Data Science, Semantic Interoperability and Standards

IEEE WIE Region 2 (R2)

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Abstract

- My experience in data collection and analysis in the context of clinical trials taught me early on the importance and benefits of standards.
- Standards ask stakeholders to adopt a common language to ensure clear communication. In an open standards' development process, stakeholders contribute a wide range of perspectives and reach consensus.
- The IEEE Engineering in Medicine and Biology (EMB) P1752 Standards Development Working Group on Open Mobile Health aims to standardize semantics of data measured by mobile solutions, starting with physical activity, sleep measures and metadata.
- In a world awash in data, standards are needed to ensure interoperability at various levels: P1752 focuses on semantic interoperability, which ensures data from various sources can be pooled for analysis and visualized.

Outline

- Clinical Trials, Data Science, Standards
- Mobile Health Data
- Semantic interoperability
- Developing the IEEE EMB P1752 standard
- Conversation, Q&A

Clinical Trials, Data Science, Standards

- Experience in Clinical Trials
  - Nurse
  - Clinical Data Coordinator
  - Data Quality Analyst
- Data Science is an inter-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data, to understand actual phenomena.
- “The key word in data science is not *data*; it is *science*. Data science is only useful when the data are used to answer a question. That is the science part of the equation.”
- Standards

Intermezzo

- Vision – Seeing the way forward with all of the tech change
- Involvement – leading and supporting with action
- Passion – Investing your whole heart into your effort

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Mobile Health (mHealth) Data

- Mobile health data encompasses personal health data collected from sensors and mobile applications
  - No point-of-care sensors/devices intended for clinician's use, EHRs, healthcare navigation apps
- Data from sensors and mobile applications that
  - help patients and clinicians understand patients' health and health states
  - inform patients and clinicians on health care actions
  - help drive patient changes in health behavior
- Data used by and for health interventions delivered using mobile technologies
  - behavior change (e.g., increasing physical activity, medication adherence,)
  - clinical treatment (e.g., virtual consultation, cognitive behavioral therapy)

Clinical Care

Impact of COVID

- The pandemic has increased the speed of changes that were underway
- Consumer adoption of telehealth increased exponentially
- Limitations of the technology were exposed, like the fact that routine clinic measurement were missing
- Enter remote patient monitoring (RPM), which is here to stay
- Chronic diseases are the leading driver of health care costs in the United States and many people have multiple chronic diseases
- How do we implement RPM in a way that is patient-centered, workflow-based, improves outcomes and contain costs?

Data for Hypertension Management

weight

blood glucose

nutrition

chest pain

blood pressure, HR

med adherence

physical activity

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From Open mHealth to IEEE P1752

- Science paper: Estrin D, Sim I. Health care delivery. Open mHealth architecture: an engine for health care innovation. *Science. 2010 Nov 5; 330(6005):759-60*.
- Open mHealth founded in 2011, non-profit, grant-funded
- IEEE PAR approved in 2017: Open Mobile Health
- P1752 Working Group kick-off meeting: February 5, 2018

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Interoperability

- "In healthcare, interoperability is the ability of different IT systems and software applications to communicate, exchange data, and use the information that has been exchanged." https://www.himss.org/previous-himss-interoperability-definitions
- Levels of interoperability
  - Foundational interoperability allows data exchange from one IT system to another
  - Structural interoperability defines the syntax of the data exchange
  - Semantic interoperability implies a mutual understanding of the meaning of data
- Syntax and semantics are tightly linked

Open mHealth Approach to Data Sharing

- First create a common language
  - schemas to structure data
  - an API to exchange it
- Then provide free and open-source tools to use the data, e.g.,
  - process and visualize data
  - move data in and out of EHRs

Example Measure Instance

fasting blood glucose

```
{
    "blood_glucose": {
        "unit": "mg/dL"
        "value": 95
    },
    "effective_time_frame": {
        "date_time": "2015-02-05T07:25:00Z"
    },
    "temporal_relationship_to_meal": "fasting"
}
```

required

required

optional, but recommended

Example Measure Instance

average fasting blood glucose over a 4 month period

```
{
    "blood_glucose": {
        "unit": "mg/dL",
        "value": 128
    },
    "effective_time_frame": {
        "time_interval": {
            "start_date_time": "2015-02-05T07:25:00Z",
            "end_date_time": "2015-06-05T07:25:00Z"
        }
    },
    "temporal_relationship_to_meal": "fasting",
    "temporal_relationship_to_sleep": "on waking",
    "descriptive_statistic": "average"
}
```

required

required

optional

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P1752 Open mHealth Working Group

- **Purpose:** The purpose of this Working Group is to provide standard semantics to enable meaningful description, exchange, sharing, and use of mobile health data across a wide spectrum of use cases addressing consumer health, biomedical research, and clinical care needs. These standard semantics will be in the form of common data and metadata schemas...
- **Main work:** 1) define priority areas for schema development; 2) prepare the draft standard for balloting; and 3) promote and support ongoing community use, contribution, and refinement of the schemas.
- Working group website: https://sagroups.ieee.org/1752/

P1752 Main Work

- Define roadmap for schema development
- Create and support subgroups
- Prepare the draft standard for balloting
- IEEE Open-Source Pilot Program https://opensource.ieee.org/omh/1752
- Promote and support ongoing community use, contribution and refinement of schemas

Intermezzo

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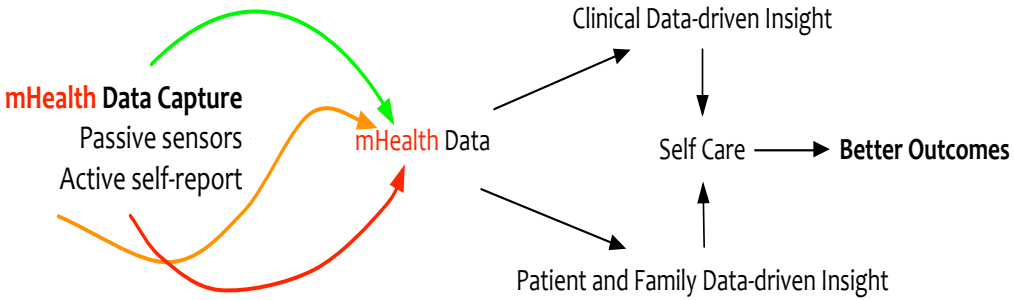
Flow From Data to Better Outcomes



Main Challenges

- validated usable sensors and apps
- supporting "bring your own device"
- *data standards to ensure that meaning is maintained across devices*
- integration into frontline workflow

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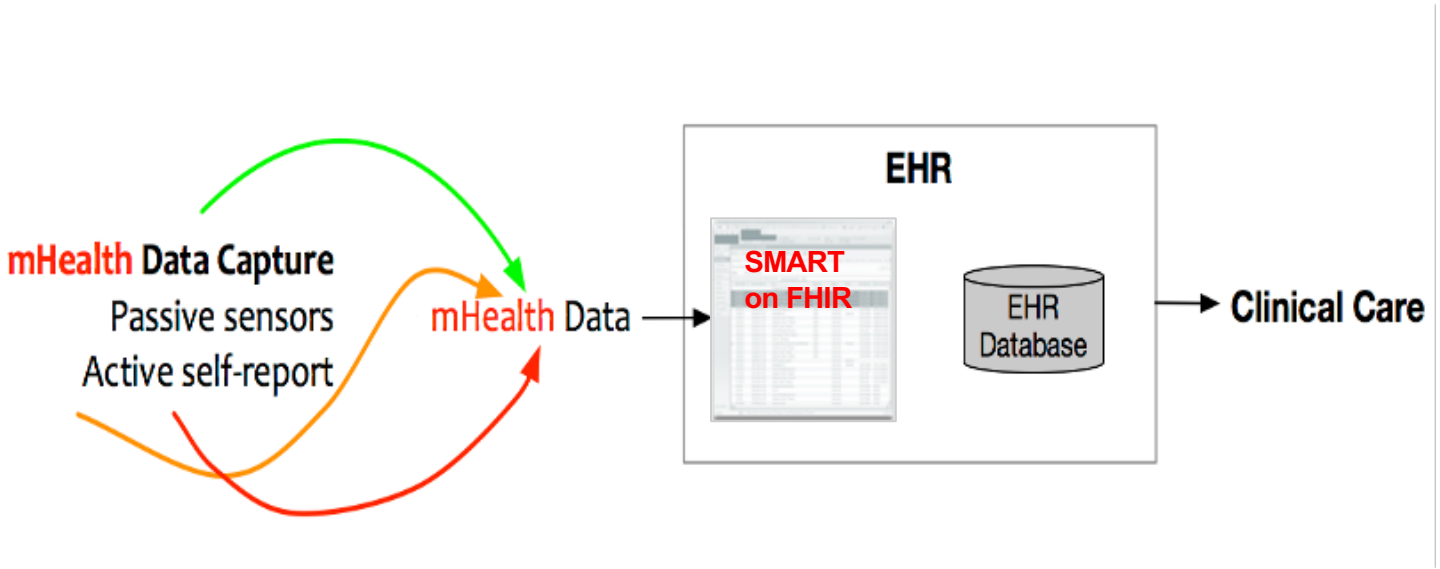

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