Collaborative: Heterogeneous Large-Scale Telemedicine for Cardiology Patients
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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

Broad Impacts
- Address heterogeneity issues in telemedicine systems
- Provide high quality connected home health care
- Introduce research projects for undergrad and grad students, and clinician training courses for nurses

Transformative
- Interconnect heterogeneous telemedicine devices and systems
- Significantly reduce the design and development costs
- Promote the quality of telemedicine system for CHF

Technical Approach
- Interoperable platform for home medical devices
- Reliable system performances for closed loop intervention
- Personalized early warning algorithm for CHF patient
- Secure and safe access control for home care

System Architecture

Interoperable platform for home devices

Medical Device Network at Home
Continuous Monitor

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

Medical Device Security

Wireless medical devices lack sufficient protection
Utilize near field communication for device pairing
Integrating patient safety model in access control

System performance and care quality

- Analysis of performance data of UPHS telemedicine systems for 300+ CHF patients over 5+ years
- Delay in data collection and intervention
- Inconsistent and noisy vital sign measurements

Predictive clinical algorithms

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