

# **Inclusive Telehealth: A Platform for Patient Engagement**

George Demiris PhD, FACMI  
University of Pennsylvania



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- The pandemic led to an unprecedented acceleration in the use of telehealth for Medicare beneficiaries
- By July 2021 telehealth utilization stabilized at levels 38 times higher than before the pandemic<sup>1</sup>

<sup>1</sup> <https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/telehealth-a-quarter-trillion-dollar-post-covid-19-reality>

# Bridging the Gap

- Findings from Penn Medicine: Racial disparity in follow-up appointments disappears with telemedicine
- An inequity in the rate of Black patients making it to their primary care appointment after a hospitalization was eliminated after telemedicine became widely used amid the COVID-19 pandemic.
- Bressman E, Werner RM, Childs C, Albrecht A, Myers JS, Adusumalli S. Association of Telemedicine with Primary Care Appointment Access After Hospital Discharge. J Gen Intern Med. 2022 Jan 11:1–3.

# Challenges

- Still facing disparities in telehealth utilization
- Lack of broadband services
- Users with inexperience using technology
- Functional, cognitive, visual or hearing limitations
- Limited English proficiency
- Lack of personal support network

# Inclusivity as a mandate for telehealth systems

- a “digital public infrastructure” that will recognize the Internet and online platforms as public utilities accessible to all (and regulated as such)
- reflected in product design for new telemedicine hardware and software and in reimbursement requirements
- partnerships with patient advocacy groups
- provide future health care providers with tools to advocate for accessibility of digital platforms
- rethink the role of patient navigators

# Precision Medicine

- Precision medicine calls for collecting and analyzing large data collected on the unique individual's:
  - behavior
  - lifestyle
  - genetics
  - environmental context



# Behavioral Sensing

- Passive monitoring & Wearable technologies
- Vision: **objectively, remotely, and continuously** measure aspects of patient physiology, behavior and symptoms

# Behavioral sensing (cont.)

- Capturing behavior and activities of daily living
- Replacing the need for human observers
- Eliminating reliance on self-report
- Shifting from episodic to continuous monitoring
- Assessment in the real world and not the lab
- Identifying events and trends and patterns



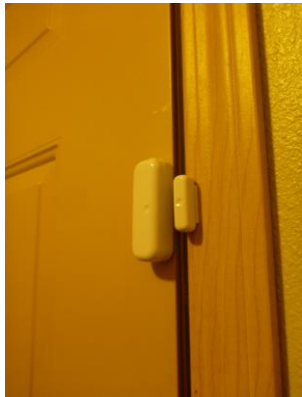
# Smart home

- A residence with embedded technology that facilitates passive monitoring of residents to enhance their safety, independence and well-being
- Emergence of IoT devices



# Smart Home Initiative

- Community dwelling older adults (65 years or older) in private residence, retirement community, assisted living facility
- Choice of sensor type and data sharing with trusted others



## Door/Window sensor

- Door/window activity tracking



## Multi-sensor

- Temperature
- Humidity
- Luminosity
- Motion

# System Features

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does not require retrofitting the home

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works passively

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individual sensors can easily be replaced when more advanced technologies become available

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does not utilize cameras or face recognition technologies

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privacy preserving approach

# Engaging Users

- **dashboard** for residents and their family members or trusted others to review **actionable information** about
  - mobility, social interactions, sedentary behavior, restlessness at night, frequency and duration of meal preparation, time spent inside vs outside the home
- **alerts** are generated in cases where an adverse event may have occurred.

# Visualizing Smart Home Data

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Various stakeholders

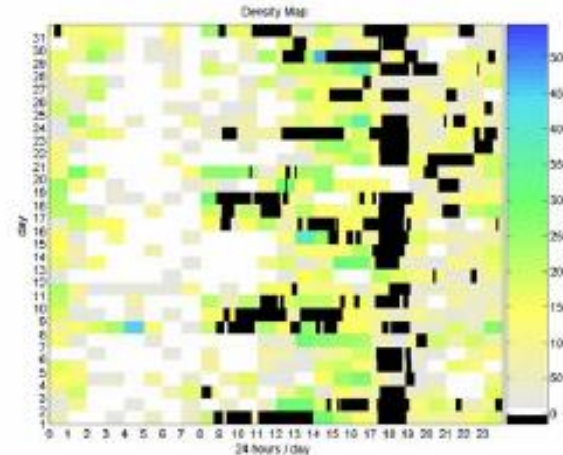
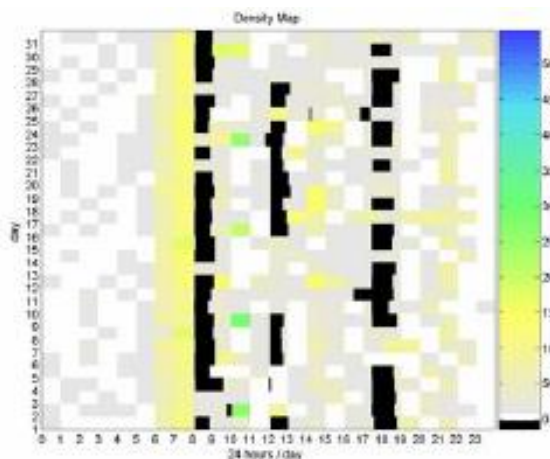
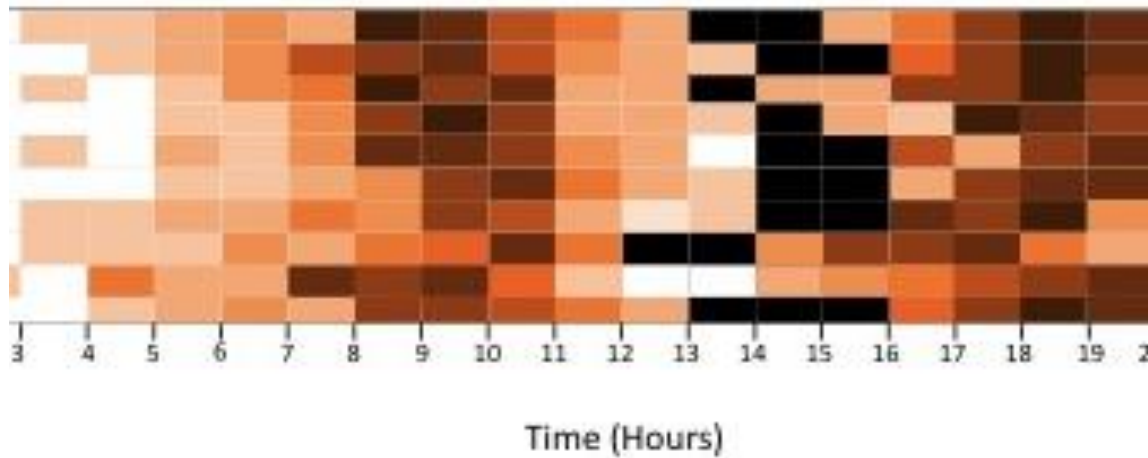
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Various information needs and purposes of use

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Support efficient and effortless extraction of important information pertaining to events, trends and patterns

Density Map of Sensor Activity Per Hour



Demiris G, Oliver DP, Dickey G, Skubic M, Rantz M. Findings from a participatory evaluation of a smart home application for older adults. *Technol Health Care*. 2008;16(2):111-8.

Wang S, Skubic M, Zhu Y. Activity Density Map Visualization and Dis-similarity Comparison for Eldercare Monitoring. *IEEE Trans on IT in Biomed*. 2012;16(4):607-614.

# Patient Engagement

- How to actively and meaningfully engage patients and families



A technology enhanced fall risk assessment and fall prevention nursing intervention for socially vulnerable older adults with mild cognitive impairment

<http://www.sense4safety.org>



# Sense4Safety

- Falls in OA a result of accumulated vulnerabilities
- MCI and housing conditions are each independent risk factors for multiple falls.
- Cognitive impairment is a leading risk factor for falls in OA.
- Over 60% of OA with MCI fall annually – *two to three times* the rate of those without cognitive impairment.
- OA living in low-resource neighborhoods with poor housing conditions have *twice* the risk of falling.

# Sense4Safety (cont.)

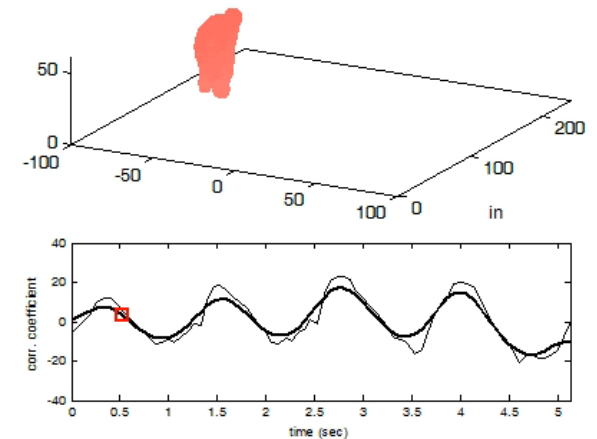
- Technology-supported intervention to:
  - link ‘at risk’ older adults with a nurse tele-coach who will guide them in implementing evidence-based individualized plans to reduce fall-risk
  - identify escalating risk for falls real-time through in-home passive sensor monitoring
  - employ machine learning to inform individualized plans to reduce fall risk



# Capturing Gait in the Home Using Depth Data



Stone & Skubic, *JAISE*, 2011, *TBE*, 2013



# Capturing Gait Changes

Gait Parameters

Estimated TUG (Fall Risk)

Walk Data Scatter Plots and Model(s)

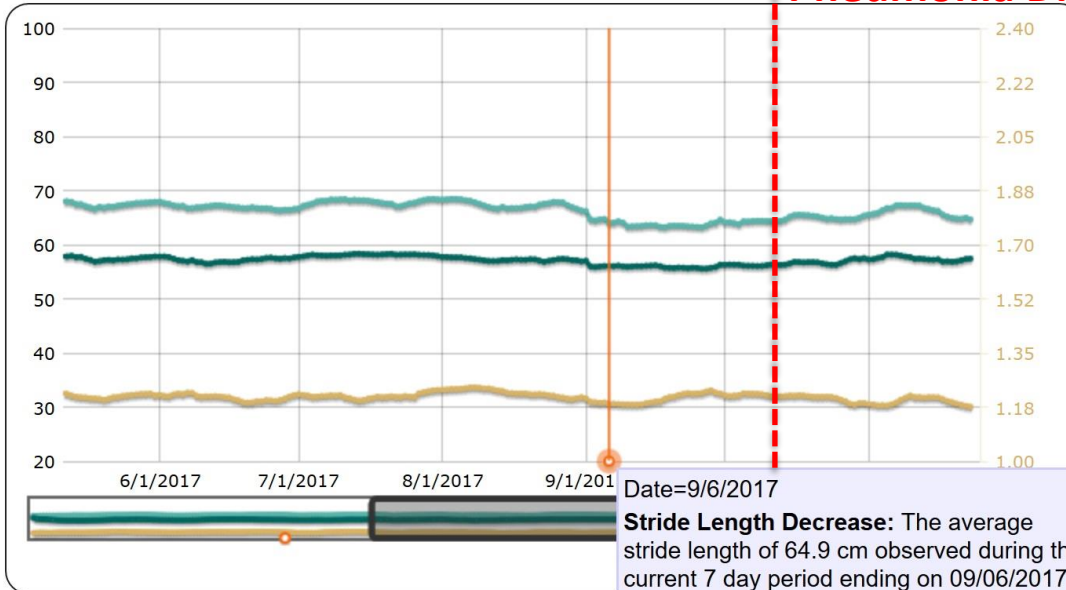
Model Initialization

Model Window Size: 30 days

Data Window Size: 14 days

**ALERT**

**Pneumonia Diagnosis**



Date=9/6/2017

**Stride Length Decrease:** The average stride length of 64.9 cm observed during the current 7 day period ending on 09/06/2017 is 3.1 cm (4.6%) lower than the average stride length of 68.0 cm observed during the 7 day baseline period which ended on 04/15/2017.

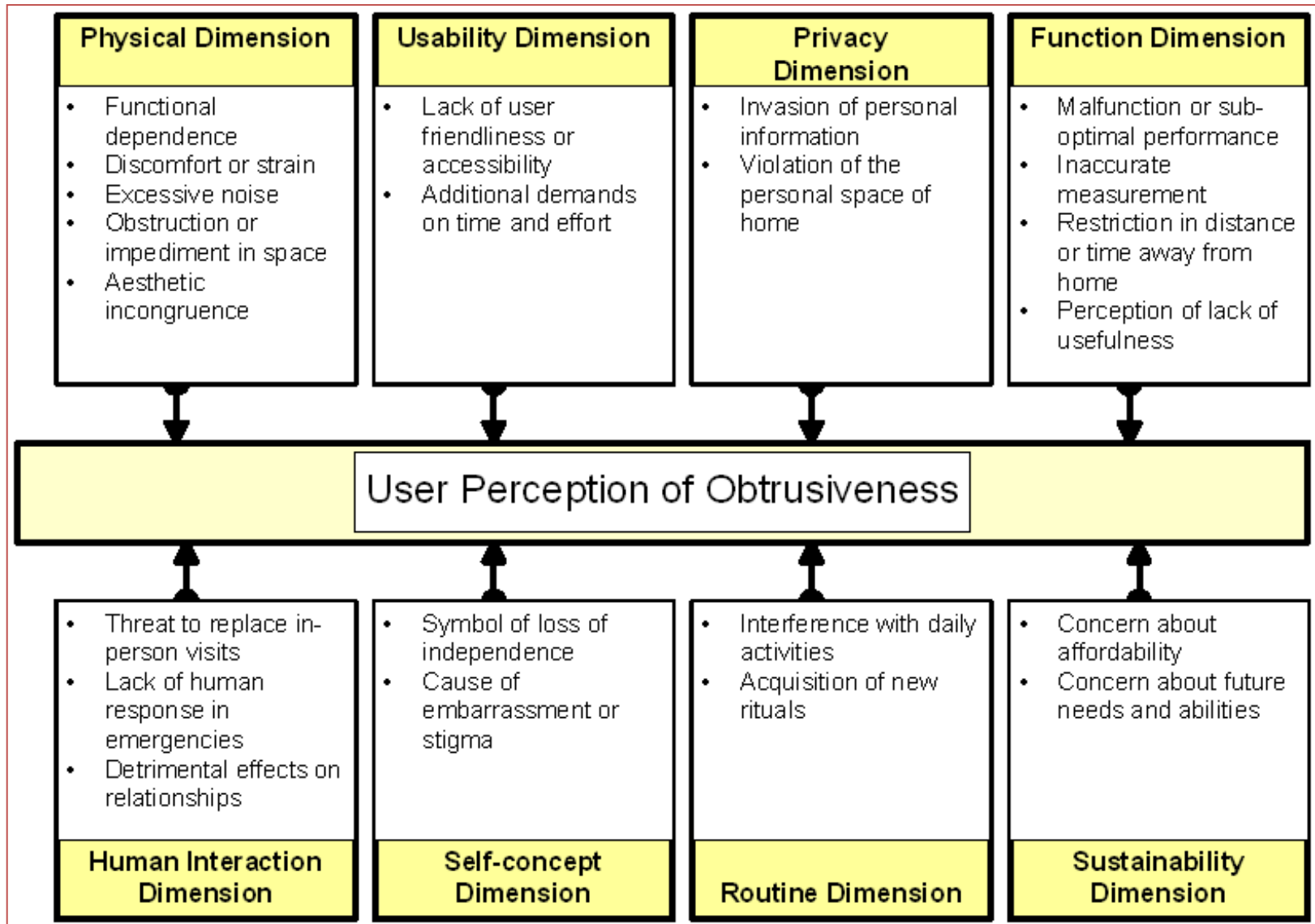
# Obtrusiveness

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- A summary evaluation by the user based on characteristics or effects associated with the technology that are perceived as *undesirable* and *physically and/or psychologically prominent*



# Obtrusiveness Framework



# Considerations

- Research
- Policy
- Implications for the Clinical Workforce
- Consumer Education

# Research

- Further explore:
  - Impact on health outcomes, cost, efficiency
  - Patient engagement
  - Shared decision making, care coordination
  - New models of patient-centered care delivery
  - Healthcare utilization
  - Accuracy and reliability of data in various settings
  - How data can be standardized
  - Data visualization



# Policy

- Guiding interoperability
- Standards around tracking modalities
- Liability
- Privacy Policy
- Reimbursement structures

# Implications for the Clinical Workforce

- Integration into clinical workflow
- Patient generated data and the EHR
- Interpreting data
- Sifting through large quantities of data
  - Real-time alert systems, artifact
- Delegation of responsibilities for review

# Consumer Education

- How to select accurate, reliable tools
- Interpretation of data
- Discuss and understand expectations
- How not to exacerbate disparities
- Introducing challenges of “*data literacy*” on top of health and digital literacy
  - Users understanding of the use of their data, where stored, who has access?

# Contact



- [gdemiris@upenn.edu](mailto:gdemiris@upenn.edu)

 @GeorgeD5PHL

