Where Communication Meets Healthcare

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Why is a Wireless Center Talking About Healthcare?

- Communications is essential to health at many levels:
  - Individual patient data is needed for managed care
  - Realtime multimodal and multipatient data is needed for smart health
  - Lifestyle management will play an increasing role in addressing diseases
  - Many diseases are the result of breakdown in biological communication pathways

- Smart Health needs 5G:
  - The patient will be mobile!
    - Preventative and sustained, personalized care
    - It will take a village: there is knowledge in the village!
    - Deep learning will lead to better predictions and recommendations
  - The communication fabric will be the infrastructure across which data will be delivered to the cloud and deep analytics!

- The patient needs better data for analysis
  - There are new sensors being developed that will make new data available for analysis
  - Critical to partner the network with bio-sensors
The IoMT and Smarth Health is really about “DATA”

- Smart healthcare is about the DATA and closing the loop!!!
  Many communications challenges: latency, ubiquity and volume!

Needs…

And…
WINLAB is collaborating with industry to develop medical sensing, inference, and active monitoring technologies.

**Sensing Layer**

- **Physical Sensors**
  - Body temperature: 98.6°F
  - Blood pressure: high
  - Insulin: bad
  - Hydration: low
  - T-cell Assay: CD8+, CD4+
  - Other: location, voice, etc...

- **External Events**
  - <weather>
  - <schedule>

- **Social Feeds**
  - <family events>

- **Wireless Link Signal**
  - <signal: strength>

**Inference Layer**

- **Feature/Context Inferences**
  - Passive Location/mobility Inference
    - Location: kitchen
    - Speed: 1m/s
    - Activity: eating

  - Passive Socialization Inference
    - Activity: talking to 3 people
    - Duration: 15 minutes
    - Last time left house: 2 hours ago

  - Passive Cognitive level Inference
    - Location: leaving kitchen
    - Stove: on

- **Behavioral/Correlation Inferences**
  - Average walking speed? Any recent degradation?
  - Does indoor atmosphere impact her balance?
  - Any leading indicators before she falls?
  - How is hydration correlated with historical data?
  - Does blood analysis suggest increasing diabetic risk?

**Wellbeing Management**

- **Assessment**
  - Degradation alerts:
    - Walked slower by 30% yesterday!
    - Talked less by 80% last week!
    - Forgot to take her pills last 3 days!

  - Causal alerts:
    - Low air pressure + slow paced walk ➔ high fall likelihood
    - Alone in Holiday ➔ social withdrawal
    - Glucose levels ➔ diabetic shock

  - Emergency alerts:
    - Still in shower after 1 hour!!!