Ambient Based Monitoring: Autonomous and unobtrusive physiology and activity monitoring

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Occupational Science & Occupational Therapy
UNIVERSITY OF TORONTO

Toronto Rehab
Rehabilitation saves life.

Problem

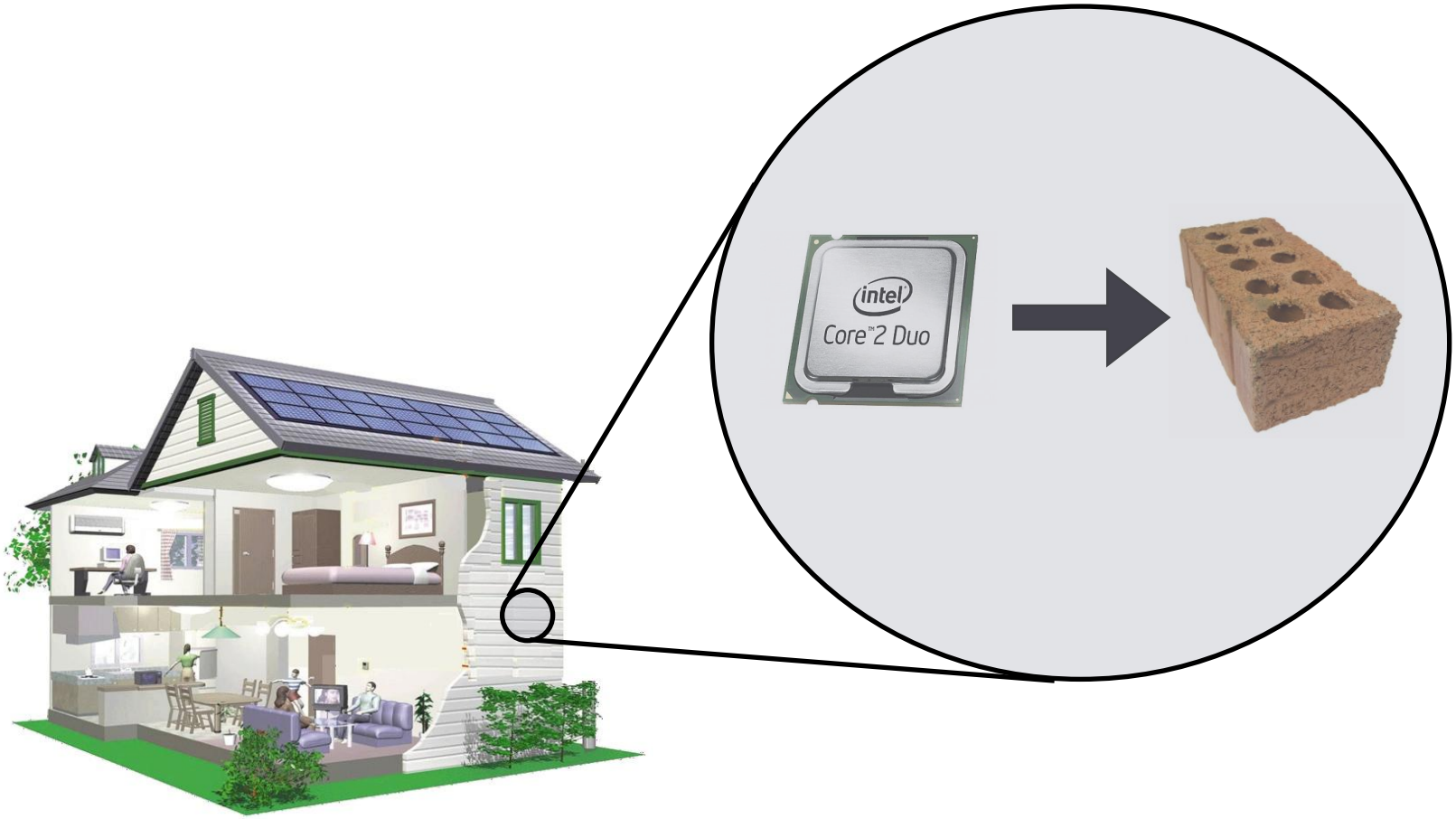
- Canada's aging population
  - Unprecedented growth in our senior population
  - Hospitals, long-term care facilities reaching limits
- Challenges in self-managing chronic conditions
  - Familiarity with the methods/frequency/actions
  - Dexterity and cognitive ability
- Physiology and activity as separate entities
  - Current systems lack the integration of the two

Zero-Effort Technology

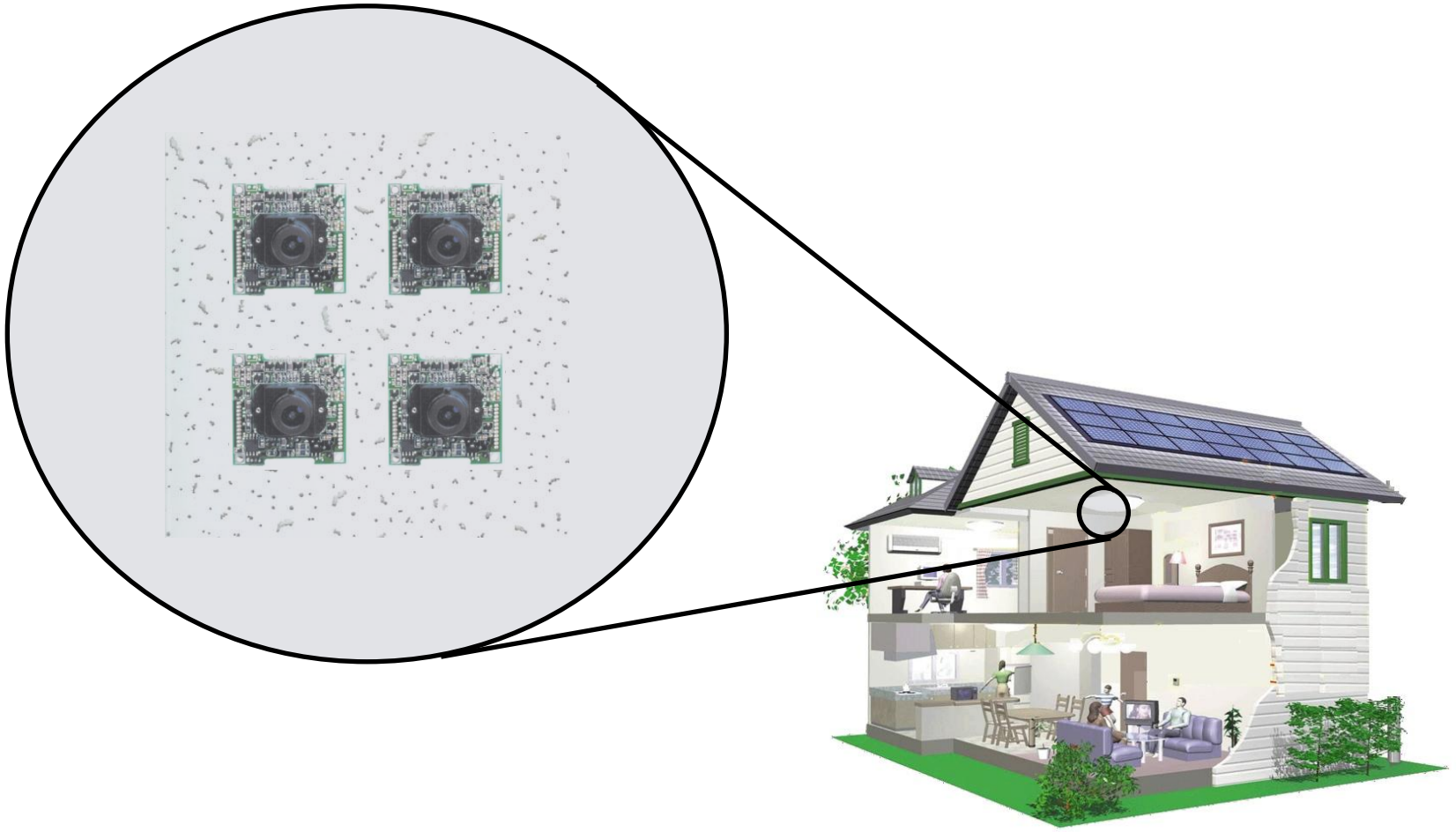
This is all accomplished without any manual input or effort by the user or caregiver

Remember from last year…

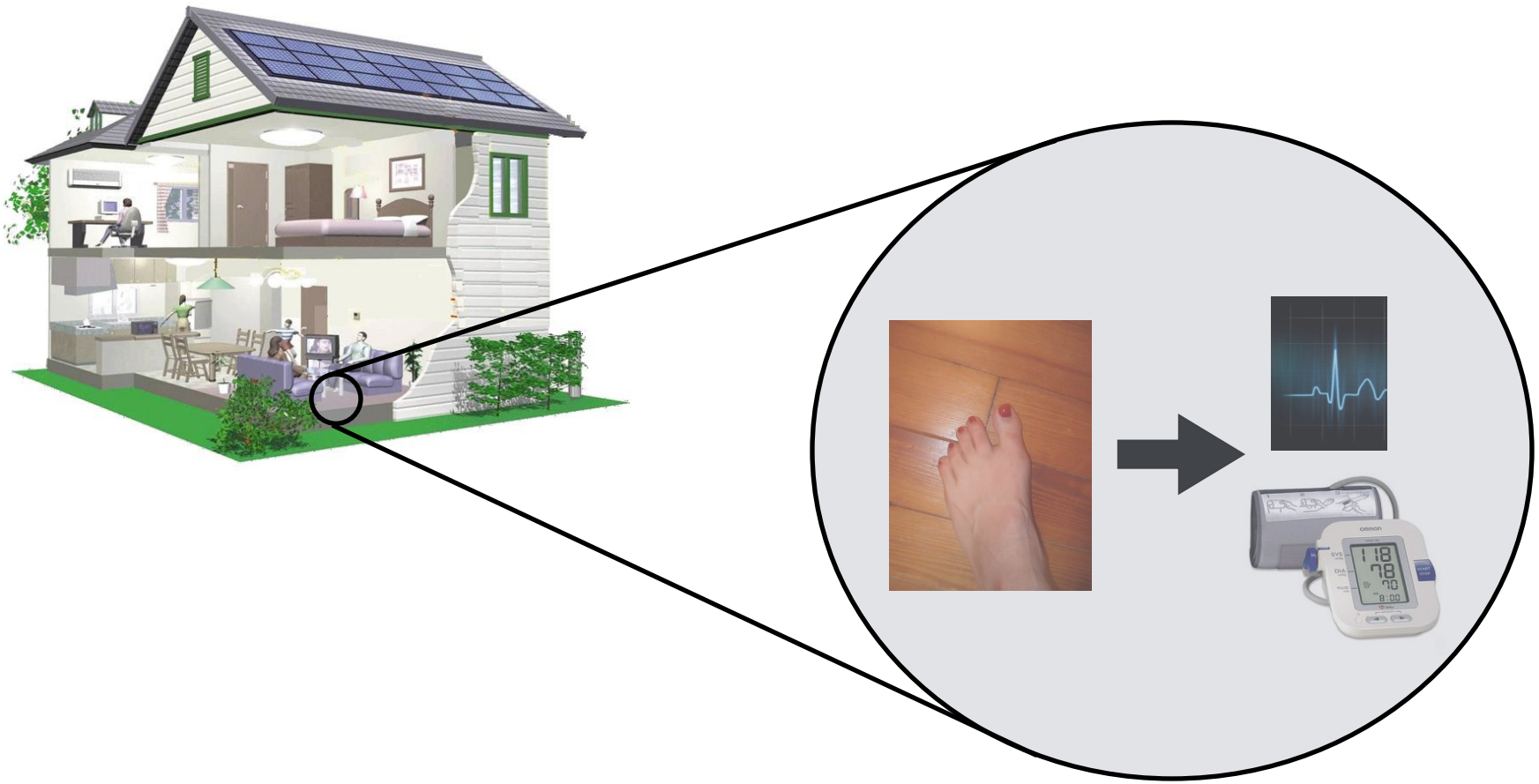
Each system is a part of the house



Each brick is a microprocessor



Each ceiling tile can sense movement and a fall



The floor can measure your heart rate and blood pressure

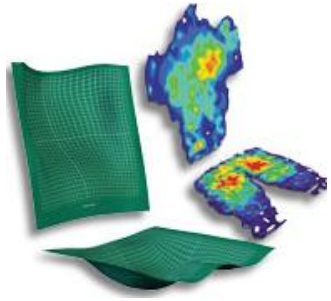
Objectives

- 3 specific objectives of this project:
  1) Design *zero-effort technology* to accurately measure physiological parameters and activity compared to wearable gold standard methods
  2) Determine whether the *zero-effort technology* can feasibly, accurately and reliably reflect the trends in an occupant's physiology and activity over time
  3) Assess the acceptability of the technology to seniors, their families and health care providers

Sensing

- Embedded Sensing:
  - Heart Rate: ECG, reflective $Sp0_2$ sensing
    - Embedded into handles, toilet seat

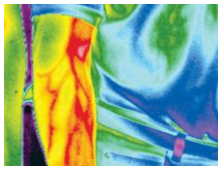
  - Respiratory Rate: pressure sensor arrays
    - Embedded in the bed, couch or chairs



Sensing

- Embedded Sensing:
  - Body weight and blood pressure: floor tile, pressure sensor arrays
    - Embedded into the floor, bed


  - Body Temperature: thermistors, IR camera
    - Embedded in the toilet, wall

Sensing

- Embedded Sensing:
  - Visual sensors
    - Embedded in the ceiling

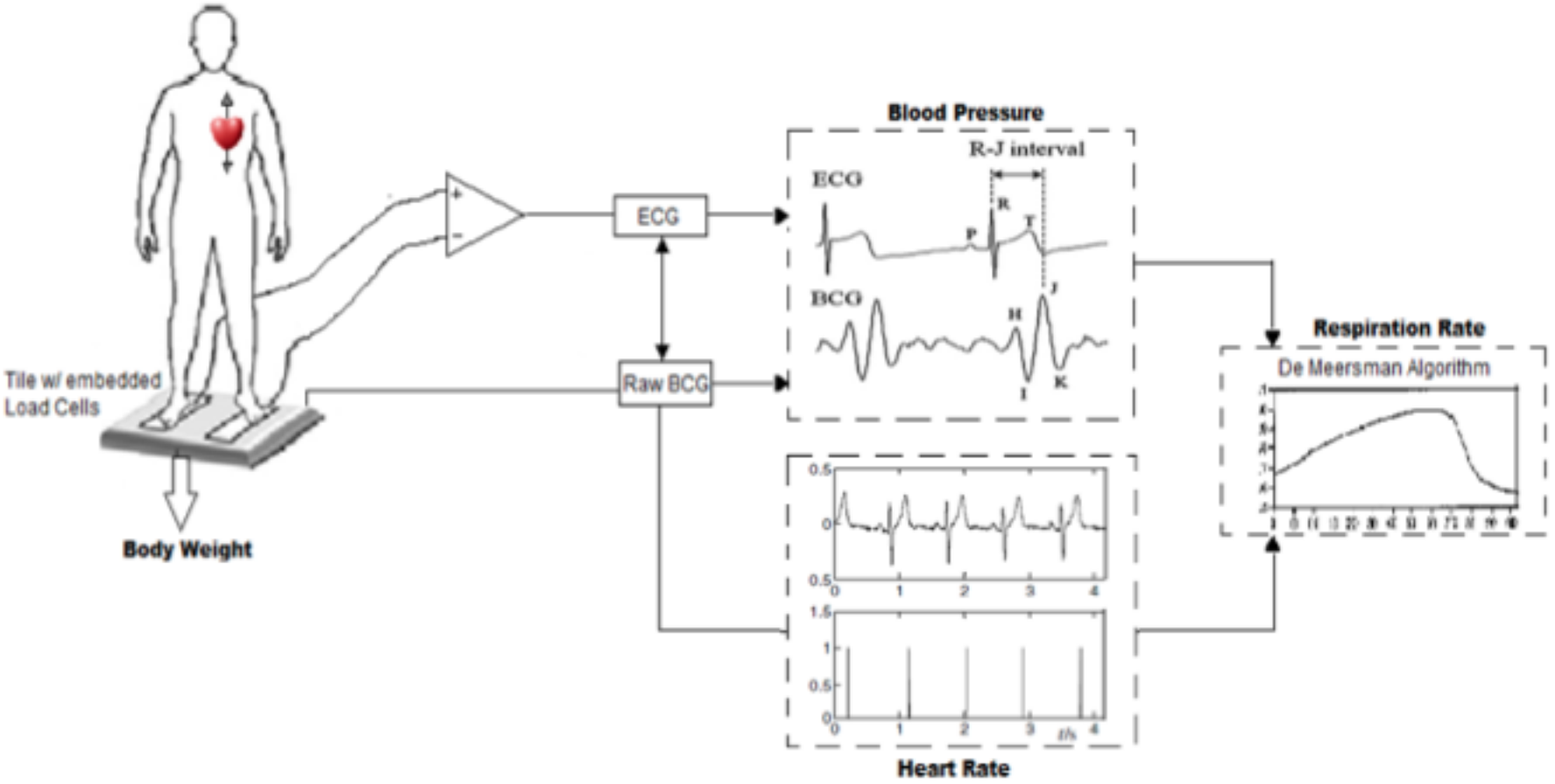
Testing

- In-home testing:
  - Homes of seniors undergoing a 4-month period of cardiac rehabilitation (CR) at the Peter Munk Cardiac Centre
  - Comparing the system's outputs to standard assessments made during regular visits to CR

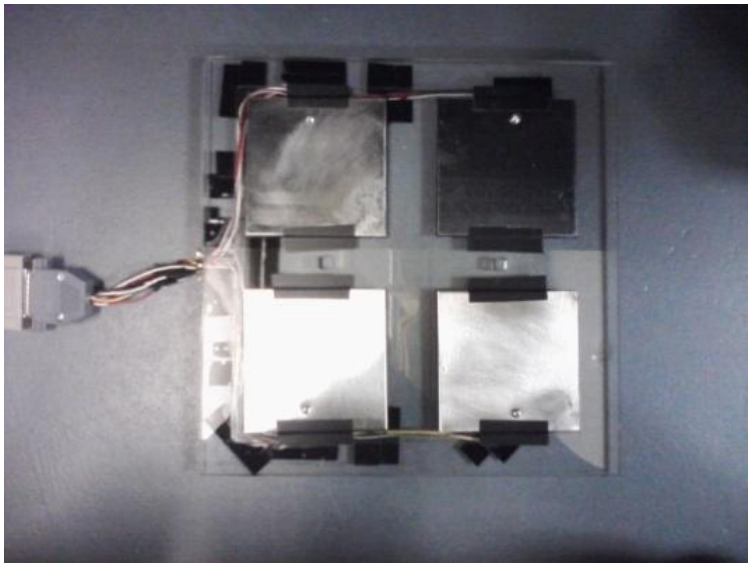
Acceptability

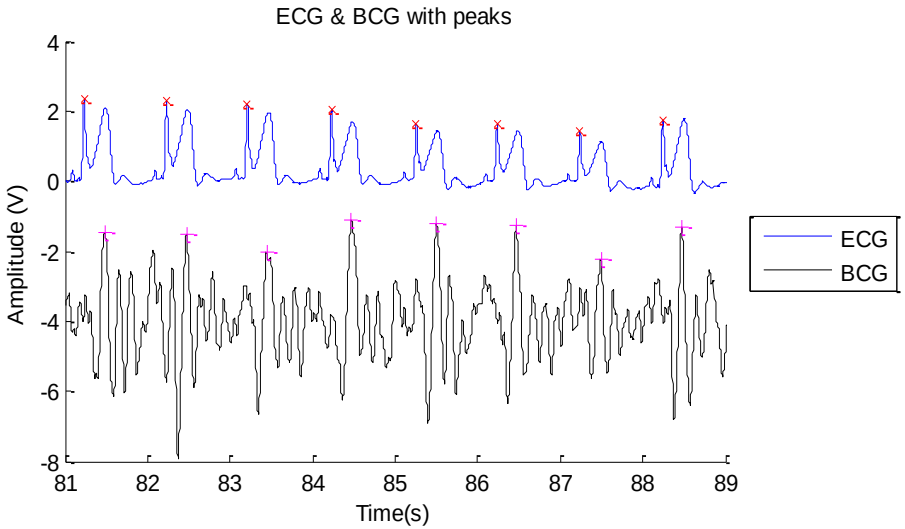
- Acceptability:
  - Weekly communication with health care providers
  - Comprehensive feedback from the seniors and their family members through questionnaires and exit-interviews
  - Focus group on the usefulness of the clinical information

Preliminary Work – Floor Tile



Pilot Results – HR from BCG





Duration: 90s

Number of heart beats = 87 beats

Mean error rate = 1.45%

R = 0.84

P-value < 0.001

Partners

- Partnerships within UHN:
  - Architecture at U of T
  - Health Sciences at York U
  - Peter Munk Cardiac Centre

Partners

- External partnerships:
  - CareLink Advantage
  - Ontario Telemedicine Network

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