

Shan Lin
shan.lin@temple.edu

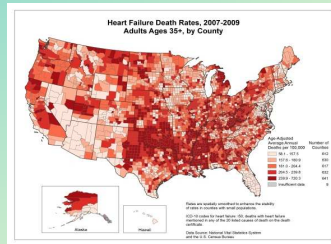
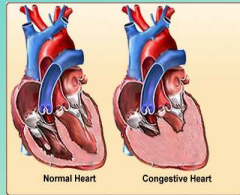
Department of Computer and Information Sciences
Temple University

Oleg Sokolsky, Insup Lee
{sokolsky, lee}@cis.upenn.edu

Department of Computer and Information Sciences
University of Pennsylvania

Margaret Mullen-Fortino
margaret.mullen-fortino@uphs.upenn.edu
Good Shepherd Hospital
University of Pennsylvania Health System

Background



Congestive Heart Failure (CHF):

- a pathophysiologic state when the heart fails to pump blood at a rate commensurate with the requirements of the metabolizing organs
- among the most serious cardiovascular diseases affecting 5.7 million Americans

Telemedicine for CHF patients:

- Existing small scale home tele-monitoring reduces CHF patients' mortality by 30% ~ 40%
- Has potential to significantly reduce frequent rehospitalization
- Currently, the potential is not fully realized
 - Closed proprietary systems, and expensive

Challenges

• Challenge I – Device Heterogeneity

Due to the intrinsic isolation among different telemedicine components, there lacks effective and efficient ways to seamlessly connect them for data collection.

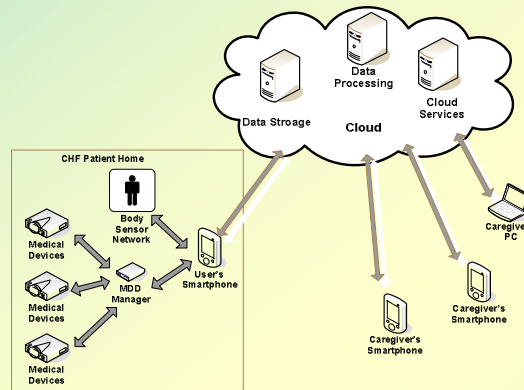
• Challenge II – Patient Heterogeneity

Due to the divergence between general patient models in theory and highly diverse patient population in practice, there lacks fundamental understanding of collected data given each patient's state and context.

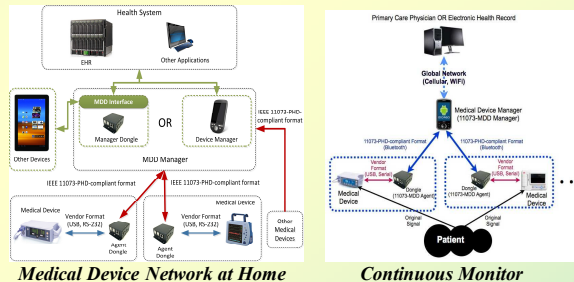
• Challenge III – Safety Heterogeneity

Due to the complex home use cases, existing telemedicine medical devices are exposed to a wide range of malicious attacks and there lacks sufficient security mechanism to protect patients' safety.

System Architecture

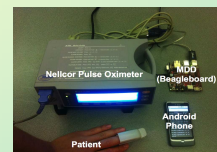


Research Direction I: Interoperable platform for home devices

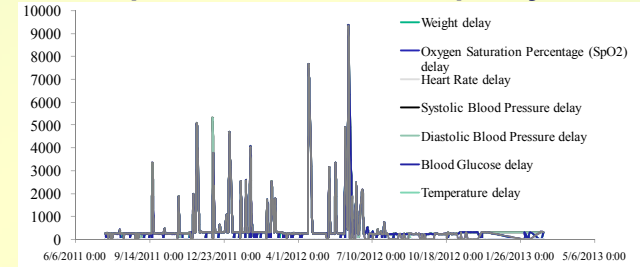


- Interconnecting IEEE 11073 medical devices over wireless
- Continuous and mobile health monitoring with body sensors
- Open source platform with rich middleware support

- Synchronization
- Coordination
- Data fusion and validation
- Black-box
- Service publish and subscribe

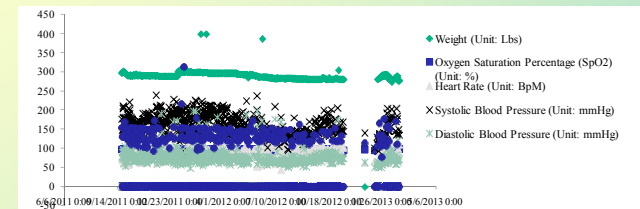


Research Direction II: Impact of system performance on care quality



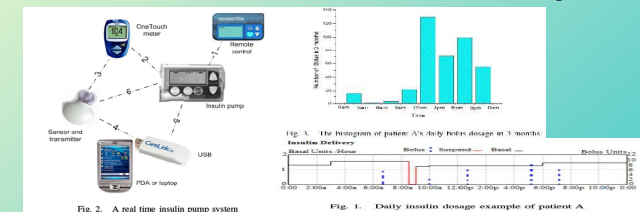
- Analysis of performance data of UPHS telemedicine systems for 300+ CHF patients over 5+ years
- Suffer long delays (>24 hrs) due to network problems
- Caused delay in intervention, and even rehospitalization

Research Direction III: Personalized early warning system



- Improve efficiency of interventions
- Develop personalized models based on patient history
- Apply learning models to detect early symptoms

Research Direction IV: Security



- Wireless medical devices lack sufficient protection
- Utilize spatio-temporal patient usage patterns
- Integrating patient safety model in access control