**Medical Cyber-Physical Systems: IoMT Applications and Challenges**

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## Overview

**IoMT Infrastructure** → **MCPS** → **IoMT Applications**

**MCPS** is the lens that provides clarity to the overwhelming volumes of information contained in medical data collected by **IoMT systems**. As clinicians become increasingly dependent upon the guidance from these systems, their safety and reliability becomes imperative.

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### IoMT Research

- **Remote Devices**
- **In-Clinic Devices**
- **Personalized Automation**

**Medical Device Interoperability**

“How to collect/exchange the RIGHT data?”

- OpenICE-lite: medical device plug-and-play and wearable platform
- VitalCore: platform for medical device dashboard, anomaly detector, clinical alert apps
- Raproto: Rapid prototyping platform for data collection via smartphone

**Clinical Decision Support**

“How to interpret data for clinicians?”

- Suppressing events: smart alarms/alerts
- Detecting events: shunt detection
- Estimating state: T1D patient behavior
- Predicting outcomes: ACL Retear

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### Infrastructure

- **VitalCore**
  - Analytics & Support Dashboard for Medical Device Integration
  - Open-source, rapid prototyping platform for data collection via smartwatches

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### Motivation and Challenges

1. **IoMT/MCPS** should be implemented in such a manner to reduce clinician load, not add to it.
2. Because of the reliance on high-quality data the first and often the most time-consuming step in many research endeavors is to build a data collection system.
3. Medical applications require high quality data from reliable, human-safe devices. Further, they present data storage issues and need ample processing and analysis to create useful applications.

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### IoMT Applications

- **RT-ACL**: a system that enhances patient outcomes by reducing their risk of an ACL re-tear by providing personalized recommendations of modifiable risk factors that can be altered during the patient’s recovery process.
- **AutoSwean**: prediction of extubation outcomes in real time to enable clinician decision support and autonomous mechanical ventilation weaning.
- **Opoid Sensing**: wearable sensing system that continuously monitors opioid levels in the interstitial fluid enabling remote and monitoring of opioid medication adherence.
- **Glucose Monitoring**: noninvasive change in glucose monitoring for prediabetes.
- **TremorSense**: tremor evaluation device to prevent falls in Parkinson’s patients.
- **Fall Risk**: fall risk prediction for an inpatient hospital setting.
- **SmartAlarms**: Clinical alarm suppression system.

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### Conclusion and Future Work

We are pushing towards a vision of the future in which technology autonomously provides comprehensive medical care. As we strive towards this reality, we have developed the IoMT and MCPS, but we still have many more challenges to surpass.