Population $\geq 65$ and $\geq 85$ Years Old
United States, 1900–2010 and Projected 2020–2050

- **$\geq 65$ years old**
  - 1900: 3 million
  - 2010: 35 million
  - 2050: 72 million
- **$\geq 85$ years old**
  - 1900: 4.2 million
  - 2010: 9 million
  - 2050: (expected growth)

---

Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, select data from Table 1a Available at www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/docs/EntireChartbook.pdf
Population ≥65 Years Old
United States, 2000

Percent

5.0–9.9
10.0–14.9
15.0–19.9
20.0–30.0

Population ≥65 Years Old
United States, 2015

Population ≥65 Years Old
United States, 2025

Population ≥65 Years Old by Race and Hispanic Origin United States, 2010 and Projected 2050

<table>
<thead>
<tr>
<th>Race/Origin</th>
<th>2010</th>
<th>Projected 2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Hispanic White</td>
<td>80</td>
<td>58</td>
</tr>
<tr>
<td>Black</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Asian</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>All other races alone or in combination</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Hispanic, any race</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>

Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, Table 1a
www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/docs/EntireChartbook.pdf
Educational Attainment of Population ≥65 Years Old United States, 1965–2010

- High school graduate or more
- Bachelor’s degree or more

Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, Table 4a
www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/docs/EntireChartbook.pdf
### Life Expectancy by Age and Sex of Population ≥65 Years Old, United States, 2009

<table>
<thead>
<tr>
<th></th>
<th>Average Years of Life Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>At birth</strong></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>76.0</td>
</tr>
<tr>
<td>Women</td>
<td>80.9</td>
</tr>
<tr>
<td><strong>At age 65</strong></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>17.6</td>
</tr>
<tr>
<td>Women</td>
<td>20.3</td>
</tr>
<tr>
<td><strong>At age 85</strong></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>5.9</td>
</tr>
<tr>
<td>Women</td>
<td>7.0</td>
</tr>
</tbody>
</table>

Percent of Population ≥65 Years Old Who Live Alone, United States, 2010

Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, Table 5a
www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/docs/EntireChartbook.pdf
In 2009, only 4% of Medicare recipients ≥65 years old were in a long-term care facility

Most older adults live in the community

Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, Table 20c
www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012/Documents/docs/EntireChartbook.pdf
Population ≥65 Years Old Unable to Perform Select Physical Functions, by Sex
United States, 2009

Among persons ≥85 years old:
40% of men and 53% of women were unable to perform at least 1 of these 5 activities

- Any of these: 30%
- Walk 2-3 blocks: Men 15%, Women 21%
- Stoop/kneel: Men 10%, Women 18%
- Reach over head: Men 3%, Women 4%
- Lift 10 lbs: Men 7%, Women 14%
- Write/grasp small objects: Men 2%, Women 2%

Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, Table 20b
www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/docs/EntireChartbook.pdf
Multiple chronic conditions (≥2 concurrent chronic conditions)

- 68% of those ≥65 years old
- 83% of those ≥85 years old
Model of Healthy Aging

Promote health, prevent injury, and manage chronic conditions

Facilitate social engagement

Optimize physical, cognitive, and mental health

Optimal or healthy aging

Supportive Design Strategies to Facilitate Function, Independence, and Safety

Carrie Bruce, MA, CCC-SLP
Research Scientist
Center for Assistive Technology and Environmental Access
Sonification Laboratory
Georgia Institute of Technology, Atlanta, GA
Design as a Barrier or Facilitator to Function, Independence, and Safety

There is a direct relationship between function, independence, and safety, and the design of spaces and products.
Typical, everyday designs are largely intended for users with “average” level of function.
Typical, everyday design contributes to activity performance problems

Activity performance problems in the home diminishes community participation

- Problems with kitchen, bathroom, and circulation-related activities are positively correlated to less mobility within the community

Supportive design in home and community settings has been repeatedly linked to positive outcomes
- Improvements in perceived and actual activity performance
- Short- and long-term benefits

Gitlin, LN. In Impact of Technology on Successful Aging. (New York: Springer, 2003), 188-202
Supportive Design Strategies to Facilitate Function, Independence, and Safety

Design of spaces and products that support people with various levels of function across abilities

**Specialized Design**
Compensates for specific abilities and functional limitations

**Universal Design**
Promotes use by people with various abilities and a range of function levels

Assistive *Technology*  
Accessible *Design*
Specialized Design

- **Assistive technologies**
  - Any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities

- **Accessible designs**
  - Products, spaces, or site-built features, often promulgated through codes and standards (e.g., ADA), that compensate for functional limitations by minimizing environmental demands on individuals with disabilities

Benefits of Specialized Design

- Independence
- Confidence in performing household activities
- Effectiveness of caregivers
- Frequency of travel to community destinations

Barriers to Specialized Design

- **Yuck factor**
  - Added on to cover up environmental barriers

- **Me-mentality**
  - Only supports specific types or levels of ability

- **Stigmatization**
  - It’s clinical (i.e., hospital) in character

- **House hog**
  - It’s big, independent of context, and independent of other design

Universal Design

- The design of all products and environments to be usable by all people to the greatest extent possible without the need for adaptation or specialized design

- Principles of universal design
  - Equitable use
  - Flexibility in use
  - Simple and intuitive use
  - Perceptible information
  - Tolerance for error
  - Low physical effort
  - Size and space for approach and use

Available at http://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm
Benefits of Universal Design

- Creates everyday spaces and products that have personal scale and character
- Benefits multiple individuals
- Allows functionality across the lifespan of an individual
- Incorporates support for assistive devices
- Sets a baseline for usability that will reduce or eliminate need for specialized design
- Is compatible with ICF framework of activity and participation

ICF, International Classification of Functioning, Disability and Health
http://www.who.int/classifications/icf/en/
Conclusion

- Design of spaces and products for people who are aging should assume functional changes and the possibility of multiple morbidities
- Use of spaces and products is influenced by more than just function, independence, and safety outcomes
- Universal design is the ideal, but combinations of supportive design strategies may be the best solution
Researching Technologies for Healthy Aging

Brian D. Jones, MSEE
Director, Aware Home Research Initiative
Senior Research Engineer, Interactive Media Technology Center
Georgia Institute of Technology, Atlanta, GA

DISCLOSURE: Brian Jones is an Advisory Board member and has stock options in Sensiotec, Inc.
Georgia Tech Vision of Healthy Aging Research

**Independence**
- Social engagement
- Autonomy
- Wellness
- Live where one prefers

**Chronic**
- Self-management
- Actionable
- Personalized

**Integration**
- Accountable care
- Clinical care
- Home care
The Georgia Tech Aware Home

- **Authentic home environment**
  - Innovate the next home technology
  - Perform human subject studies of our research in a controlled environment
  - Test installation of solutions before deploying into peoples’ actual homes

http://www.awarehome.gatech.edu/
Areas Where Technology Can Help

- Personal safety
- Medication adherence
- Social communication
- Wellness
- Health
- Integration of data for holistic understanding
Safety
Personal Emergency Response System (PERS)

- **Purpose:** Faster response to emergencies by pressing a button

- **Features might include**
  - User-initiated help button
  - Worn as pendant, watch, or on belt
  - Home landline and cellular connectivity
  - Two-way speaker in base station
  - 24/7 monitoring
  - GPS to track location when pressed
Safety
Detection of Falls

- **PERS capability plus automatic fall detection**
  - Accelerometer sensor detects patterns that are similar to a fall

- **Worn as**
  - Chest strap, pendant, belt

- **Connectivity**
  - Phone line, cellular/GPS

![Philips Lifeline](image1)

![MobileHelp MyHalo Communicator and Tracker](image2)

PERS, Personal Emergency Response System
Safety
Ambient (Passive) Monitoring

- **Advanced in-home monitoring**
  - Motion sensing (passive infrared)
  - Automatic monitoring of routine
    - Out of bed
    - Bathroom time
    - Kitchen
    - Medicine cabinet
  - Door sensors
    - Household doors
    - Refrigerator doors
    - Cabinet doors
  - Rules-driven response
Safety
RemindMe Use Case

- **Appliances in the home can cause hazards**
  - Oven, stove, iron, space heater

- **Intelligent ambient alerting can help**
  - RemindMe uses a picture on the wall in common areas to draw attention
    - Lights light when iron is ON
    - Lights blink when iron is ON and no motion in the ironing room
Medication Adherence

- Pill boxes
- Reminders (watch)
- Smartphone apps

- Smart pill bottles
  - CleverCap

- Automated dispenser
  - AMAC MedSmart
  - TabSafe

GreatCall MedCoach
Social Communication

**Challenges**
- Simplification of tasks required to communicate successfully
- Reduced dexterity, vision, and hearing problems
- Lack of computing knowledge

**Solutions**
- Easier e-mail
- Cell phones
- Skype/FaceTime
- Tablets
- Social networking
OnaCom: Accessible solution for communicating with younger generations, without computing knowledge
- Single interface for communication: text, e-mail, instant messaging
- Physical interface for low vision

OnaCom devices: generation 2 (left) and 3 (right)
Wellness (Self-tracking)

- Automatically record information relevant to well-being
  - Weight: Wireless scale
  - Exercise: Wireless pedometer
    - Minutes active
    - Minutes sedentary
    - Exertion
  - Sleep: Wireless pedometer
Visualizing Trends in Potentially Related Data
Wellness Mashups

- **Salud! Mobile**: Automate the capture of information and generate useful observations for the user
  - Steps (FitBit)
  - Sleep (FitBit)
  - Weight (Withings scale)
  - Location (Android phone)
  - Weather (phone)
  - Free or busy calendar (phone)
  - Self-report (food, mood, pain)

http://salud.cc.gatech.edu/welcome/
Observations generated automatically from correlations of captured information against other recorded information.
Health at Home

- **Wellness data applicable to health**
  - Exercise
  - Nutrition
  - Weight

- **Telehealth and home monitoring**
  - Vitals measurements
  - Medication tracking

- **Longitudinal trends**
What does a “typical day” look like?
- On the electric and waterlines

Can trends in water and electricity use be monitored to detect changes in people’s behavior and health?
- Electrisense: System can detect noise on the power line
  - Noise signals can identify an electrical load (light switch)
- Hydrosense: System measures pressure changes on the waterlines
  - Pressure patterns can identify fixture use (toilet, shower)
Health Waterline Sensing Research

Actual Faucet Valve Open Event

pressure (psi)

46.5
45
43.5

t (sec.)

0 2 4 6 8

Initial Detection
Critical Pressure at Local Minimum
Stabilized Pressure Drop
Critical Decrease in dP/dt

utility water meter

pressure regulator
thermal expansion tank
hot water heater

bathroom 1
kitchen
dishwasher
bathroom 2

HomeLab is a network of participants $\geq 50$ years old willing to evaluate technology from research or from industry in their homes and lives.
Georgia Tech research:
Improve today’s technology solutions to address greater challenges facing the aging population tomorrow
Individual-Centered Technology

Leanne West, MS Physics, MS EE
Principal Research Scientist
Director, Landmarc Research Center
Associate Director, Petit Institute for Bioengineering and Bioscience
Georgia Tech Research Institute, Atlanta, GA

DISCLOSURE: Leanne West is the owner/founder of Intelligent Access, LLC.
Individual-Centered Health – Why Now?

- Technology is no longer a limiting factor
- People expect information on the go, in real time
- More people own a mobile phone than a toothbrush
- “Apple hires health sensor talent, likely for iWatch”
- “Mobile health sensor market to hit $5.6B by 2017”

http://60secondmarketer.com/blog/2011/10/18/more-mobile-phones-than-toothbrushes/
mobihealthnews.com, July 22, 2013
Intelligent Bathroom: Sensors in the Home

- **Sensor suite**
  - Home/assisted living, extended-care facility, hospitals

- **Data fusion**
  - Sensors
    - Chronic condition
    - Medication
    - At-risk patients
    - Activities of daily living
  - Patient data

- **Long-term trends**

- **Monitored by healthcare professional or caregiver**

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Intelligent Bathroom: Sensors in the Home

- **Intelligent mirror**
  - Interactive (speech control, visual tests)
  - Eye tracking
  - Face recognition (identify patient)
  - Cameras
    - Infrared (temperature)
    - Visible (color changes, movement)
  - Image analysis
Intelligent Bathroom: Sensors in the Home

- **Intelligent floor (pressure sensors, etc.)**
  - Weight
  - Balance
  - Falls
  - Gait
  - Triggers
    - Has the person entered the bathroom?
    - Which person entered? Based on weight and in conjunction with face recognition from mirror
    - Has a person stepped off floor into the shower and for how long?

![Load cell sensor](image1.png)

![Wii Fit Board](image2.png)

![Results showing fall/weight](image3.png)
Intelligent Bathroom: Sensors in the Home

- **Intelligent toilet**
  - Chemical/biological sensor
    - Blood, protein, drugs, etc. in 24-hour urine sample
  - Antibody targeted for specific bacteria, virus, or protein

- **Other possible sensors**
  - Toothbrush
  - Water sensor for shower
  - iHouse smart faucet
    - Face recognition
    - Temperature and flow control
    - Color coding
iCare4U (app)

- Assists caregiver (family member or professional)
- Alerts in near real time of vital sign reading
- Provides readings and history at a glance
- Easy access to patient, doctor, or other designees
Sensiotec: Remote Vital Signs Monitoring

- Fits under mattress or in chair
- Collects respiratory rate and heart rate
- Detects movement
- For use at home or in hospital

http://sensiotec.com/
Thank You
Way Forward

Lynda A. Anderson, PhD
Healthy Aging Program Director
Applied Research and Translation Branch
Division of Population Health
National Center for Chronic Disease Prevention and Health Promotion
Social Ecological Model

Social Ecological Model

Society

Community

Relationships

Individual

Smart homes
“Intelligent” bathroom

Medication reminders (pill box reminder to automated dispensers)

Universal design
Social communications

Patient-safety monitoring (e.g., special apps to alert family or professional caregivers)
Aging and Technology
Public Health Challenges and Opportunities

- **Accessibility**
  - Use of technology is increasing but still limited
  - Adults ≥65 years old used Internet or e-mail
    - 38% in 2008
    - 53% in 2012

- **Affordability**
  - Costs covered by individuals and families as out-of-pocket expenses

- **Adaptability and adoptability**
  - Need to address an increasingly diverse population
  - Need to overcome stigma to increase adoption of new technologies

Confidentiality and privacy issues
- Meet ethical standards and regulatory guidelines for protection of information

Scalability and sustainability
- Build on robust body of work from pilot programs
- Conduct applied research on testing and translating technologies into public health practice
- Engage older adults to help ensure they benefit as well as our society benefits from their contributions
Technology and Health
Aging Safely and More Independently