests focus on the demography of older populations, health, and mortality. Her research projects include one on the role of biological factors in determining differences in health by education and income level and another on healthy life expectancy in the older population. In addition, she is working on male-female differences in health and mortality as well as differences by gender in life stresses and strains. Crimmins is the director of the Center on Biodemography and Population Health. She has a B.A. in mathematics from Chestnut Hill College and M.A. and Ph.D. degrees in demography from the University of Pennsylvania.

Linda P. Fried (*Presenter*) is dean, DeLamar professor of public health, and professor of epidemiology in the Mailman School of Public Health at Columbia University. She is also professor of medicine at Columbia's College of Physicians and Surgeons. An expert in the fields of epidemiology and geriatrics, she has dedicated her career to the science of healthy aging, especially the prevention of frailty and disability. She conducts clinical and population-based research that focuses on health for an aging population, especially the causes, prevention, and care of chronic diseases and resulting disability and frailty in older adults. She has an M.D. from Rush Medical College and an M.P.H. from the School of Hygiene and Public Health at Johns Hopkins University.

M. Chris Gibbons (*Presenter*) is associate director of the Urban Health Institute and assistant professor in the Schools of Medicine and Public Health at Johns Hopkins University. He works primarily in the area of consumer health informatics, focusing on using health information and communications technologies to improve urban health care disparities. He is an adviser and expert consultant to several state and federal agencies and policy makers in the areas of urban health, e-health, minority health, and health care disparities. At the National Research Council, he is a member of the Committee on the Role of Human Factors in Home Health Care. He has an M.D. from the University of Alabama and an M.P.H. in health promotion among urban and disadvantaged populations from Johns Hopkins University.

Robert M. Hauser (*Planning Committee Member*) is Vilas research professor of sociology and director of the Center for Demography of Health and Aging at the University of Wisconsin–Madison. His research has included sociology and demography, aging and the life course, social and economic inequality, stratification and mobility, and cross-national and cross-temporal comparisons of intergenerational mobility. Since 1980, he has led the Wisconsin Longitudinal Study (WLS) and published dozens of reports based on its data. He is a fellow of the American Statistical Asso-

ciation and a member of the National Academy of Sciences. He has served on numerous National Research Council committees, including the Panel on Institutional Review Boards, Surveys, and Social Science Research and the Panel to Review the Statistical Procedures for the Decennial Census. He has a B.A. in economics from the University of Chicago and M.A. and Ph.D. degrees, both in sociology, from the University of Michigan.

James S. Jackson (*Planning Committee Member/Presenter*) is professor of psychology, health behavior, and health education in the School of Public Health at the University of Michigan, where he also is director of the Institute for Social Research. He studies immigration, race and ethnic relations, physical and mental health, adult development and aging, attitudes and attitude change, and black American politics. He directs the National Survey of American Life, a survey designed to document the physical, emotional, mental, structural, and economic conditions of black Americans. He serves on the Board of Scientific Counselors of the National Institute on Aging. He has a B.S. in psychology from Michigan State University, an M.A. in psychology from the University of Toledo, and a Ph.D. in social psychology from Wayne State University.

Gordon L. Jensen (*Presenter*) is professor and head of nutritional sciences at the Pennsylvania State University. He is also professor of medicine at the Hershey Medical Center and a specialist in nutrition with Centre Medical and Surgical Associates at the Mt. Nittany Medical Center. His research interests have focused largely on geriatric nutrition concerns, including nutrition screening and assessment for older persons and the impact of obesity on functional and health outcomes. He is past president of the American Society for Parenteral and Enteral Nutrition and past chair of the Medical Nutrition Council of the American Society for Nutrition. At the National Academies, he is a current member of the Food and Nutrition Board. He has an M.D. from Cornell University Medical College and a Ph.D. in nutritional biochemistry from Cornell University.

Arthur Kramer (*Presenter*) is Swanlund chair and professor of psychology and neuroscience at the University of Illinois. His research projects include topics in cognitive psychology, cognitive neuroscience, aging, and human factors. A major focus of his lab's recent research is the understanding and enhancement of cognitive and neural plasticity across the life span. He is the director of the Biomedical Imaging Center at the University of Illinois and Zukunftskolleg senior fellow at the University of Konstanz in Germany. He is a fellow of the American Psychological Association and the American Psychological Society, a member of the executive committee of the International Society of Attention and Performance, and a

recent recipient of a Ten Year MERIT Award from the National Institutes of Health. At the National Research Council, he was a member of the Committee on Human-Systems Integration. He has a Ph.D. in cognitive/experimental psychology from the University of Illinois.

Kenneth Langa (*Presenter*) is associate professor in the Department of Internal Medicine, a research investigator in the Veterans Affairs Health Services Research and Development Service Center of Excellence, a faculty associate in the Institute for Social Research, and an associate director of the Institute of Gerontology at the University of Michigan. He is a coinvestigator for the Health and Retirement Study and the Aging, Demographics, and Memory Study. His research focuses on the epidemiology and costs of chronic disease in older adults, with an emphasis on Alzheimer's disease and other dementias. He is currently focusing on the relationship of cardiovascular risk factors to cognitive decline and dementia in middle-aged and older adults. He has M.D. and Ph.D. degrees in public policy from the University of Chicago. He is a practicing general internist treating adult patients with chronic medical conditions.

Ronald Lee (*Planning Committee Chair/Presenter*) is director of the Center for the Demography of Aging and Economics at the University of California, Berkeley. His current research topics include modeling and forecasting demographic time series, the evolutionary theory of life histories, population aging, Social Security, and intergenerational transfers. He is a member of the National Academy of Sciences, the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and a corresponding member of the British Academy. He has chaired the population and social science study section for the National Institutes of Health and served on the National Advisory Committee on Aging (NIA Council). At the National Research Council, he chaired the Committee on Population. He has an M.A. in demography from the University of California, Berkeley, and a Ph.D. in economics from Harvard University.

Charles M. Lucas (*Planning Committee Member*) is a consultant with Osprey Point Consulting. He is the former global head of market risk management at AIG Corporation, a financial services firm, where he headed its quantitative finance group. Prior to joining AIG, he was at the Federal Reserve Bank of New York, from which he retired as a senior vice president; while there he created and managed the organization's capital markets unit. He has a B.A. and a Ph.D. in economics from the University of California, Berkeley.

Andrew Mason (*Presenter*) is professor of economics at the University of Hawaii at Manoa and senior fellow at the East-West Center in Honolulu. He is a member of the Center for the Economics and Demography of Aging at the University of California, Berkeley. He codirects the National Transfer Accounts Project (http://www.ntaccounts.org), an international project involving researchers from more than 25 countries developing a comprehensive approach to measuring and studying the systems countries use to meet the economic needs of children and the elderly. National transfer accounts are being used to study the evolution of familial support systems, public pensions, health care, and education systems and their influence on economic growth, generational equity, and other features of the macroeconomy. He has a Ph.D. from the University of Michigan.

Richard A. Miller (*Presenter*) is professor of pathology and associate director of the Geriatrics Center at the University of Michigan. He is also a research scientist at the Ann Arbor VA Medical Center. His main research interests are in the genetic and immunobiological aspects of aging. His laboratory works on topics ranging from biochemistry of signal transduction in T cells from aged mice, studies of gene expression in long-lived mutant dwarf mice, and mapping of genes for longevity and resistance to late-life diseases, to the development of new mouse models for alterations in the rate of aging. He has served in a variety of editorial and advisory positions on behalf of the Gerontology Society of America, the American Federation for Aging Research, and the National Institute on Aging. He is the recipient of the Nathan Shock Award, the Allied Signal Award, and the Kleemeier Award for aging research. He has a B.A. from Haverford College and M.D. and Ph.D. degrees from Yale University.

Phyllis Moen (*Presenter*) is the McKnight presidential chair in sociology at the University of Minnesota. She studies occupational careers, gender, families, and well-being over the life course, including the frequently obsolete social, cultural, and policy ecologies in which lives play out. She has published numerous books, including *Women's Two Roles: A Contemporary Dilemma* and *It's about Time: Couples and Careers*. She has a Ph.D. from the University of Minnesota.

Alicia Munnell (*Presenter*) is the Peter F. Drucker professor in the Carroll School of Management at Boston College and also director of the Center for Retirement Research. She has served on the President's Council of Economic Advisers (1995-1997), as assistant secretary of the U.S. Treasury for economic policy (1993-1995) and as senior vice president and director of research at the Federal Reserve Bank of Boston. Munnell has published many articles, authored numerous books, and edited several volumes on

tax policy, Social Security, public and private pensions, and productivity. Munnell was cofounder and first president of the National Academy of Social Insurance. She is currently a member of the American Academy of Arts and Sciences, the Institute of Medicine, and the National Academy of Public Administration. She has a B.A. from Wellesley College, an M.A. from Boston University, and a Ph.D. from Harvard University.

David B. Reuben (*Planning Committee Member/Presenter*) is director of the Multicampus Program in Geriatric Medicine and Gerontology and chief of the Division of Geriatrics in the Center for Health Sciences at the University of California, Los Angeles. He is also the Archstone Foundation chair and professor in the David Geffen School of Medicine and director of the Claude D. Pepper Older Americans Independence Center. His professional interests are in clinical care, education, research, and administrative aspects of geriatrics. He has won seven awards for excellence in teaching. Dr. Reuben's current research interests include redesigning the office visit to improve health care quality and measurement of how older adults function. He is a past president of the American Geriatrics Society and the Association of Directors of Geriatric Academic Programs. He has an M.D. from Emory University School of Medicine.

Sandra Rosenbloom (*Presenter*) is professor of planning, adjunct professor of natural renewable resources, adjunct professor of gerontology, and adjunct professor of women's studies at the University of Arizona. Her research explores the intersection between the social sciences and transportation, examining the implications for transportation and community development of societal trends—notably, suburbanization, the aging of society, the increased role in the labor force of women with children, and the growth of groups with special needs. At the National Research Council, she is a member of the Transportation Research Board (TRB) executive committee, chaired the Committee on Paratransit, has served on several other TRB committees and task forces, received the 2004 TRB Roy W. Crum distinguished service award, and was named a national associate of the National Academies. She has a bachelor's degree, a master's degree in public policy, and a Ph.D. in political science, all from the University of California, Los Angeles**.**

Barbara Boyle Torrey (*Presenter*) is a visiting scholar at the Population Reference Bureau. Previously she served as executive director of the National Research Council's Division of Behavioral and Social Sciences and Education and the Census Bureau's Center for International Research. Her areas of expertise include demography, international policy, population vulnerabilities, and comparative economics. She has been the principal

investigator on several population dynamics and population/economic studies. She is a member of the board of the Population Reference Bureau and the science committee of the International Institute for Applied Systems Analysis near Vienna, Austria. At the National Research Council, she serves on the International Advisory Board. She has B.A. and M.S. degrees in international relations from Stanford University.

David R. Weir (*Planning Committee Member*) is research professor in the Survey Research Center of the Institute for Social Research at the University of Michigan and director of the Health and Retirement Study. Previously he was visiting associate professor in the Department of Economics and research associate in the Harris School of Public Policy at the University of Chicago. His current research interests include the use of longitudinal data to study chronic disease processes, especially diabetes; health care decision making at older ages, including Medicare Part D; how couples jointly plan for risks of old age, including retirement, widowhood, and disability; the role of personality factors in lifetime economic success; and the use of biomarkers in population surveys. He is the recipient of a Special Emphasis Research Career Award in the Economics and Demography of Aging from the National Institute on Aging. He has an A.B. in history from the University of Michigan and a Ph.D. in economics from Stanford University.