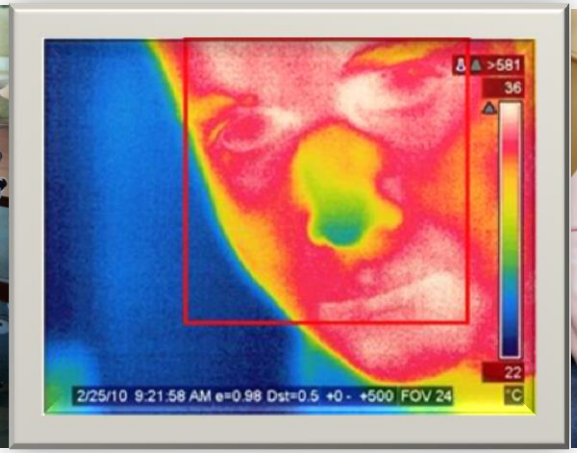
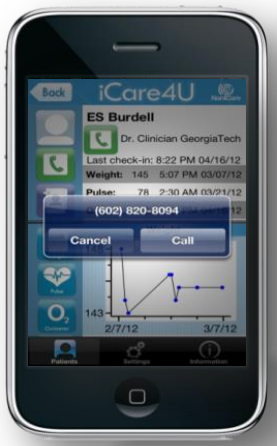
Public Health and an Aging Society





Lynda A. Anderson, PhD

Healthy Aging Program Director

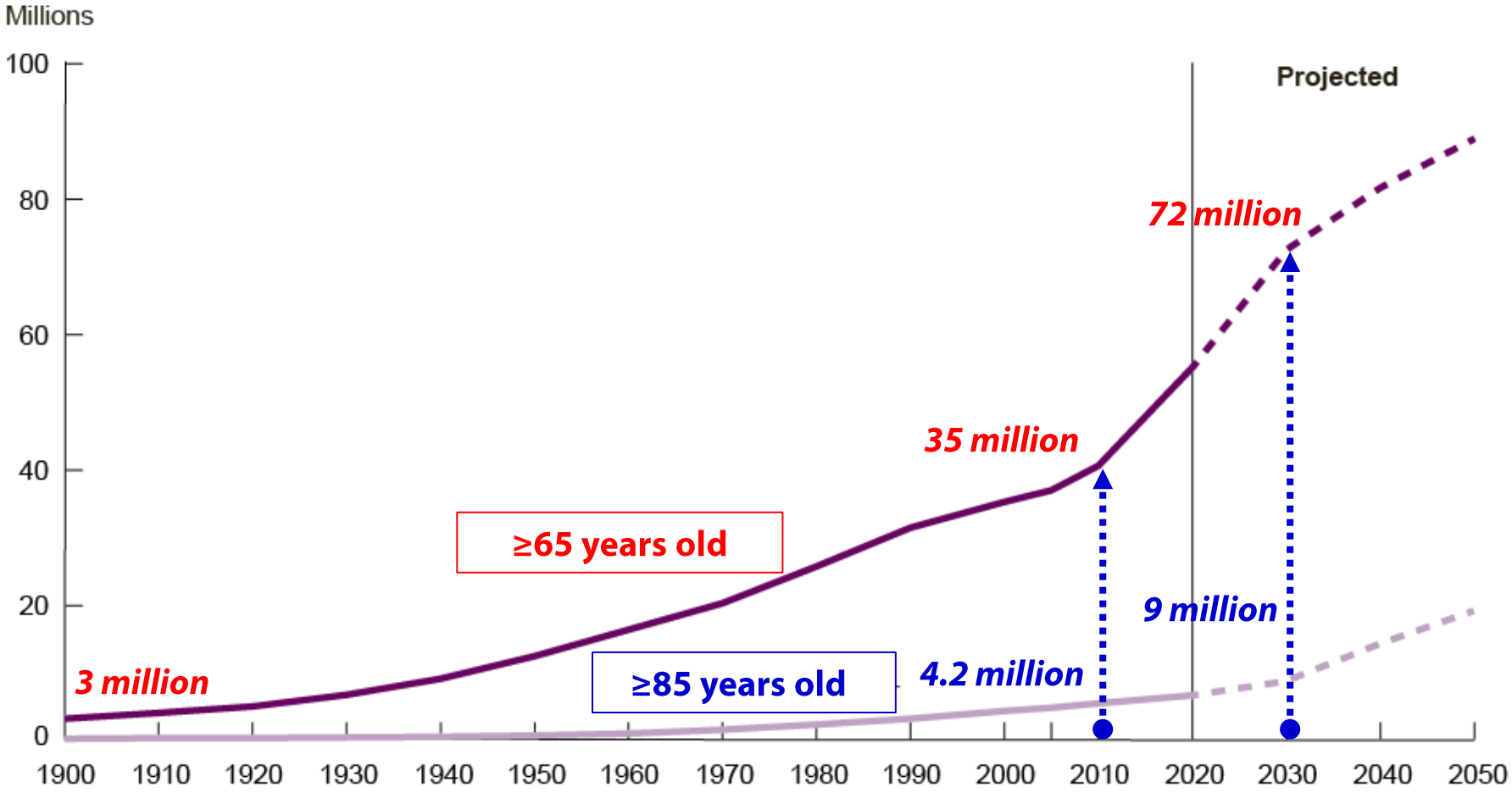
Applied Research and Translation Branch

Division of Population Health

National Center for Chronic Disease Prevention and Health Promotion

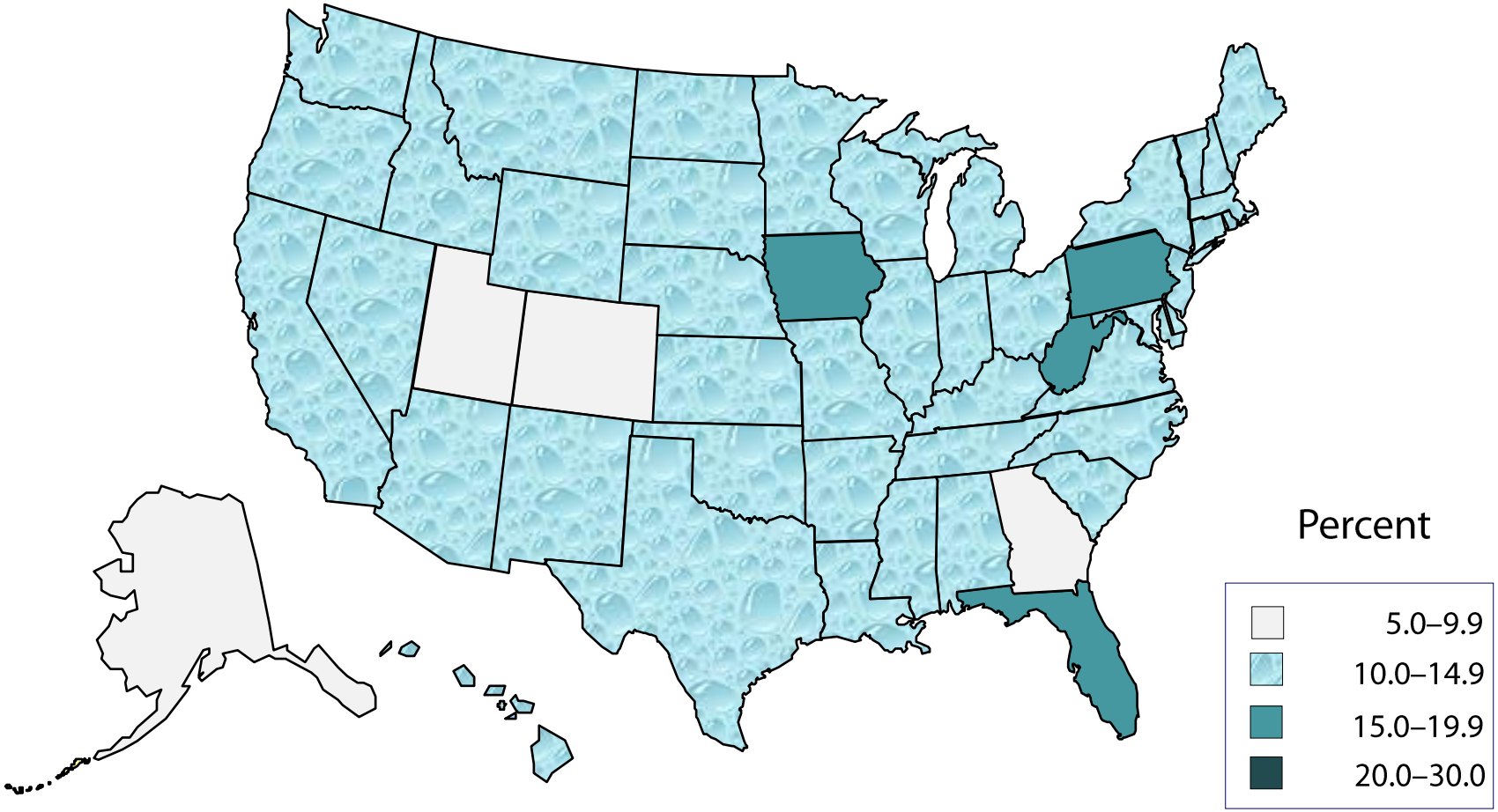
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Population ≥65 and ≥85 Years Old United States, 1900—2010 and Projected 2020—2050



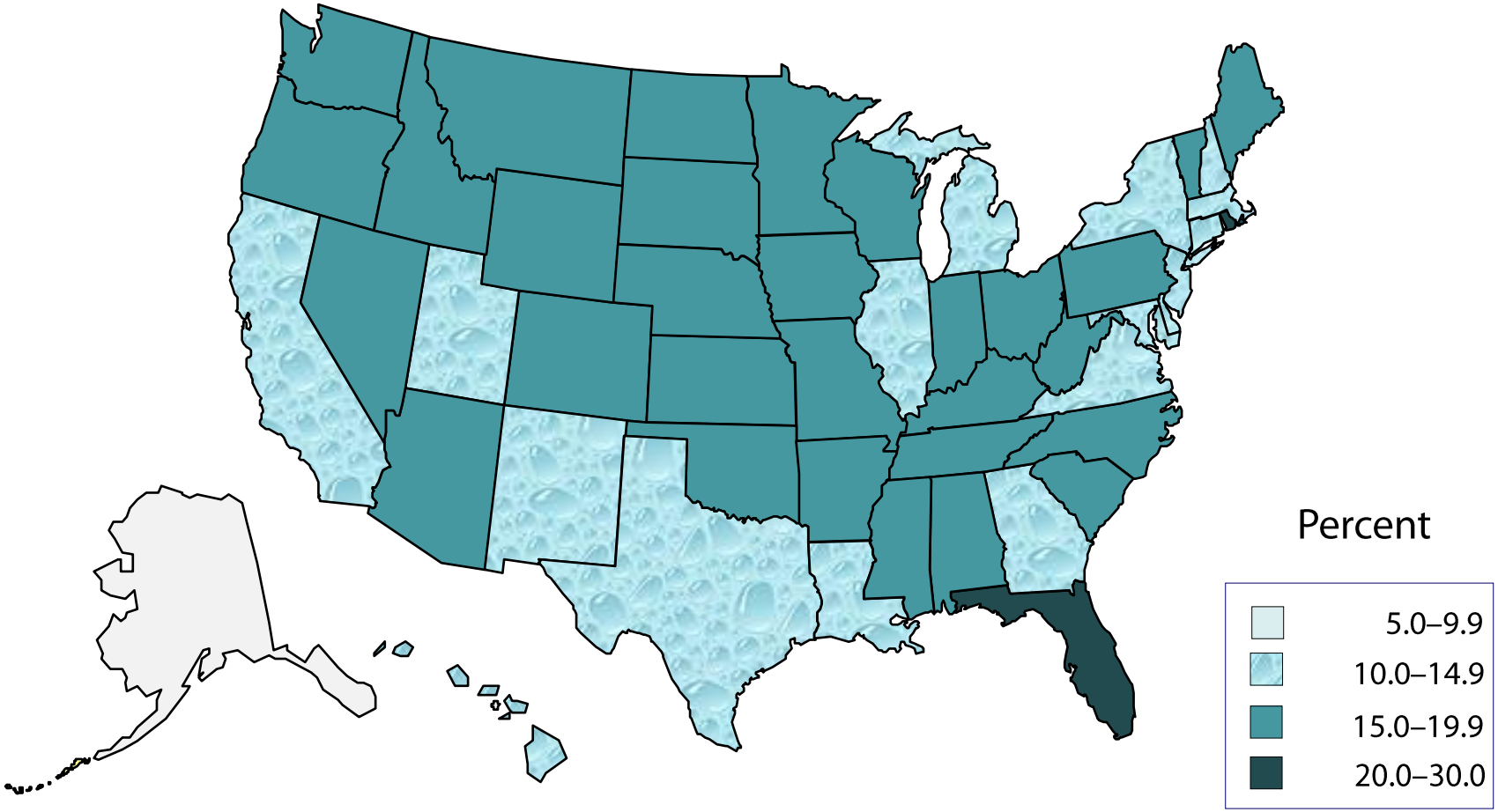
Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, select data from Table 1a Available at www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/docs/EntireChartbook.pdf

Population ≥65 Years Old
United States, 2000



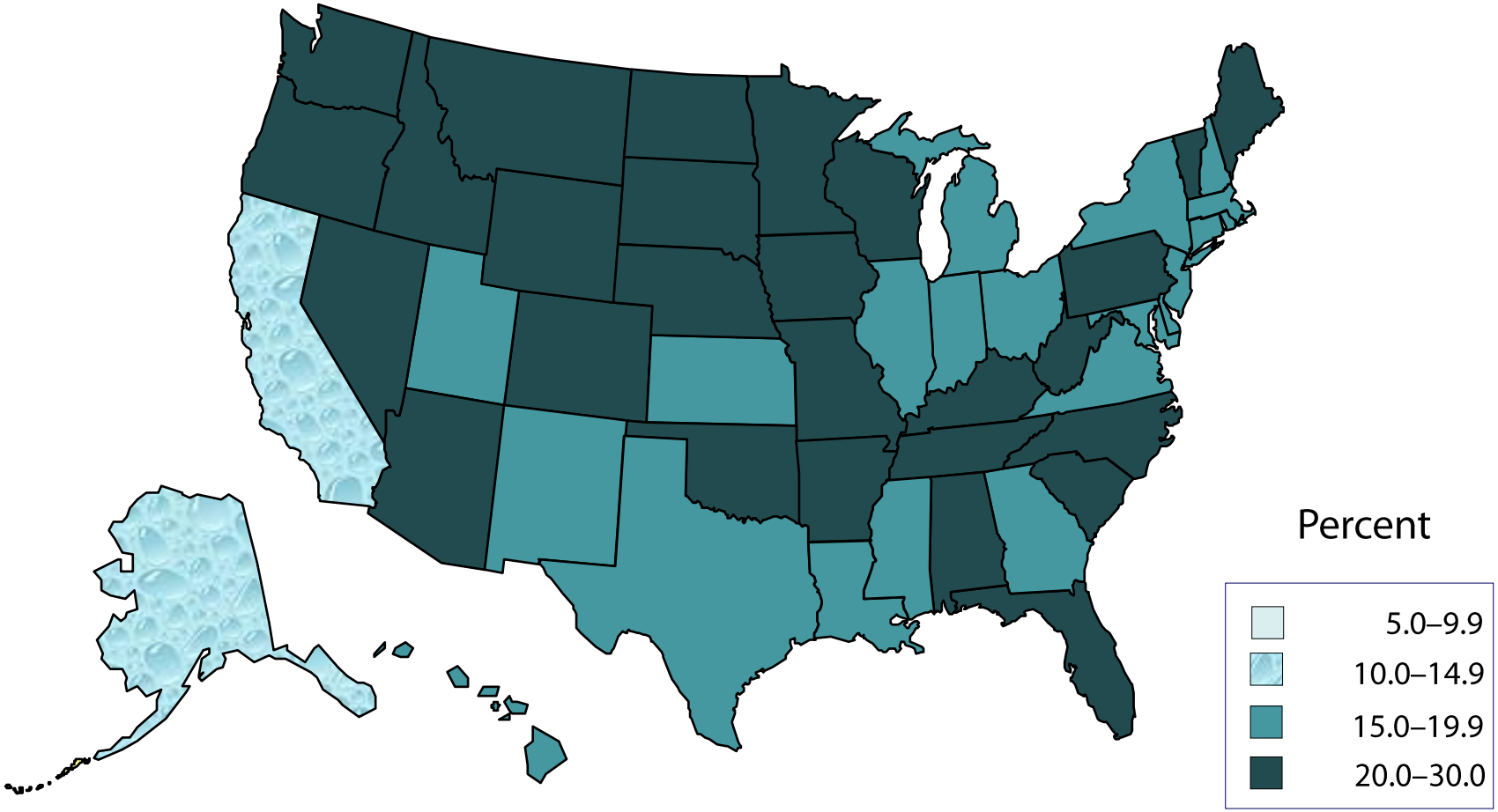
U.S. Census Bureau, 2003. Available at: www.census.gov/population/projections/data/state/st_comp-chg.html

Population ≥65 Years Old
United States, 2015



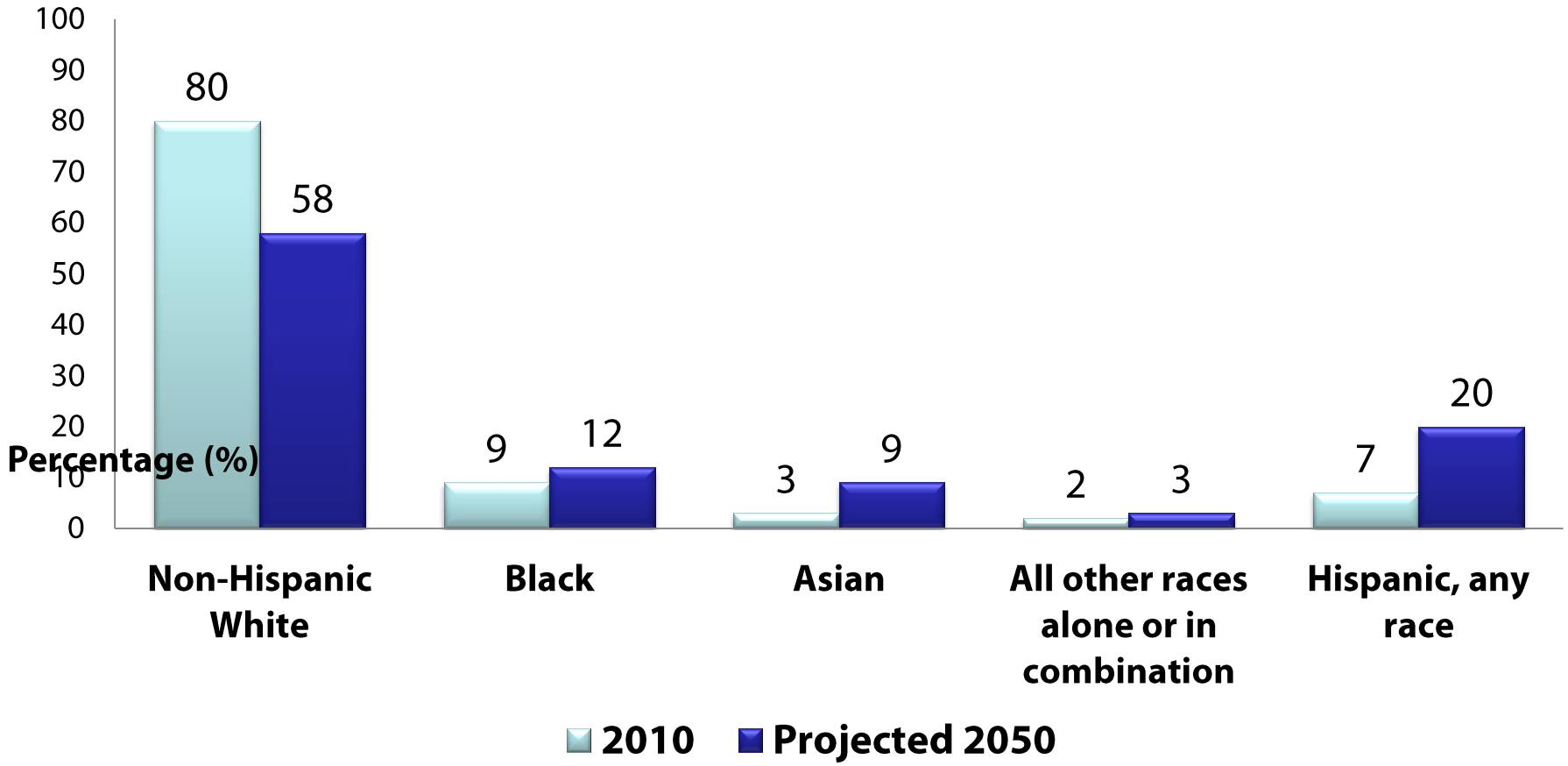
U.S. Census Bureau, 2003. Available at: www.census.gov/population/projections/data/state/st_comp-chg.html

Population ≥65 Years Old
United States, 2025



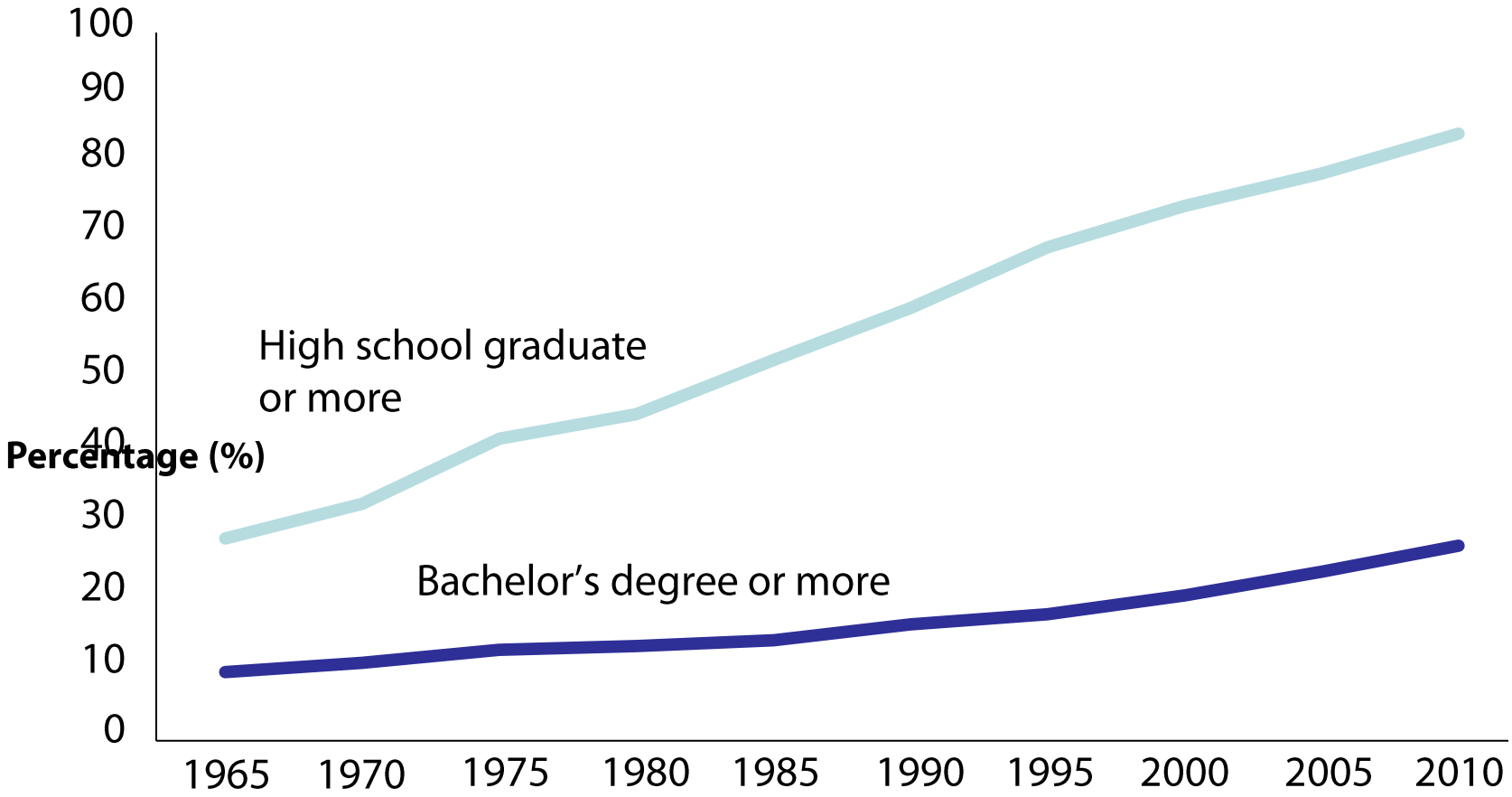
U.S. Census Bureau, 2003. Available at: www.census.gov/population/projections/data/state/st_comp-chg.html

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



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



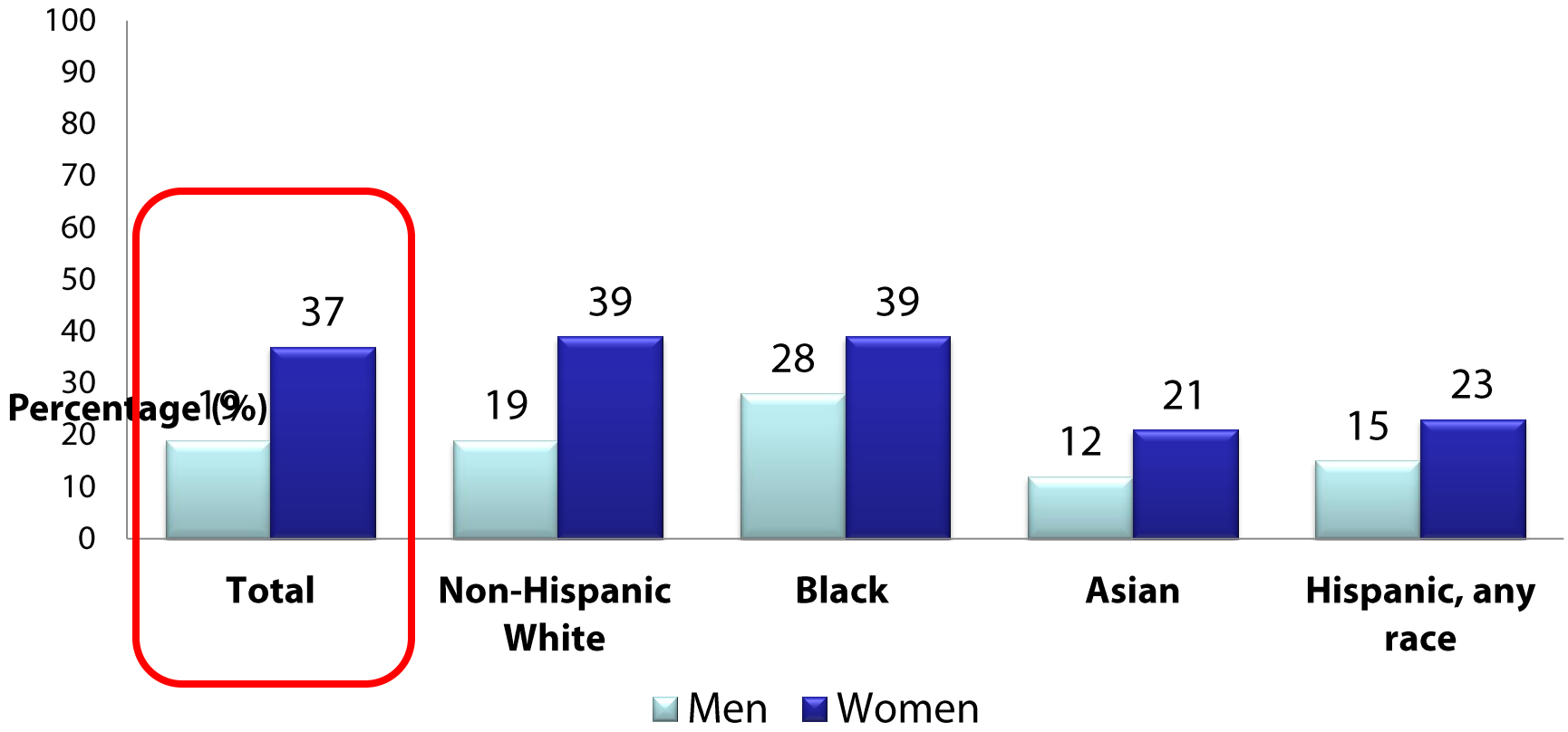
Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, Table 4a
www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/docs/EntireChartbook.pdf

Life Expectancy by Age and Sex of Population ≥65 Years Old, United States, 2009

Average Years of Life Remaining		
At birth	Men	76.0
	Women	80.9
At age 65	Men	17.6
	Women	20.3
At age 85	Men	5.9
	Women	7.0

Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, Table 14a
www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/docs/EntireChartbook.pdf

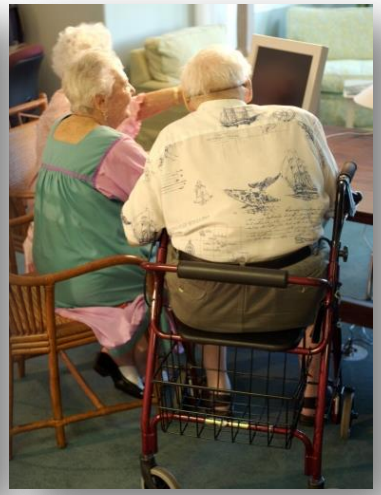
Percent of Population ≥65 Years Old Who Live Alone, United States, 2010



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

Living Arrangements of Population ≥65 Years Old United States, 2009

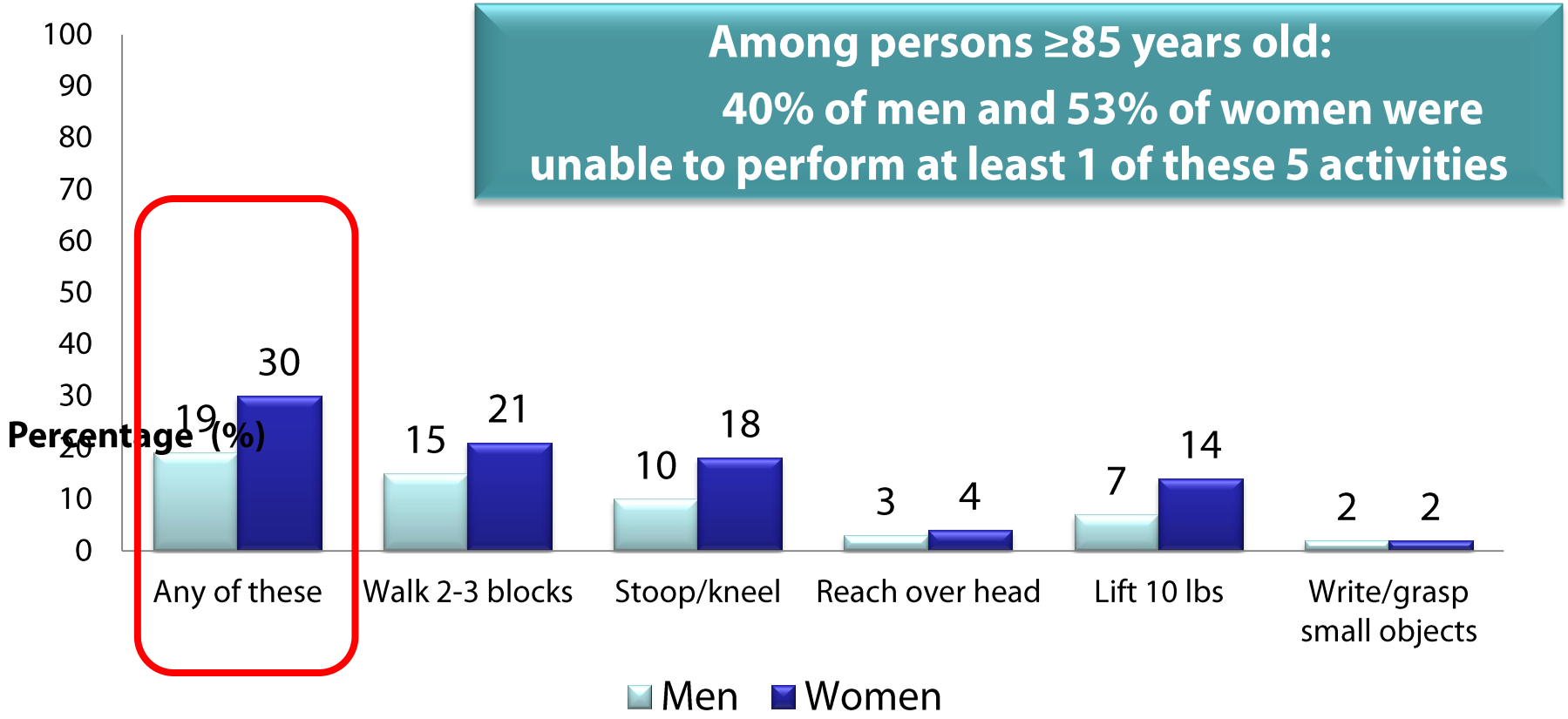
- In 2009, only 4% of Medicare recipients ≥65 years old were in a long-term care facility



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



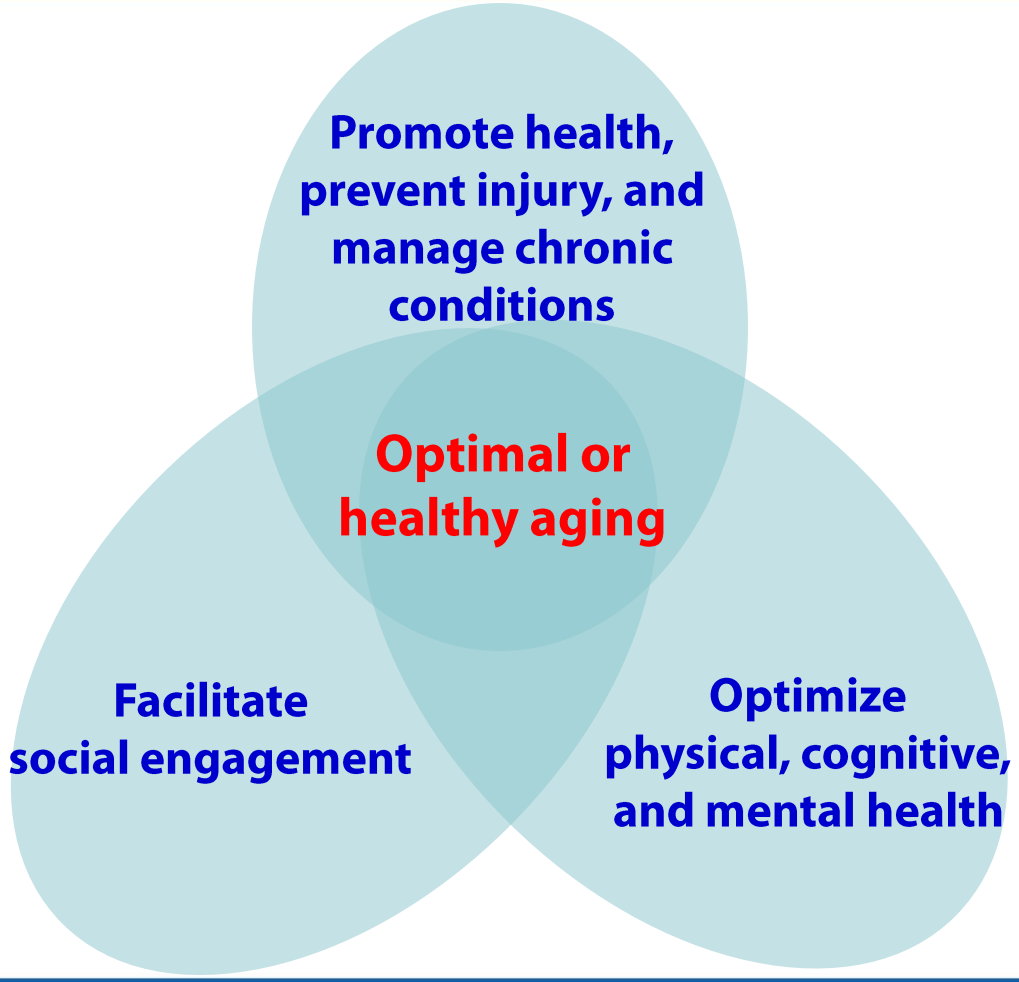
Federal Interagency Forum on Aging-Related Statistics. Older Americans 2012: Key Indicators of Well-being, Table 20b
www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/docs/EntireChartbook.pdf

Chronic Conditions and Older Adults

- **Multiple chronic conditions (≥2 concurrent chronic conditions)**
  - 68% of those ≥65 years old
  - 83% of those ≥85 years old

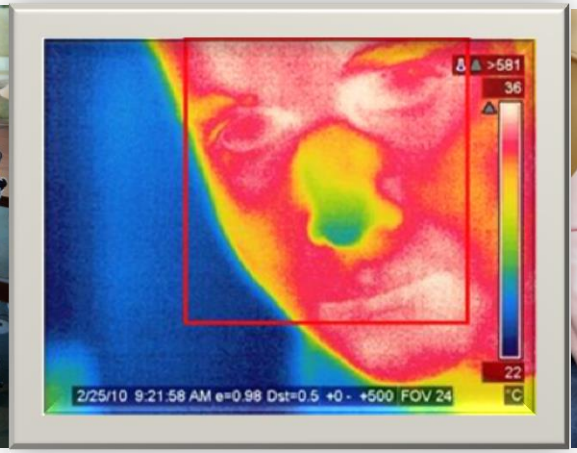
U.S. Department of Health and Human Services, 2010. Available at www.hhs.gov/ash/initiatives/mcc/mcc_framework.pdf
Centers for Medicare and Medicaid Services, 2012. Available at http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Chronic-Conditions/Downloads/2012Chartbook.pdf

Model of Healthy Aging



Modified from: Rowe JW, Kahn RL. *Successful Aging*. New York: Pantheon, 1998
Marshall VW, Altpeter M. Health & Social Work. 2005; 30 (2): 135-144

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

Georgia Institute of Technology

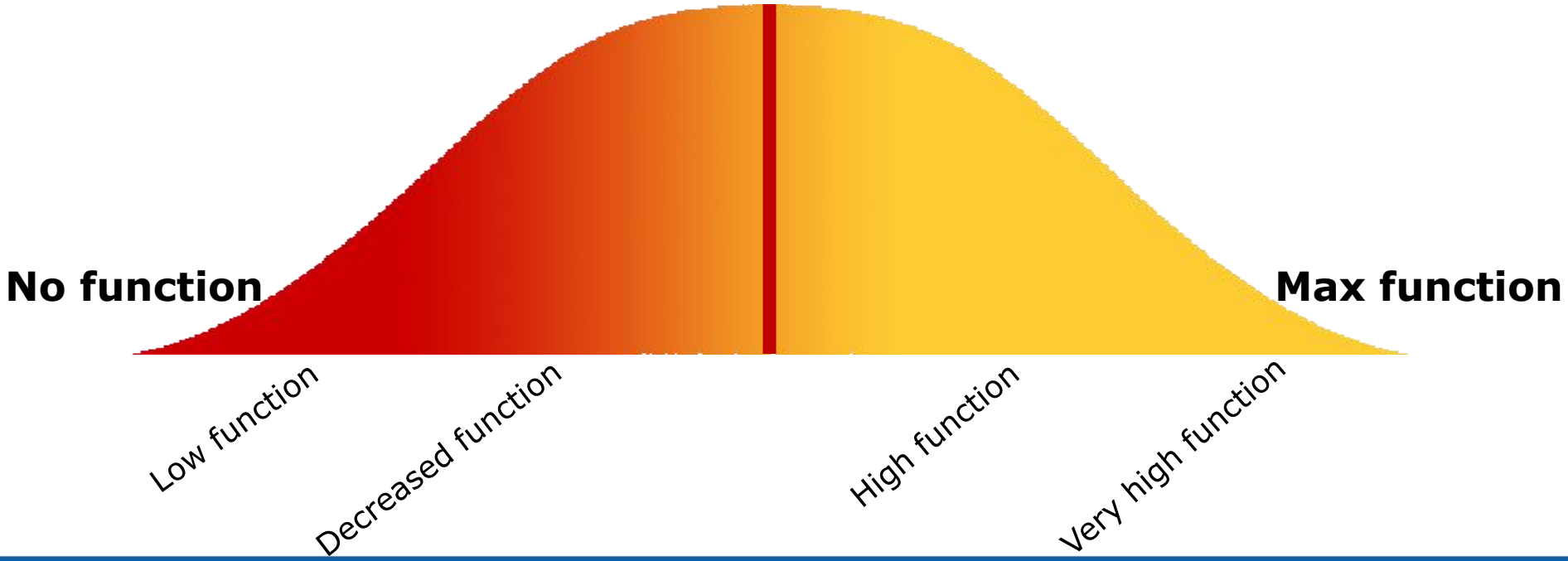
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

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

Design and Function, Independence, and Safety

Typical, everyday designs are largely intended for users with "average" level of function



Design as a Barrier or Facilitator to Function, Independence, and Safety

- **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

Yang HY, et al. J Aging Res 2012;625758

Design as a Barrier or Facilitator to Function, Independence, and Safety

- **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 et al. J Am Geriatr Soc. 2006; 54(5): 809-16
Stark, S et al. Can J Occup Ther. 2009; 76 Spec No: 235-45
Gitlin, LN. In Impact of Technology on Successful Aging. (New York: Springer, 2003), 188-202
Pynoos J et al. Clinics in Geriatric Medicine. 2010; 26(4): 633-44

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

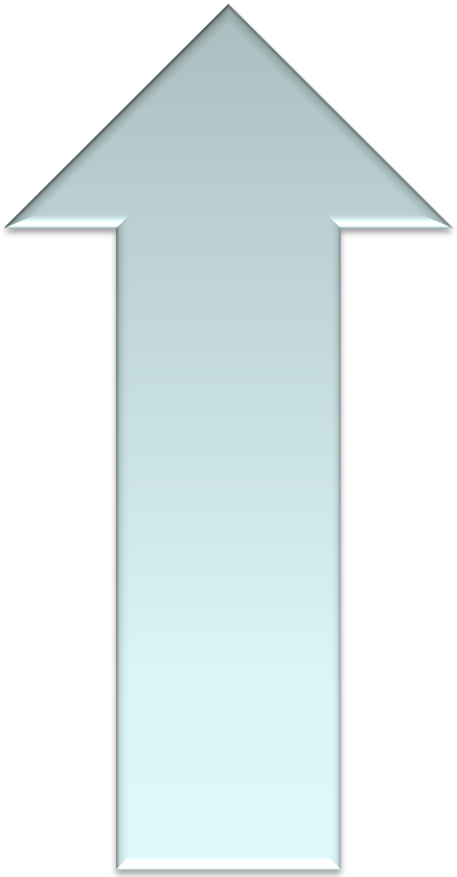
Accessible Design

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

ADA, Americans with Disabilities Act. http://www.ada.gov

Benefits of Specialized Design



Independence

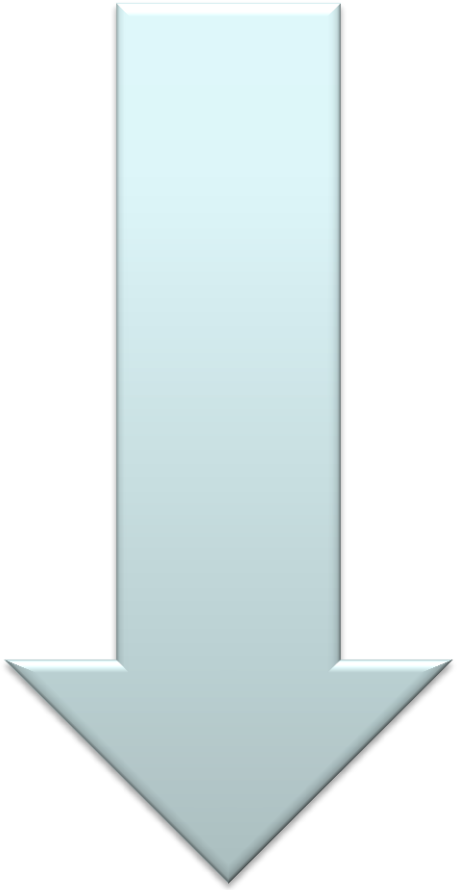
Confidence in performing household activities

Effectiveness of caregivers

Frequency of travel to community destinations

Yang HY, et al. J Aging Res. 2012;625758
Allen SL, et al. Gerontologist. 2006; 46(1):115-23
Mann WC, et al. Archives of Family Medicine. 199; 8(3): 210-17
Stark S. OTJR: Occupation, Participation and Health. 2004;24(1):32-9

Benefits of Specialized Design



Functional decline and disability

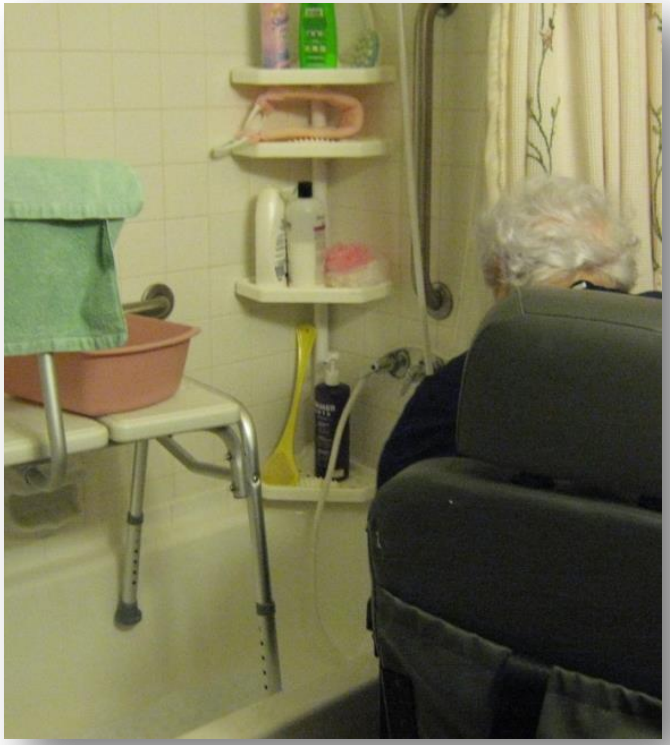
Likelihood of institutionalization

Risk of falls

Pynoos J, et al. Clinics in Geriatric Medicine. 2010; 26(4): 633-44
Connell BR, et al. Technology and Disability. 1993; 2(4): 9-18

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



Sanford JA. Design for the Ages: Universal Design as a Rehabilitation Strategy. New York: Springer, 2012

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

Connell BR, et al. The Principles of Universal Design: Version 2.0
Available at http://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm

Benefits of Universal Design

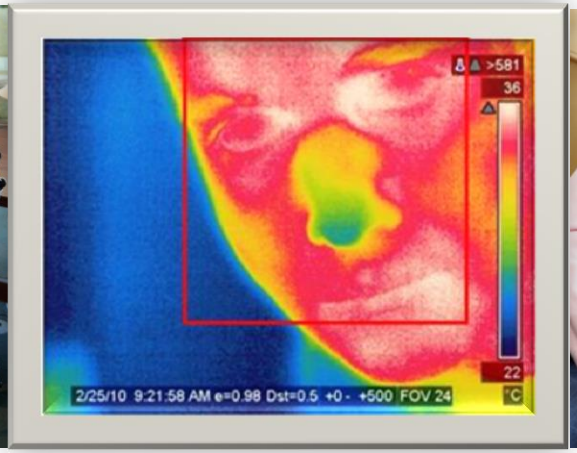
- Creates everyday spaces and products that have personal scale and character
- Benefits multiple individuals
- Allows functionality across the lifespan of an individual
- Incorporates support for assistive devices
- Sets a baseline for usability that will reduce or eliminate need for specialized design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

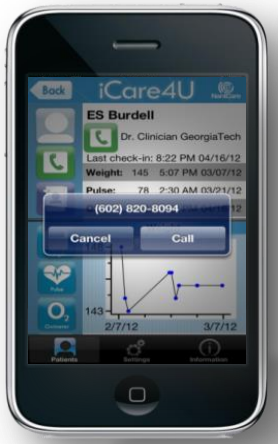
ICF, International Classification of Functioning, Disability and Health
http://www.who.int/classifications/icf/en/

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 Institute of Technology

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Georgia Tech Vision of Healthy Aging Research

Independence

Social engagement

Autonomy

Wellness

Live where one prefers

Chronic

Self-management

Actionable

Personalized

Accountable care

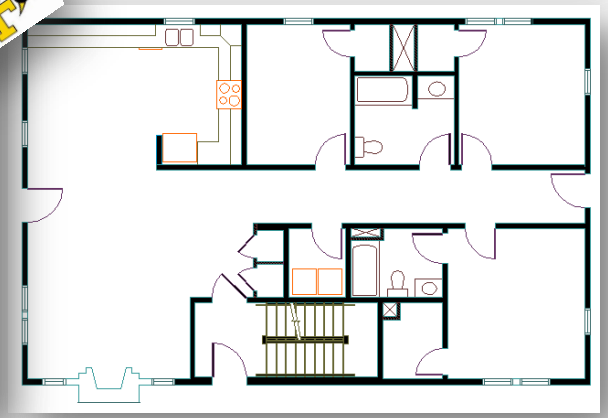
Clinical care

Home care

Integration

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

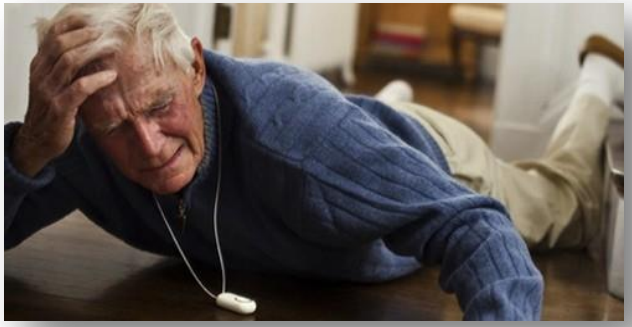
Safety
Personal Emergency Response System (PERS)

- **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

MobileHelp System

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

MobileHelp MyHalo Communicator and Tracker

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

QuietCare System

CloseBy System

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

GreatCall MedCoach

- Smart pill bottles

CleverCap

- Automated dispenser

AMAC MedSmart

TabSafe

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

Jitterbug phones

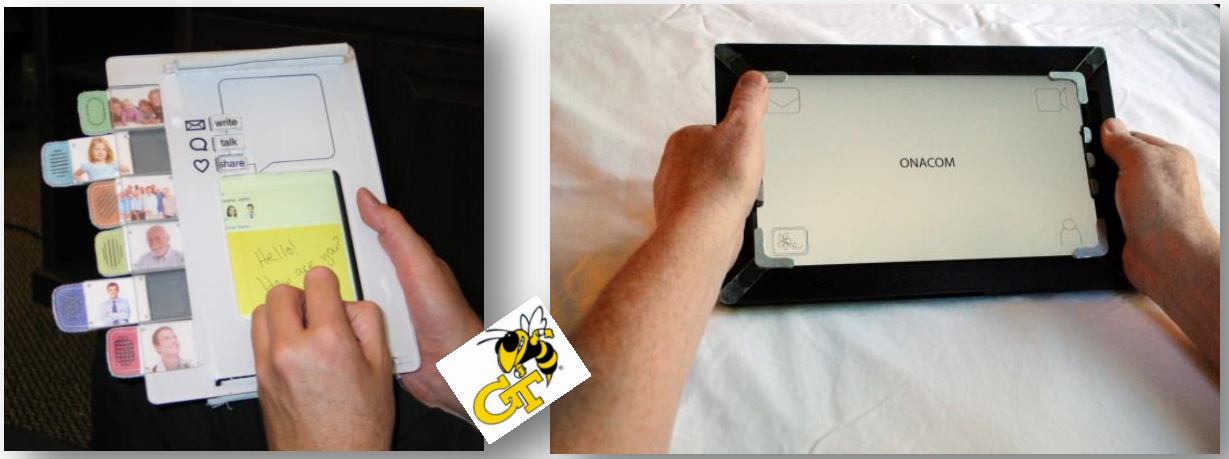
Celery (fax to e-mail)

FaceTime on iPad2

ASUS Eee Videophone

Social Communication

- **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

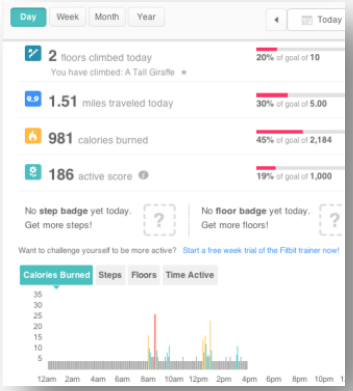


OnaCom devices: generation 2 (left) and 3 (right)

Wellness (Self-tracking)

- **Automatically record information relevant to well-being**
  - Weight: Wireless scale
  - Exercise: Wireless pedometer
    - Minutes active
    - Minutes sedentary
    - Exertion
  - Sleep: Wireless pedometer

BodyMedia Fit tracker and web dashboard



FitBit pedometer and scale products and dashboard

Visualizing Trends in Potentially Related Data

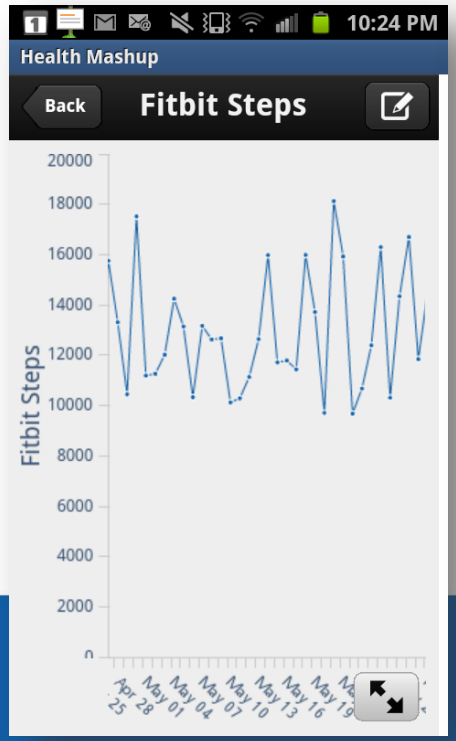
Wellness Mashups

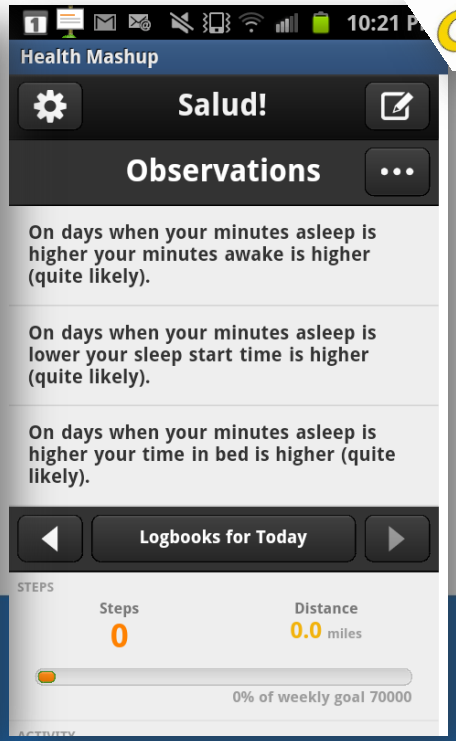
- **Salud! Mobile: Automate the capture of information and generate useful observations for the user**
  - Steps (FitBit)
  - Sleep (FitBit)
  - Weight (Withings scale)
  - Location (Android phone)
  - Weather (phone)
  - Free or busy calendar (phone)
  - Self-report (food, mood, pain)

http://salud.cc.gatech.edu/welcome/

Wellness Mashups
Integration of data

- **Observations generated automatically from correlations of captured information against other recorded information**





Health at Home

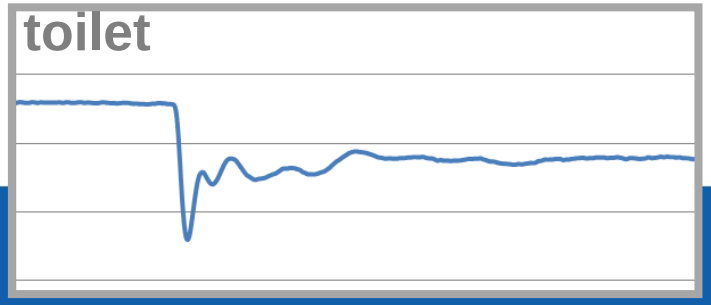
- **Wellness data applicable to health**
  - Exercise
  - Nutrition
  - Weight
- **Telehealth and home monitoring**
  - Vitals measurements
  - Medication tracking
- **Longitudinal trends**

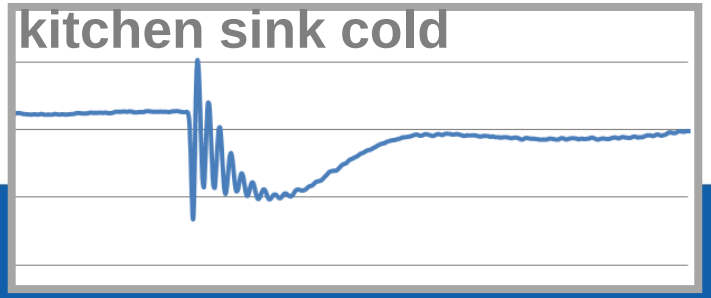
Intel Health Guide

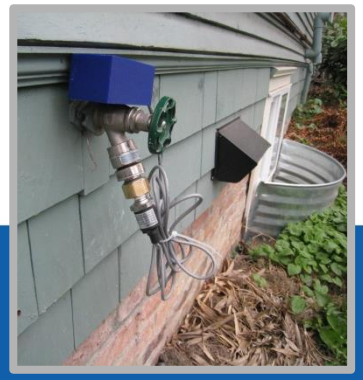
WellAWARE Trends

Health
Sensing Research

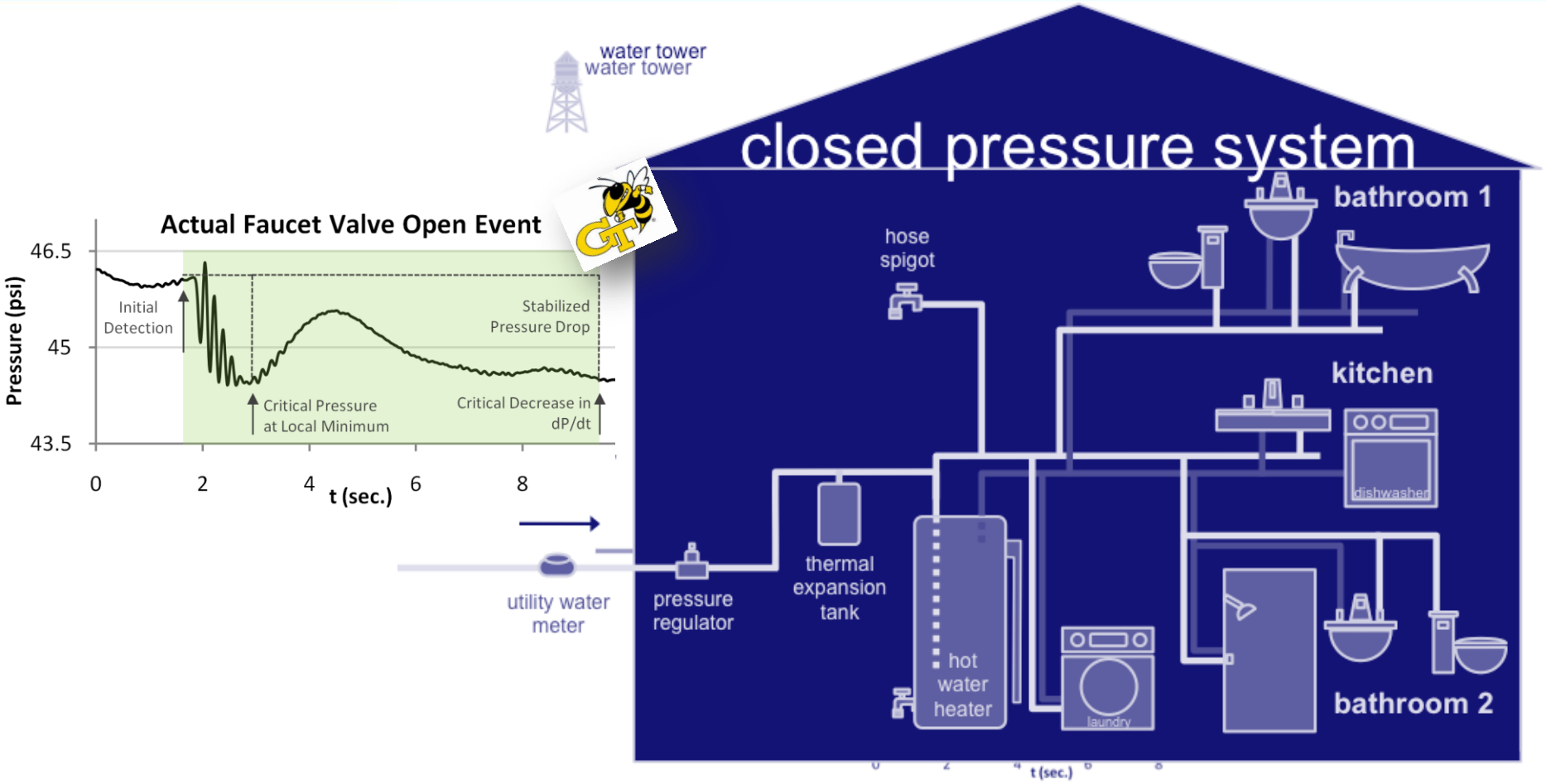
- **What does a "typical day" look like?**
  - On the electric and waterlines
- **Can trends in water and electricity use be monitored to detect changes in people's behavior and health?**
  - Electrisense: System can detect noise on the power line
    - Noise signals can identify an electrical load (light switch)
  - Hydrosense: System measures pressure changes on the waterlines
    - Pressure patterns can identify fixture use (toilet, shower)







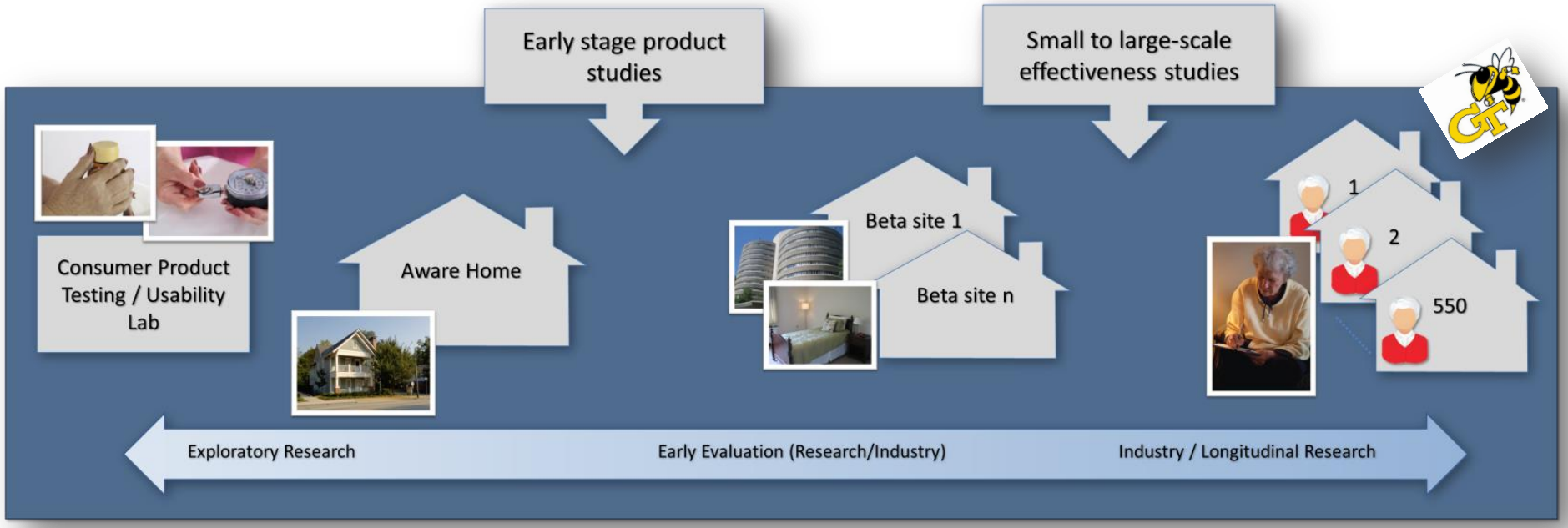
Health
Waterline Sensing Research



http://ubicomp.cc.gatech.edu/papers/hydrostream-chi2012.pdf

Georgia Tech HomeLab

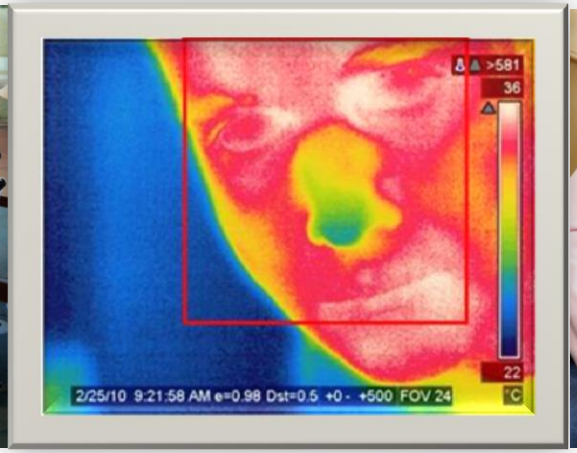
HomeLab is a network of participants ≥50 years old willing to evaluate technology from research or from industry in their homes and lives.

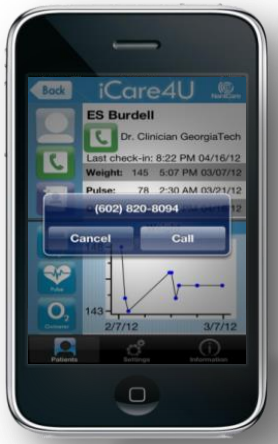


http://homelab.gtri.gatech.edu/

Georgia Tech research:
Improve today's technology solutions to address greater challenges facing the aging population tomorrow

Individual-Centered Technology





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Director, Landmarc Research Center

Associate Director, Petit Institute for Bioengineering and Bioscience

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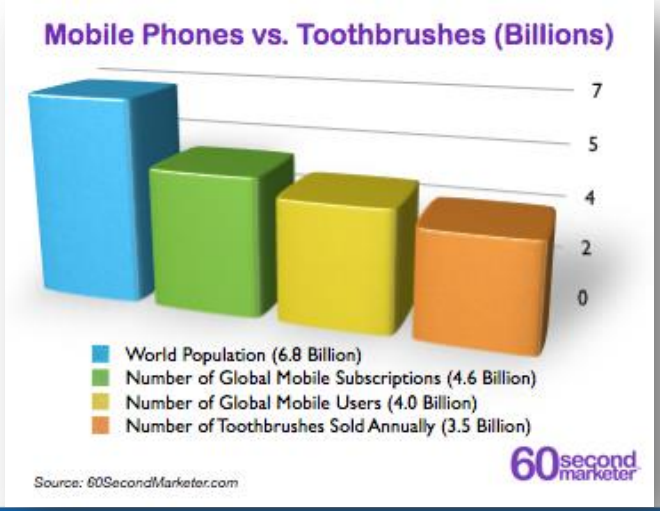
DISCLOSURE: Leanne West is the owner/founder of Intelligent Access, LLC.

Georgia Institute of Technology

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

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**

Census.gov, 2010. Available at http://www.census.gov/prod/2010pubs/p25-1138.pdf

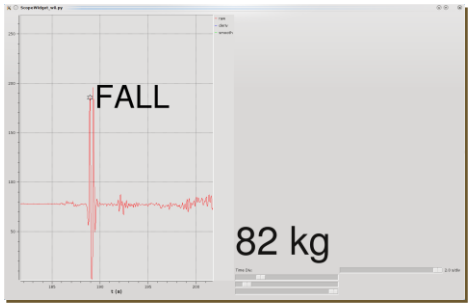
Intelligent Bathroom: Sensors in the Home

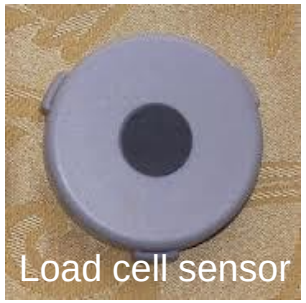
- **Intelligent mirror**
  - Interactive (speech control, visual tests)
  - Eye tracking
  - Face recognition (identify patient)
  - Cameras
    - Infrared (temperature)
    - Visible (color changes, movement)
  - Image analysis

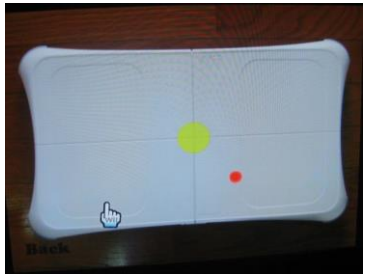
Intelligent Bathroom: Sensors in the Home

- **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?

Results showing fall/weight



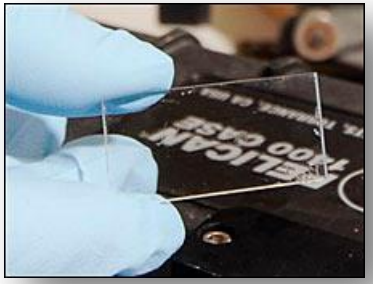




Wii Fit Board

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



Chem/bio sensor chip

Urine collection cup

Intelligent faucet

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

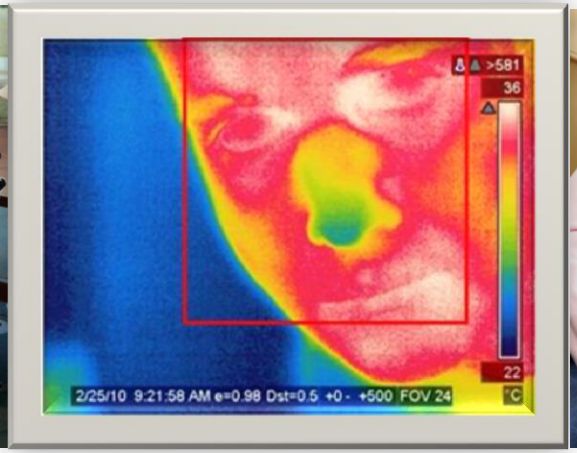
Sensiotec: Remote Vital Signs Monitoring

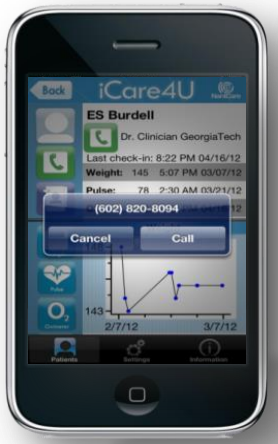
- Fits under mattress or in chair
- Collects respiratory rate and heart rate
- Detects movement
- For use at home or in hospital

http://sensiotec.com/

Thank You

Way Forward





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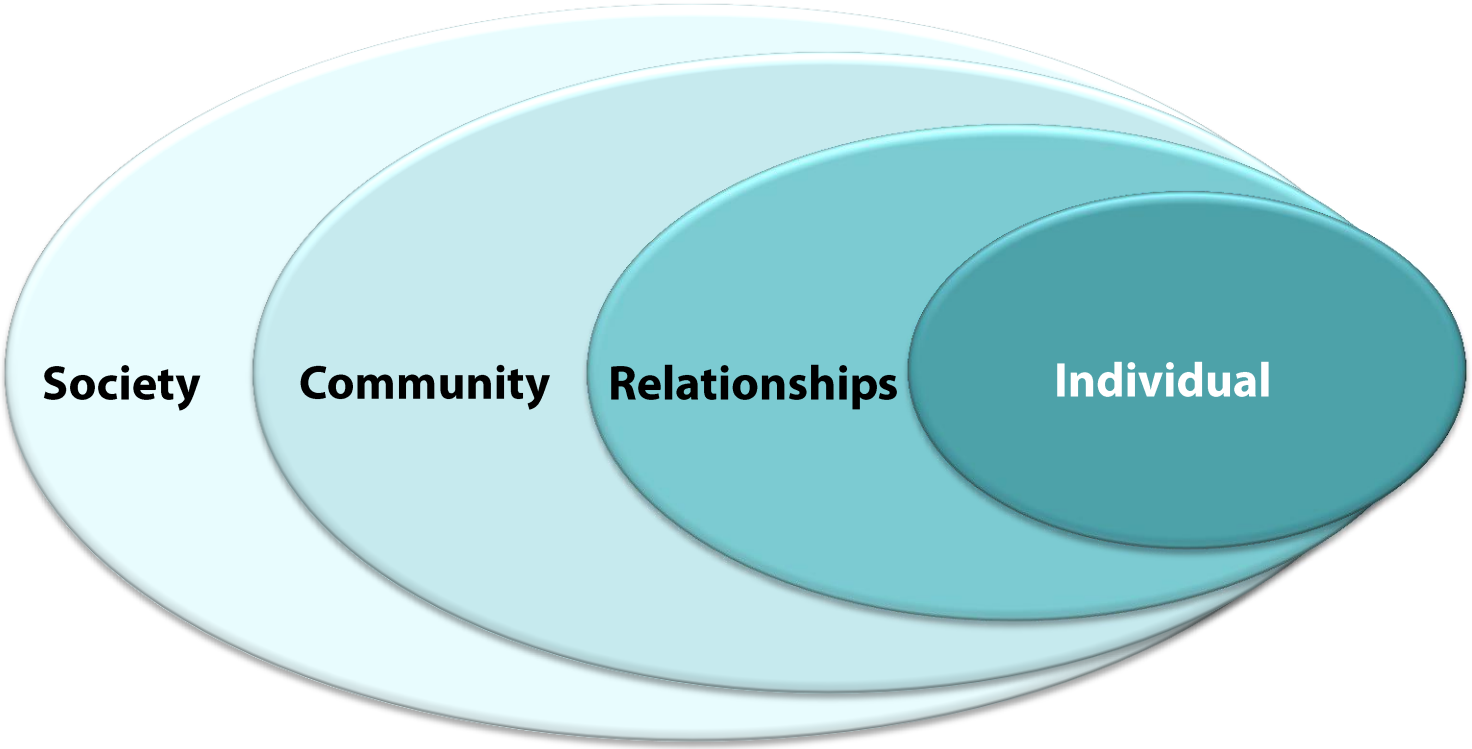
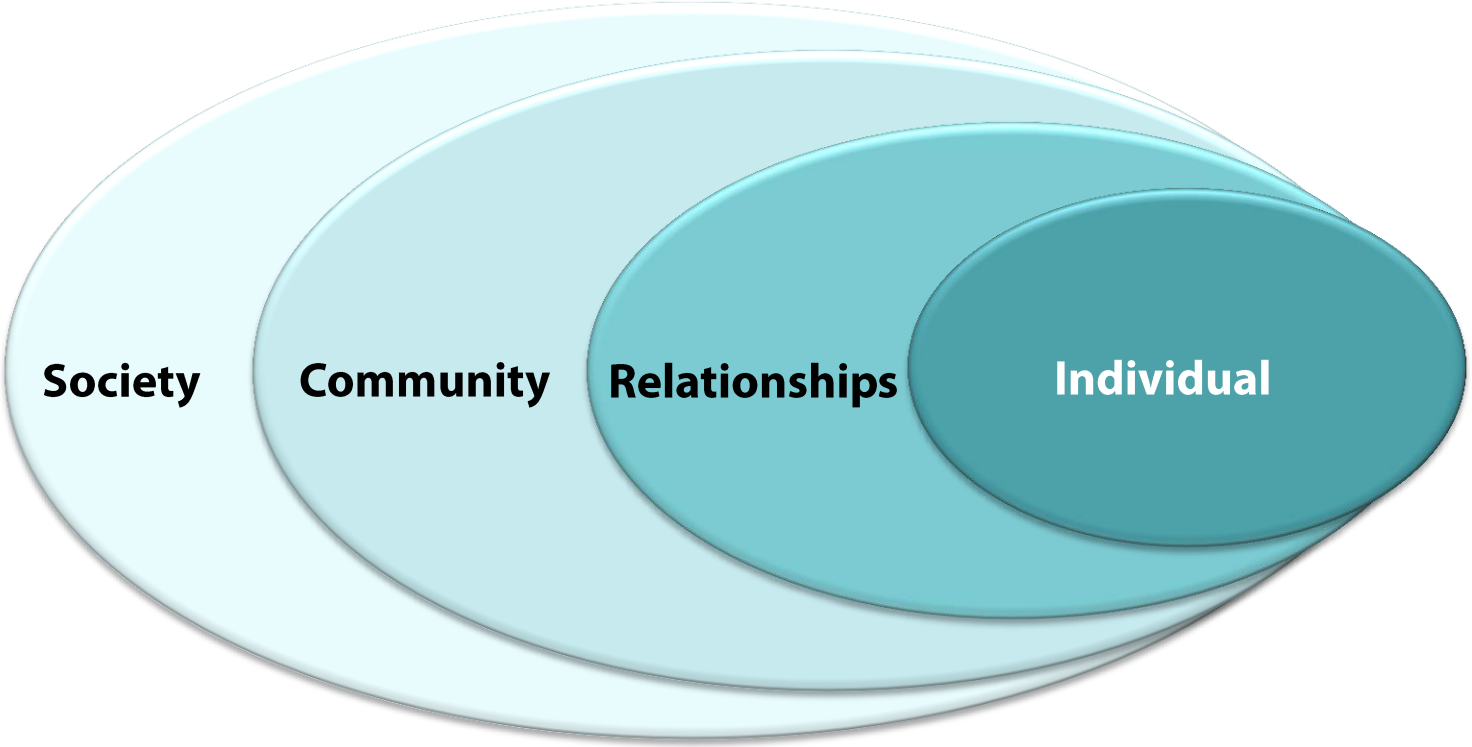
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Social Ecological Model



Dahlberg LL, Krug EG. Violence–a global public health problem. In: WHO World Report on Violence and Health, 2002. Available at http://whqlibdoc.who.int/publications/2002/9241545615_chap1_eng.pdf

Social Ecological Model



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

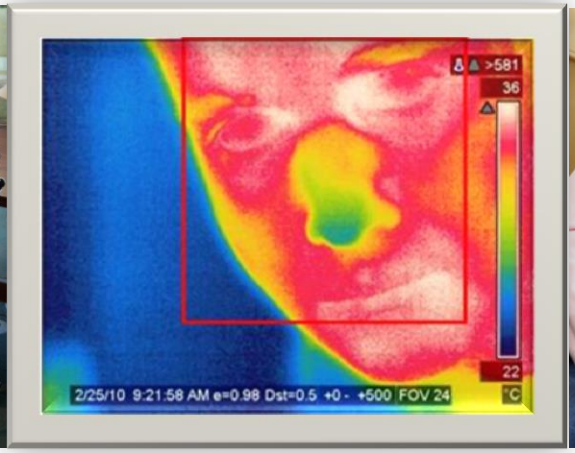
Zickuhr K, Madden M, 2012. Available at http://pewinternet.org/~/media//Files/Reports/2012/PIP_Older_adults_and_internet_use.pdf
Lindeman D. Technology and Aging. In: Public Health for an Aging Society. Baltimore: Johns Hopkins University Press, 2012

Aging and Technology
Public Health Challenges and Opportunities

- **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

Lindeman D. Technology and Aging. In: Public Health for an Aging Society. Baltimore: Johns Hopkins University Press, 2012

Technology and Health
Aging Safely and More Independently



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention