Alarm-Reducing Environmental Sensors (ARES) Program for IV Infusion Pumps

An IoT Solution to Reduce Lost Productivity Costs Resulting from False Medical Device Alarms

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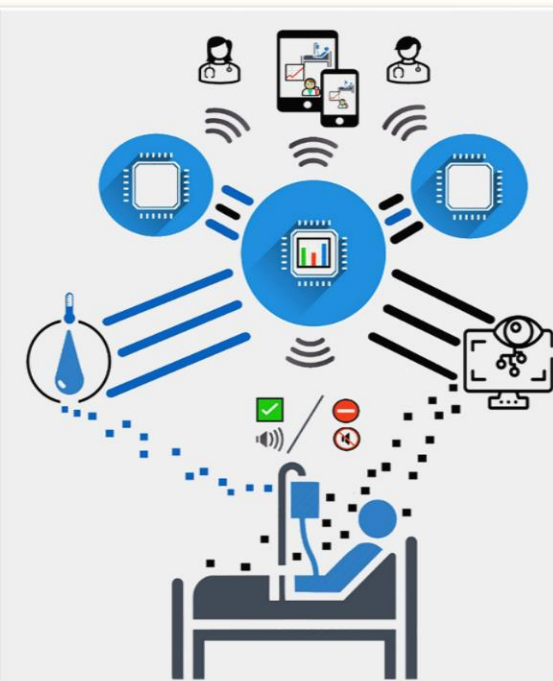
Raineman Solutions:
Alarm-Reducing Environmental Sensors: ARES

- **85-90%** of medical device alarms in medical facilities/hospitals **are false**/require *no clinical action or intervention*

- Costs medical facilities up to **40%** of a single nurse's time **in lost productivity**= **1,000s hrs= >$100,000/PER NURSE**[1]

- **Raineman Solutions (RMS)** has developed a vision-based, IoT infusion pump monitor/alarm management system, to *reduce productivity losses & increase patient recovery outcomes*

  - Uses *Federated Learning (FL)* to securely decrease the number of nonactionable device alarms

ARES Infusion Pump Sensor+Computational Network

Why ARES?

❖ Nurse/staff shortages (>1.1M additional nurses needed by 2022, *pre-pandemic estimate*)
  - COVID-19 has *accelerated attrition & negative retention outcomes*
  - Remote monitor system *especially useful for infectious patients*
❖ FL = Secure, localized architecture designed to work with <u>ANY</u> infusion pump

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Significance of Problem/Opportunity

HIGH COSTS of Poor Alarm Management & Alarm Fatigue			
840 HOURS/YEAR IN LOST PRODUCTIVITY	**40% FTE** SPENT ON FALSE DEVICE ALARMS	**>$130,000** PER/NURSE IN LOST PRODUCTIVITY	**9.9%** CAGR: HEALTH IOT DEVICE SPENDING

- A *broad and common priority*: Joint Commission standards identify reduction of nonactionable/distracting alarms as a longstanding goal

- Seamless commercialization: universal hardware works with any infusion pump; requires little/no redesign between broad applications (hospitals, in-home, residential care, military)
  - Represents a patient outcome/quality control issue *anywhere* infusion pumps are used

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Technical Merit/Risk Summary

- Current infusion pump solutions include only basic (pressure/hall/position/temp/air) sensors (_no_ vision appliances)

- ARES combines FL+ silicon/microcontrollers to _efficiently & securely_ learn actionable vs. non-actionable device alarms

  - _ARES Advantage_: Locally transmits ephemeral patient [image] data across computational chip array

    - Drastically reduces threat surface associated with remote patient monitoring systems

  - Device security priorities:

    1. Communication protocols [encryption, map general threat surface]
    2. Client data manipulations [ID individual threat vectors]
    3. Potential central server vulnerabilities [node selection/model assignment]
    4. Aggregation algorithm weaknesses [inefficient/suboptimizations]
    5. Programming bias [AI reflects programmers']

- RMS' _ARES_ team has experience: developing lean, externally-funded products and programs/devices and creating microcontroller-based wireless hardware

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Team: Performance and Commercialization Capabilities

Key personnel	Title and Company	Expertise/Experience	Relevance to the Proposed Effort
Josh Raines	CEO/Founder, Raineman Solutions	Product Design and Implementation/Statistical Analysis/Project Management/Commercialization	Principal Investigator
Chris Turvey	ARES Engineer	Programming/NFC-Networking/IoT/Web-Based Applications/Federated ML	Product Engineer
Dr. Barbara Carlson	Associate Dean of Research/University of Oklahoma Health Sciences Center	Registered Nurse/Clinical Research/Medical Device Design/Alarm Management Programs	Clinical/Research Methods Consultant

- ARES team has both *Lean* and *Agile* project management experience, emphasizing:
  - Strong focus on customer acquisition,
  - Experience deploying efficient, effective, and non-obtrusive tech field tests/pilot studies,
  - Development experience with NFC/wireless IoT, microcontroller, and on-chip computational systems.

- Strong team history determining customer needs/relationships

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