Public Health and an Aging Society

Accessible version: https://youtu.be/XRYyGtAWXnQ
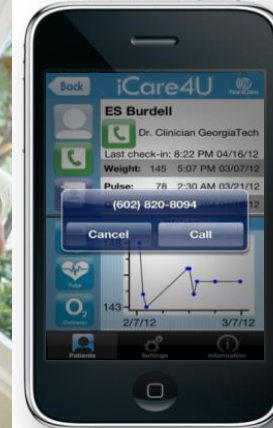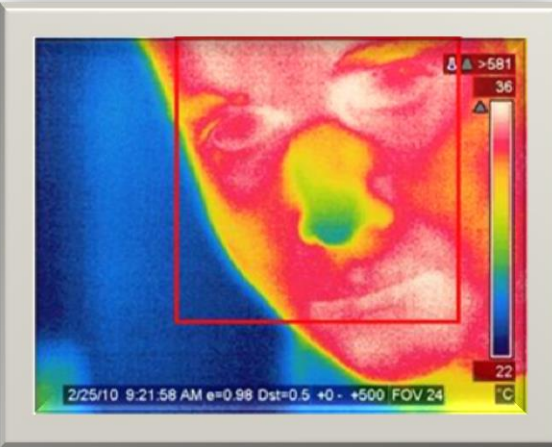
Lynda A. Anderson, PhD
Healthy Aging Program Director
Applied Research and Translation Branch
Division of Population Health
National Center for Chronic Disease Prevention and Health Promotion

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

Millions

Projected

72 million

35 million

≥65 years old

9 million

3 million

≥85 years old   4.2 million

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

Percent

	5.0–9.9
	10.0–14.9
	15.0–19.9
	20.0–30.0

Population ≥65 Years Old
United States, 2025

Percent

	5.0–9.9
	10.0–14.9
	15.0–19.9
	20.0–30.0

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

Percentage (%)

	Non-Hispanic White	Black	Asian	All other races alone or in combination	Hispanic, any race
2010	80	9	3	2	7
Projected 2050	58	12	9	3	20

◻ 2010 **■ Projected 2050**
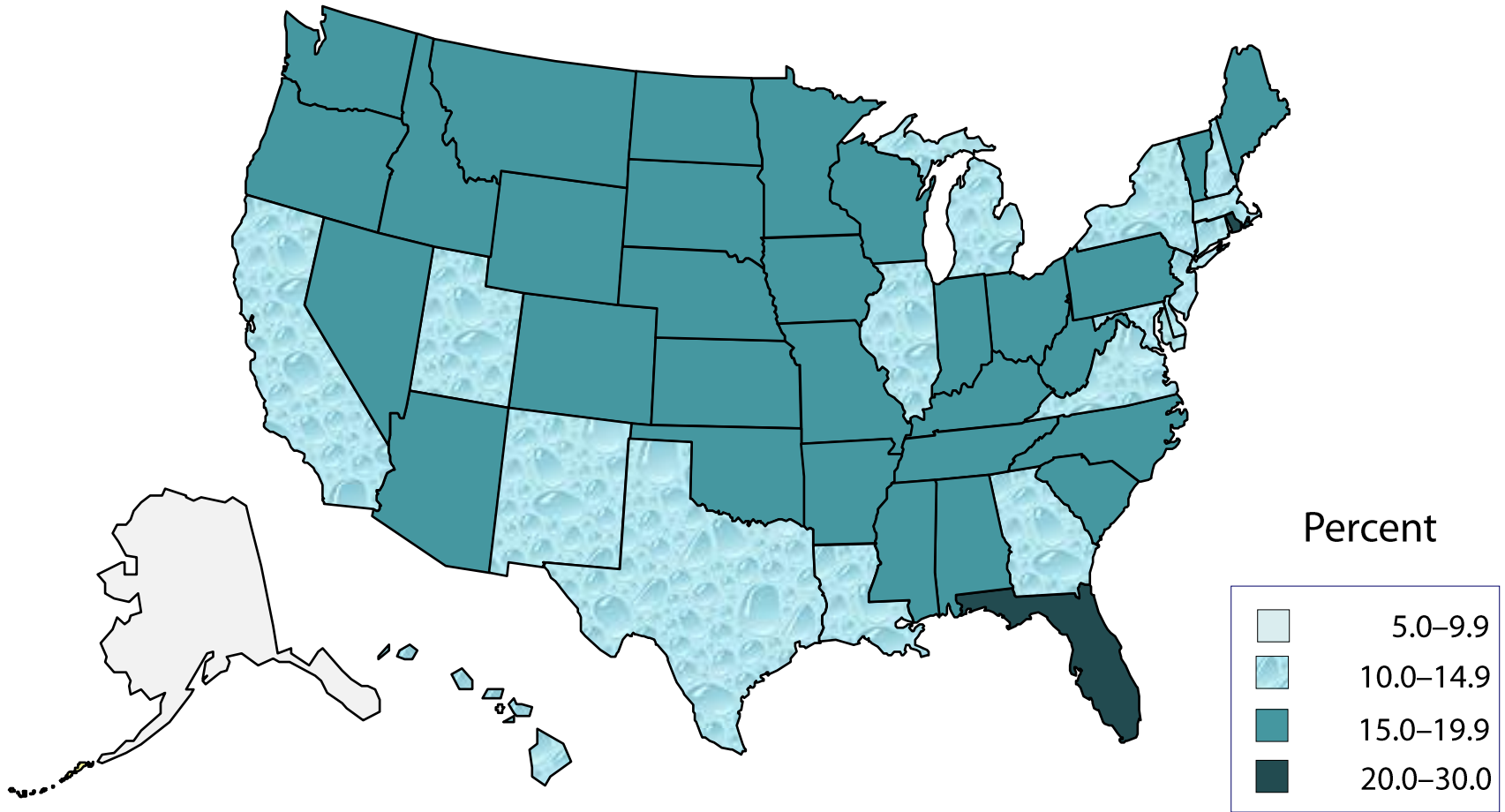
Educational Attainment of Population ≥65 Years Old United States, 1965–2010

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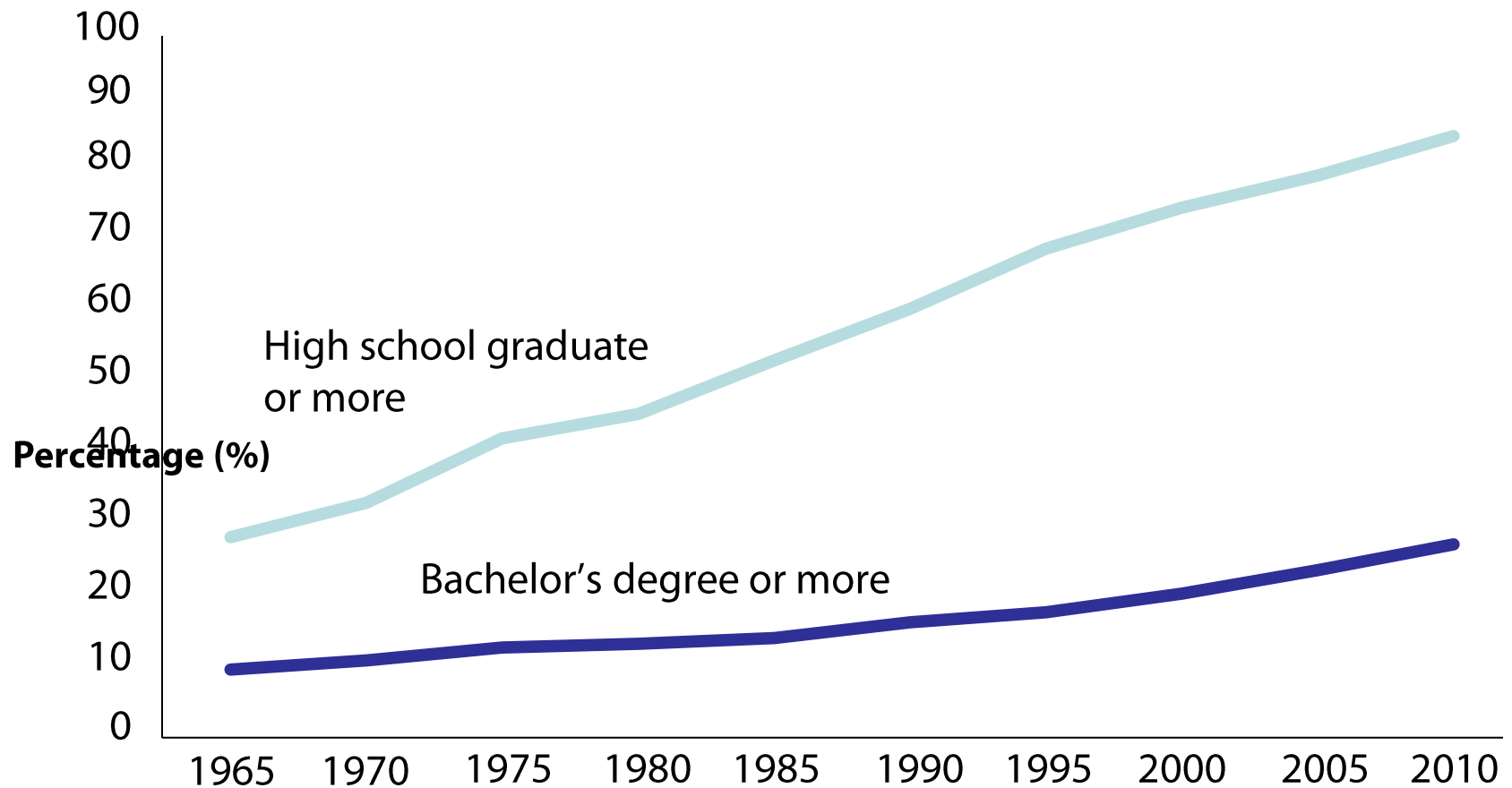
Life Expectancy by Age and Sex of Population ≥65 Years Old, United States, 2009

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

Percent of Population ≥65 Years Old Who Live Alone, United States, 2010
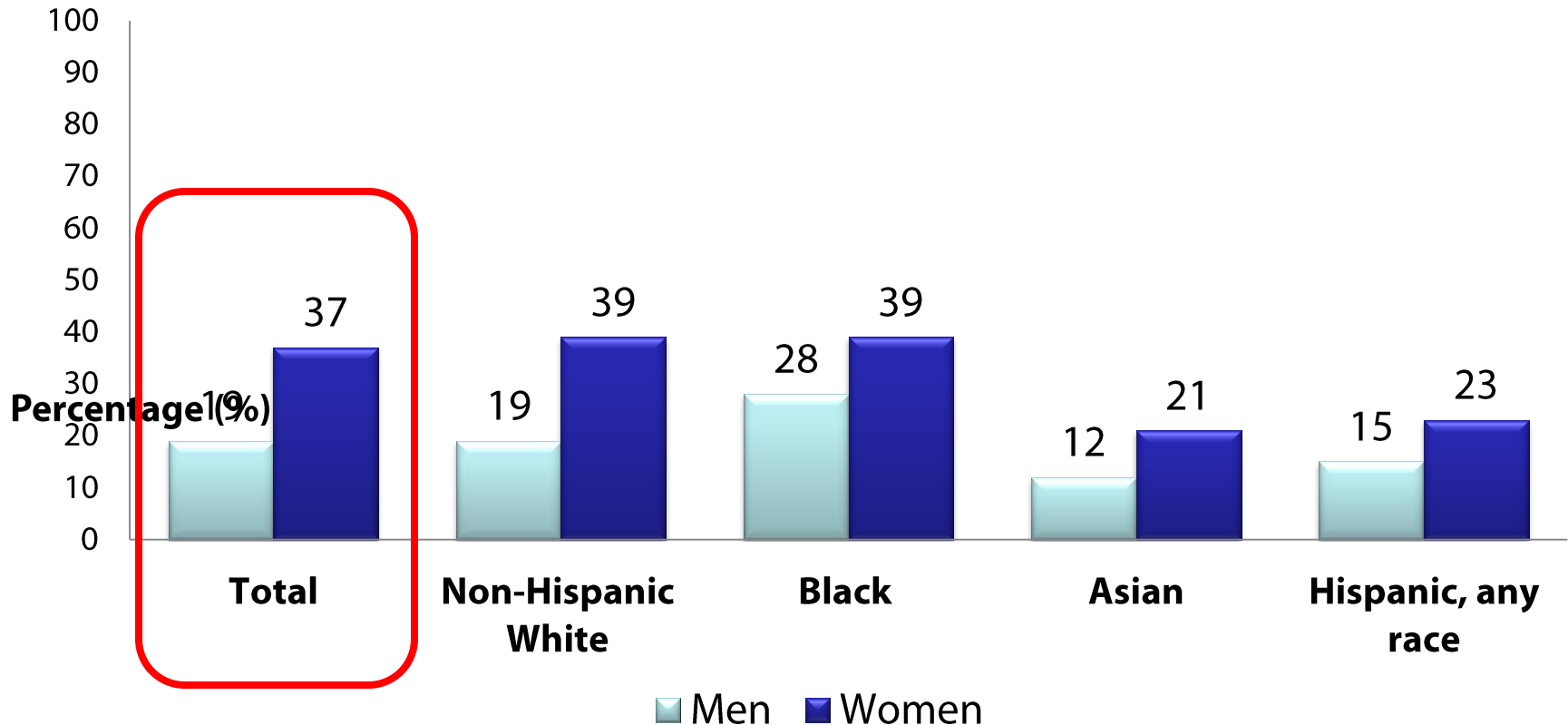
Living Arrangements of Population ≥65 Years Old United States, 2009

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

Most older adults live in the community

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

Percentage (%)

Activity	Men	Women
Any of these	19	30
Walk 2-3 blocks	15	21
Stoop/kneel	10	18
Reach over head	3	4
Lift 10 lbs	7	14
Write/grasp small objects	2	2

Men ☐ Women ■
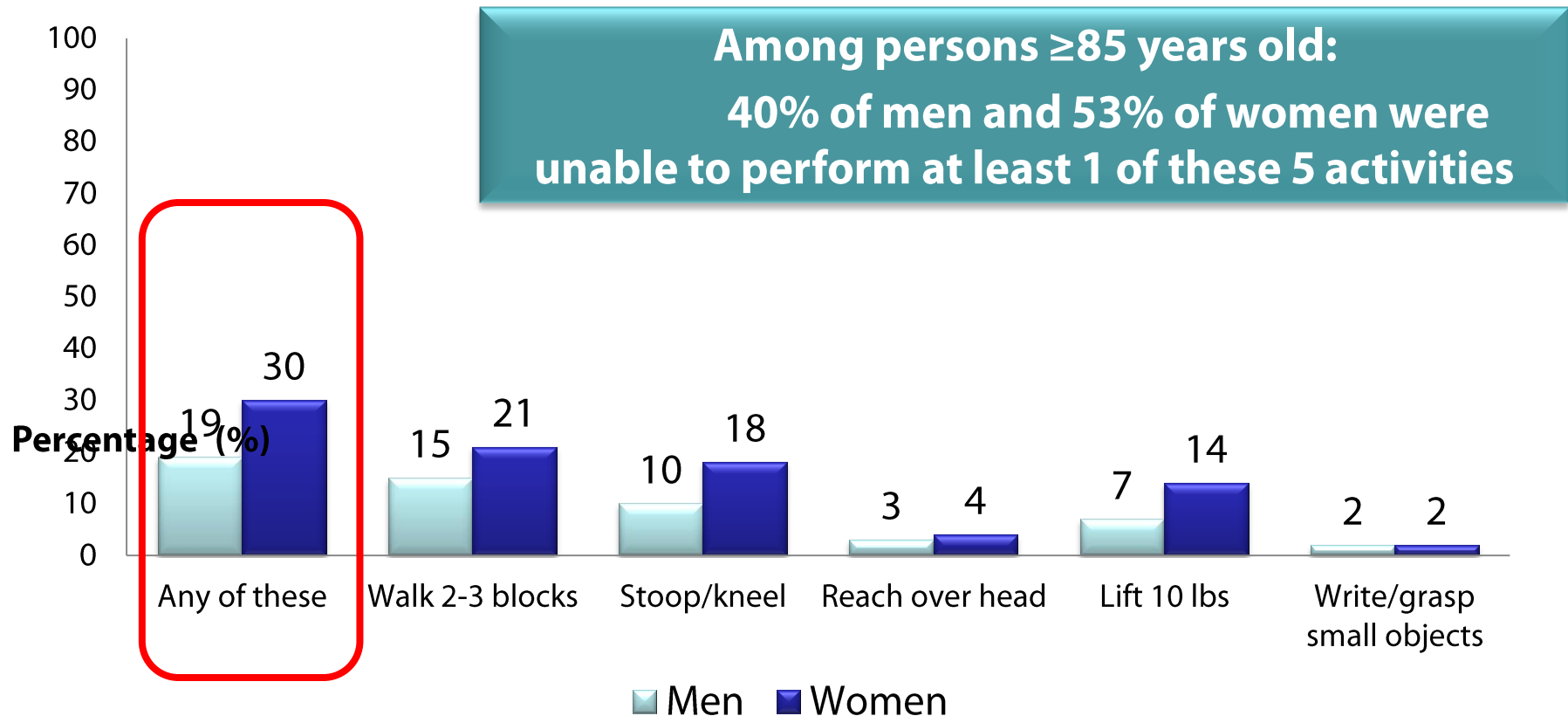
Chronic Conditions and Older Adults

□ **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

Promote health, prevent injury, and manage chronic conditions

Optimal or healthy aging

Facilitate social engagement

Optimize physical, cognitive, and mental health

Supportive Design Strategies to Facilitate Function, Independence, and Safety
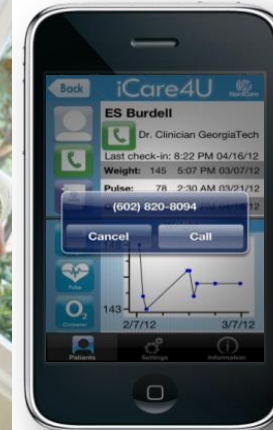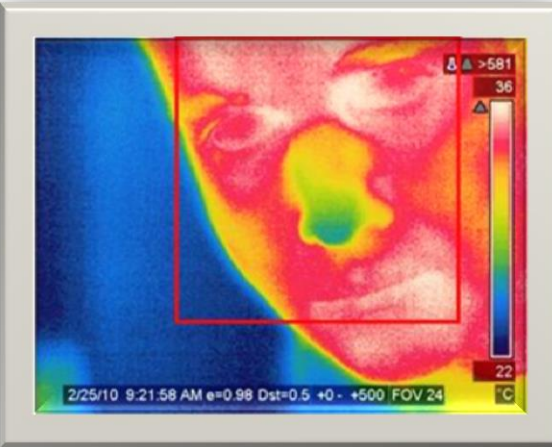
Carrie Bruce, MA, CCC-SLP

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

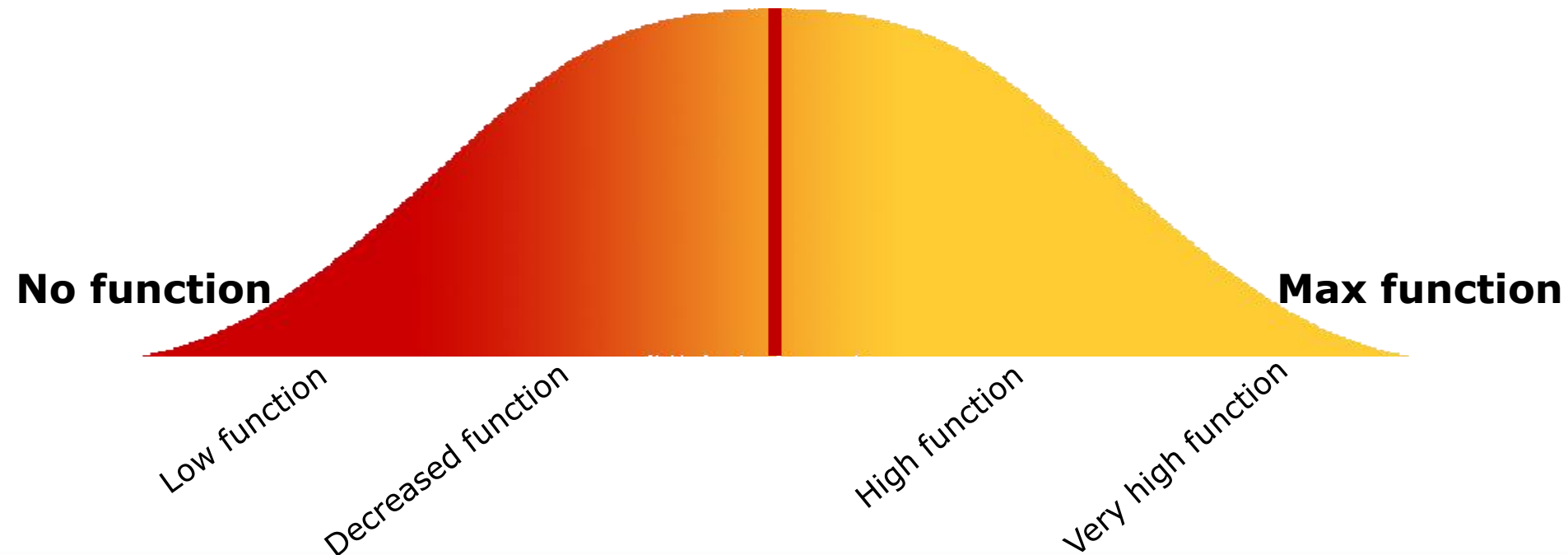**Typical, everyday designs are largely intended for users with "average" level of function**

No function

Max function

Low function

Decreased function

High function

Very high 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

Benefits of Specialized Design
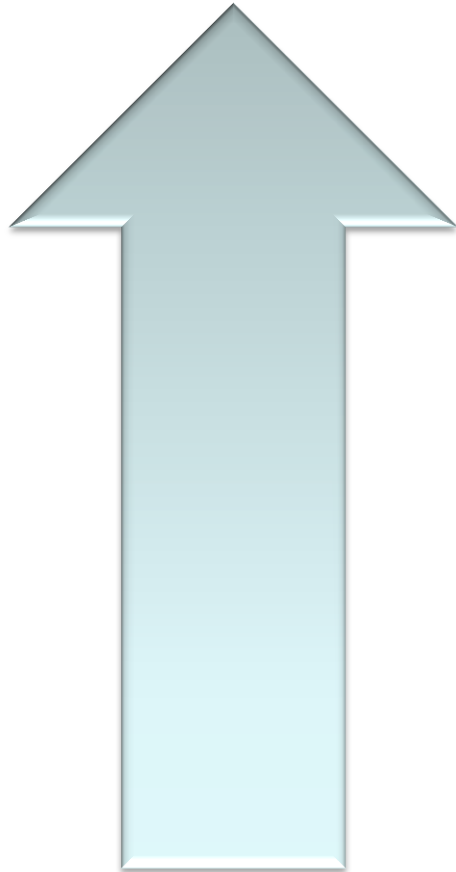
Independence

Confidence in performing household activities

Effectiveness of caregivers
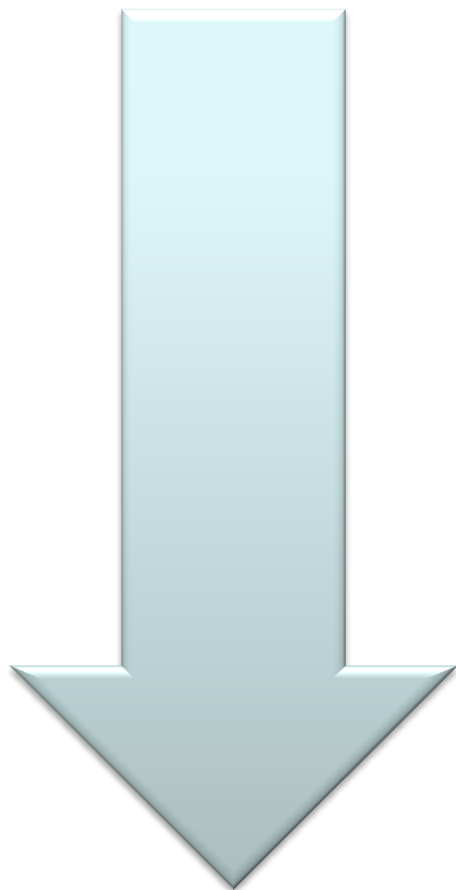
Frequency of travel to community destinations

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

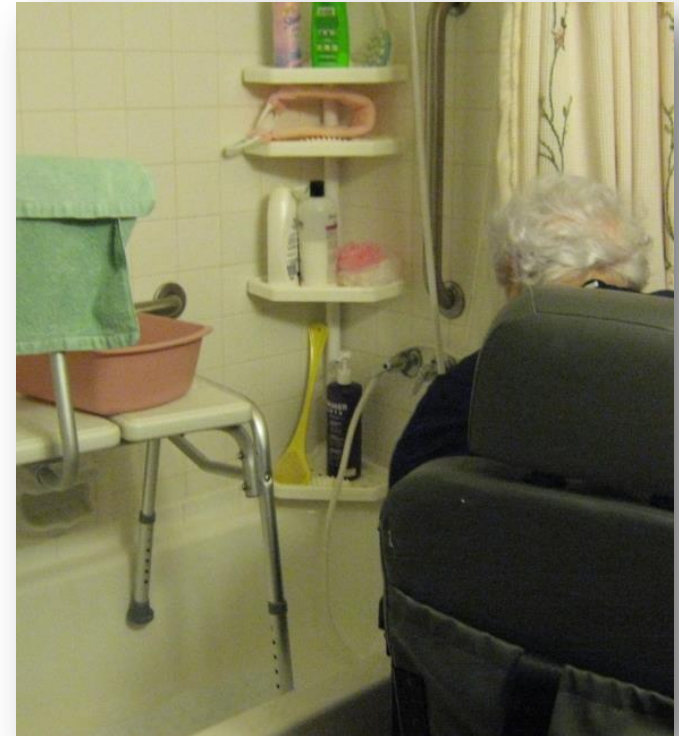# Benefits of Specialized Design

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
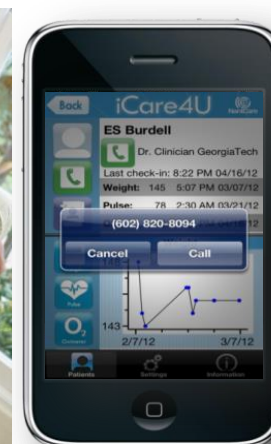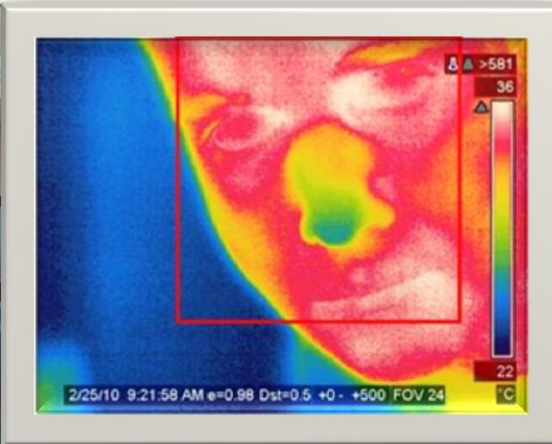
Brian D. Jones, MSEE

Director, Aware Home Research Initiative
Senior Research Engineer, Interactive Media Technology Center
Georgia Institute of Technology, Atlanta, GA

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
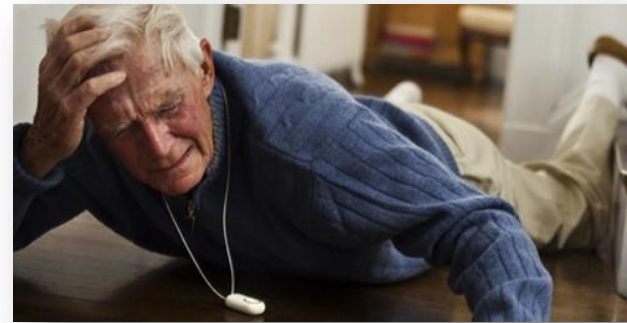
❑ **PERS capability plus automatic fall detection**

  ➢ 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

Safety
Ambient (Passive) Monitoring

QuietCare System

❑ **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

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
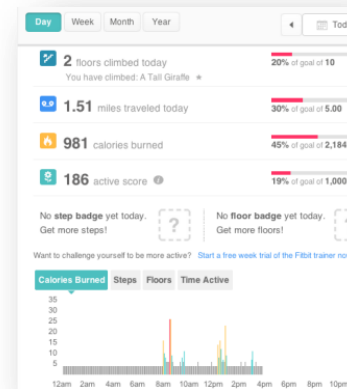

OnaCom devices: generation 2 (left) and 3 (right)

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)
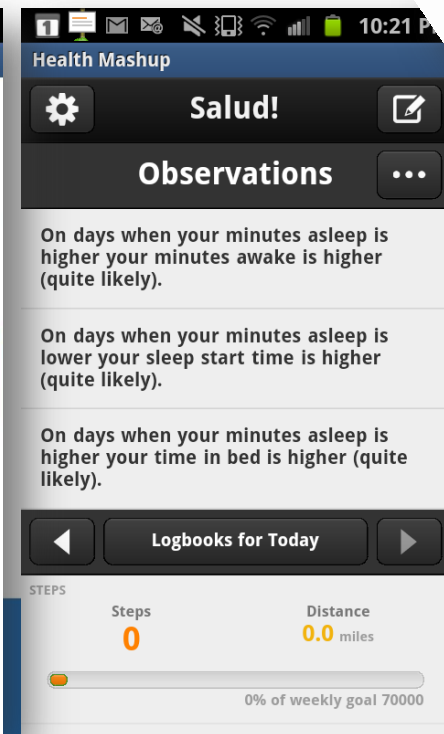 ➢ Free or busy calendar (phone)
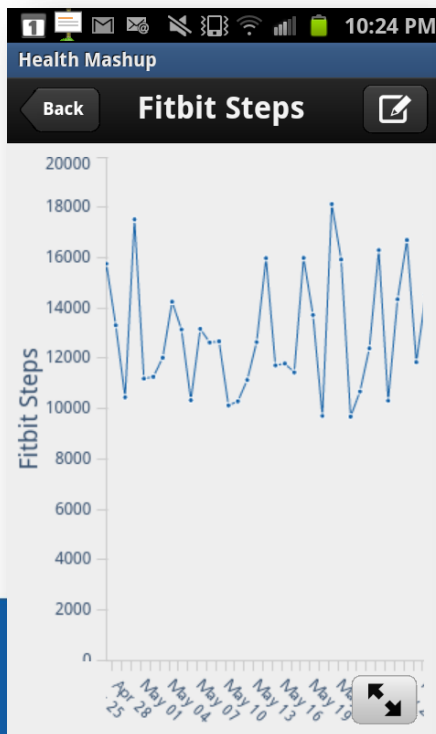 ➢ Self-report (food, mood, pain)

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

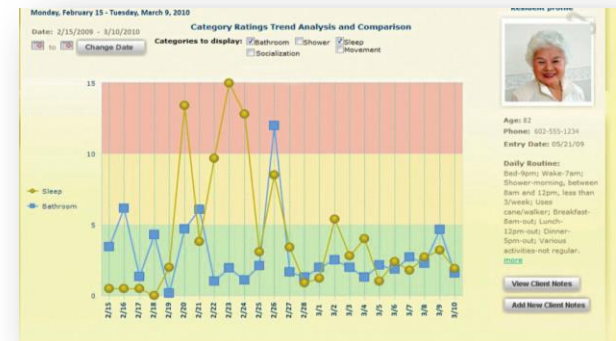- ❑ **Wellness data applicable to health**
  - ➤ Exercise
  - ➤ Nutrition
  - ➤ Weight
- ❑ **Telehealth and home monitoring**
  - ➤ Vitals measurements
  - ➤ Medication tracking
- ❑ **Longitudinal trends**

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

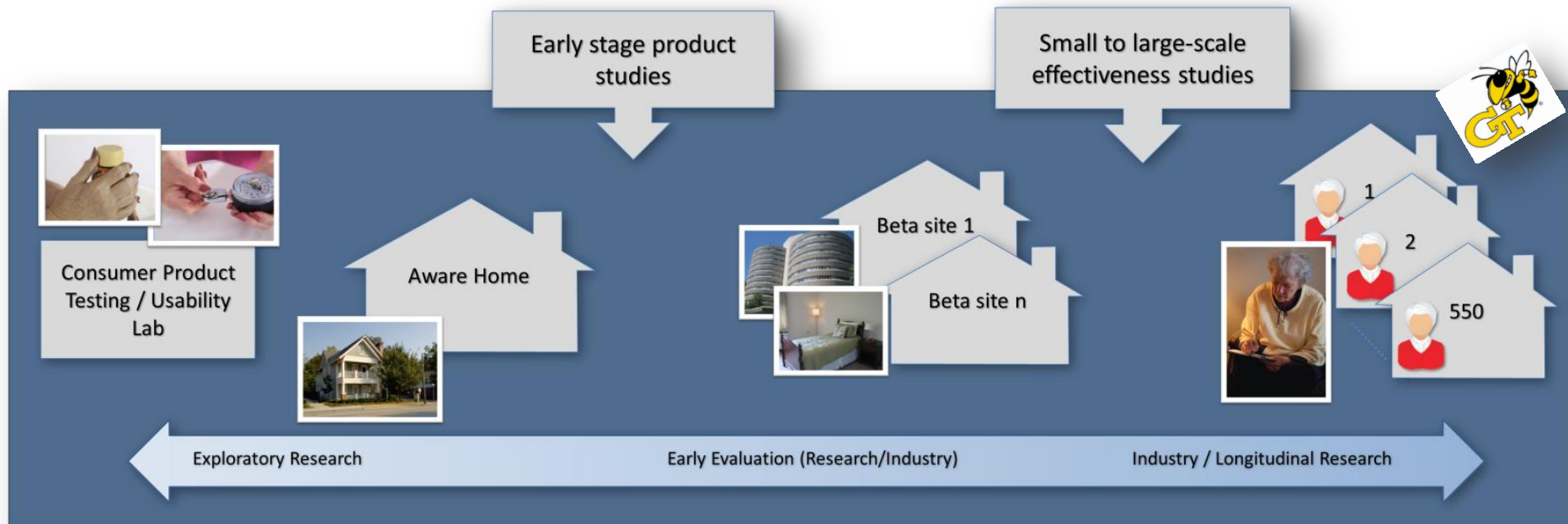 ▪ Pressure patterns can identify fixture use (toilet, shower)

toilet

kitchen sink cold
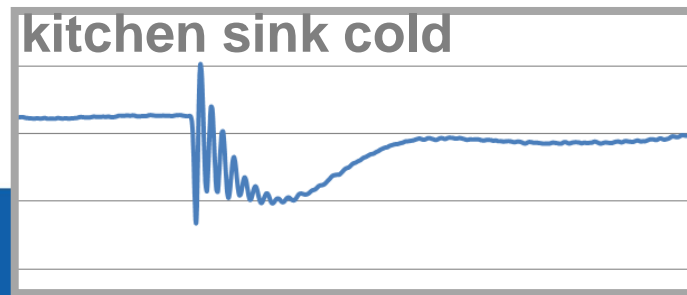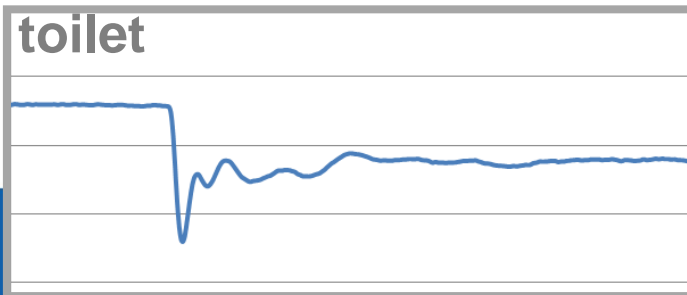
![Georgia Tech HomeLab]
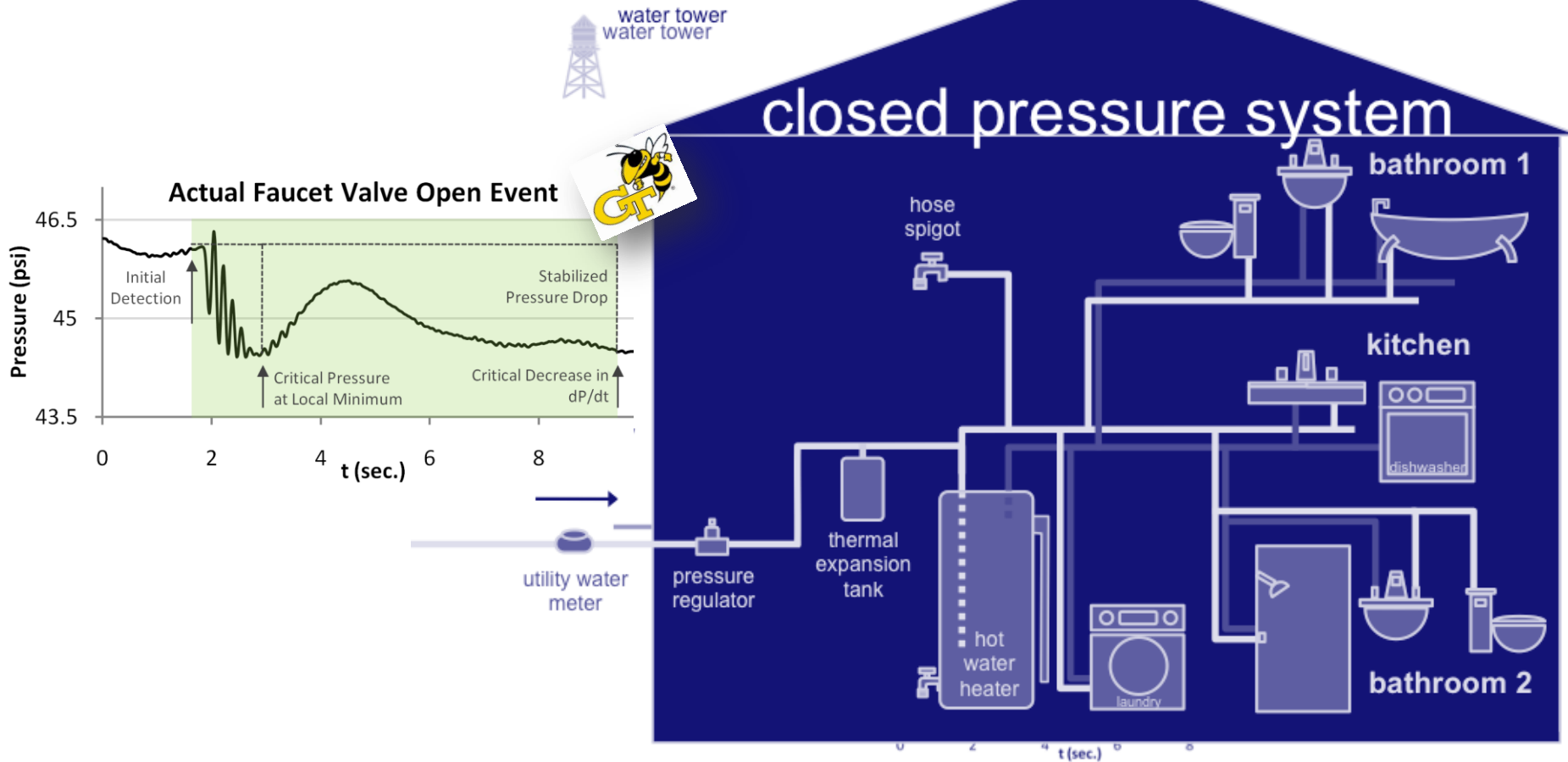
HomeLab is a network of participants ≥50 years old willing to evaluate technology from research or from industry in their homes and lives.

Early stage product studies

Small to large-scale effectiveness studies

Consumer Product Testing / Usability Lab

Aware Home

Beta site 1

Beta site n

1

2

550

Exploratory Research

Early Evaluation (Research/Industry)

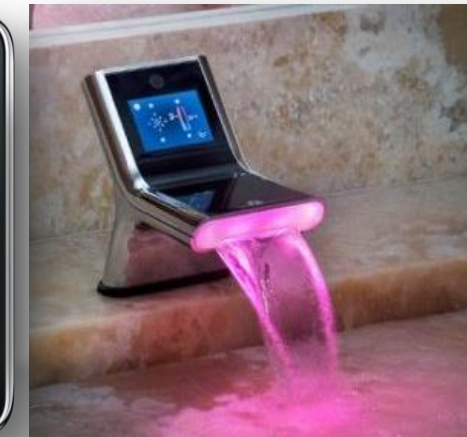Industry / Longitudinal Research

http://homelab.gtri.gatech.edu/
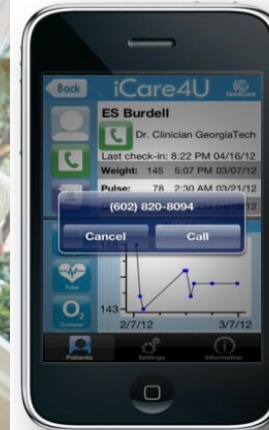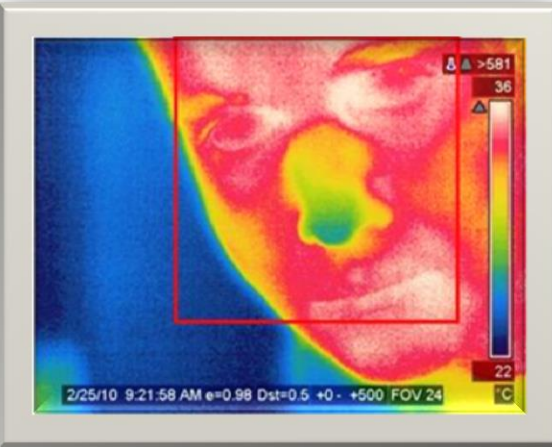
Georgia Tech research:
Improve today's technology solutions to address greater challenges facing the aging population tomorrow

Individual-Centered Technology

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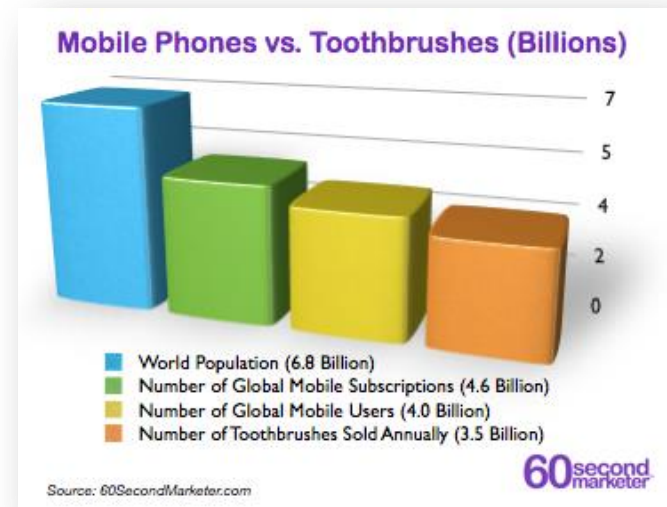Georgia Tech Research Institute, Atlanta, GA

GeorgiaInstitute 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"**

Mobile Phones vs. Toothbrushes (Billions)

- World Population (6.8 Billion)
- Number of Global Mobile Subscriptions (4.6 Billion)
- Number of Global Mobile Users (4.0 Billion)
- Number of Toothbrushes Sold Annually (3.5 Billion)

Source: 60SecondMarketer.com

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 mirror**

➤ Interactive (speech control, visual tests)

➤ Eye tracking

➤ Face recognition (identify patient)

➤ Cameras

  ▪ Infrared (temperature)

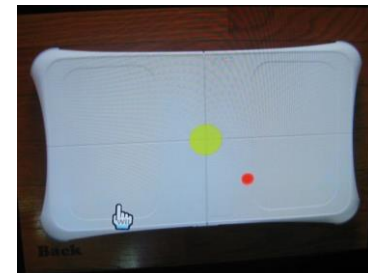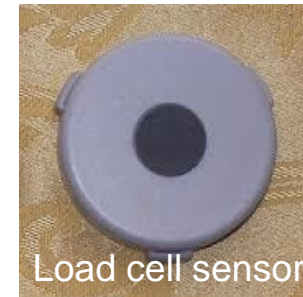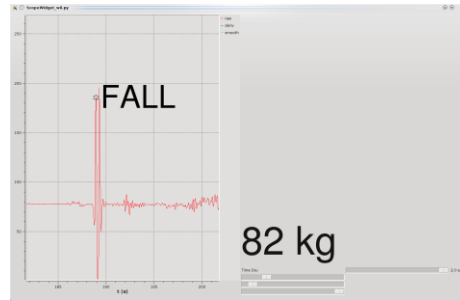 ▪ Visible (color changes, movement)

➤ Image analysis

Intelligent Bathroom: Sensors in the Home

❑ Intelligent floor (pressure sensors, etc.)

- ➢ Weight
- ➢ Balance
- ➢ Falls
- ➢ Gait
- ➢ Triggers

Results showing fall/weight

FALL

82 kg


Load cell sensor

Wii Fit Board

- ▪ 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?

Chem/bio sensor chip

❑ **Intelligent toilet**

➤ Chemical/biological sensor

▪ Blood, protein, drugs, etc. in 24-hour urine sample

➤ Antibody targeted for specific bacteria, virus, or protein
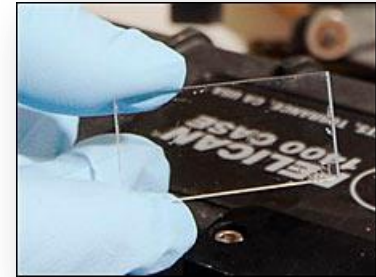
❑ **Other possible sensors**

➤ Toothbrush

➤ Water sensor for shower

➤ iHouse smart faucet

▪ Face recognition

▪ Temperature and flow control

▪ Color coding

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**
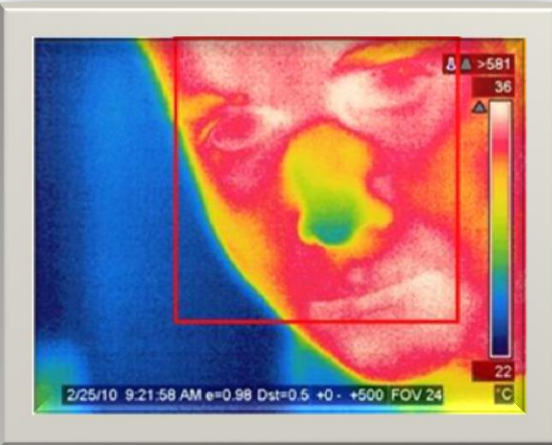- ❑ **For use at home or in hospital**

http://sensiotec.com/

Thank You

Way Forward
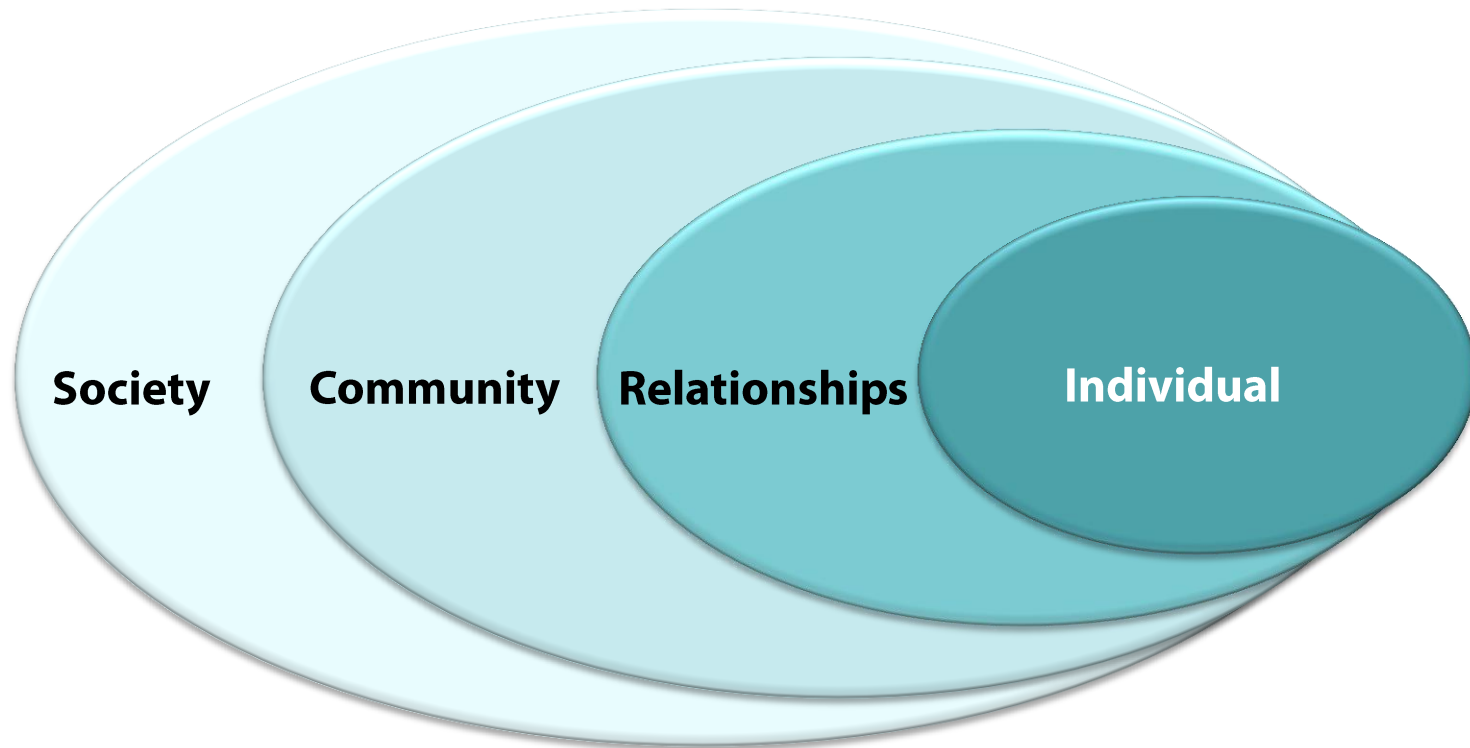

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U.S. Department of Health and Human Services
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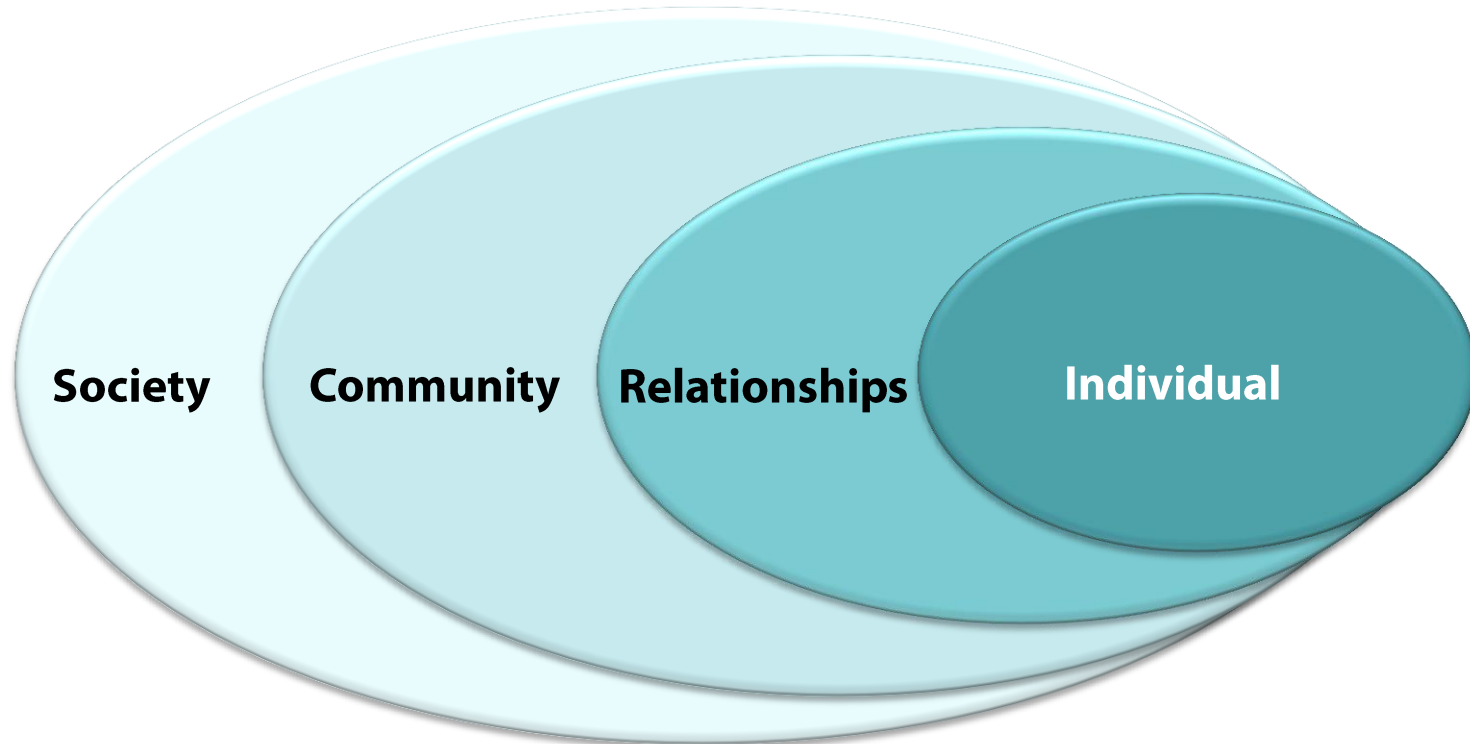
Social Ecological Model

Society   Community   Relationships   Individual

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

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

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

❑ **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