Health Informatics in Clinical Practice

JAMES RYAN, DO

ryanjam4@msu.edu

Disclosures

I have no relevant financial relationships

Why I’m Giving This Presentation

Provide an overview of the informatics landscape in and out of the clinic

Give clinicians hope.

Find interested explorers.

Why Do We Feel the Need for Hope?

- Why does it feel so overwhelming?

- Transformative period in clinical work.
- On par with the beginning of writing.

The Challenge of Expanding Data

“Medical students graduating in the year 2020 will enter a world with 50 times as much health data as there was when they applied to medical school; biomedical knowledge will double every 73 days. Yet, at today's rate of health care quality improvement, and with today's decade-long lethal lag between new knowledge discovery and its widespread application, it would take 35 years for quality to double. The time is long overdue to harness the power of data, analytics, and knowledge to drive improvements that can touch people's lives and health. That’s what we do.”
- Joshua C. Rubin

Restructuring and Optimizing Tools

- Restructuring and optimizing the tools we use to interact with information and knowledge is not a luxury, it is critical to work well in this era.

Traditional Clinical Practices

- We are used to working in our clinical spaces with our patients and implementing the best recommendations. We learned this in med school.
- Identify the problem and fix it.
- At first we memorized it then we look it up.

Outgoing Data and Quality Metrics

- The piece of the big picture we often struggle with is outgoing data. New payment models are often built around reported data and tied to measurable quality metrics.

Example: A1C Measurements

- Some of this is obvious, keep the A1C in a controlled range and the patient does better. We are told that an A1C in a particular range is optimal and we apply the guidelines until that happens. How do we know that one range of A1Cs is optimal and others are not?

The Scientific Process

- Collect data, construct a hypothesis (model), test that model's ability to affect measurable outcomes and if it works use it, if not modify.
- The data we collect and pass out from our clinics forms a significant portion of what these models are built on. It's worth the effort.
- Can we improve the technology that we use to do this stuff?

My Experience and Journey

- My experience can help others start to explore and that is one of my goals here:
- Personal story: from index cards to EMRs while rotating through clinics, writing AV software, using EPIC, thinking of a better option, finding advisors, building a prototype, publishing and maintaining the software.

Getting technical: How are we actually doing this?

Key learning points: understanding the Learning Health System (LHS), Computable biomedical Knowledge (CBK), and the fundamental architectural needs of clinical software can help us to plan for the future.

Learning Health System (LHS) Definition

- The Agency for Healthcare Research and Quality (AHRQ) defines a learning health system as a health system in which internal data and experience are systematically integrated with external evidence, and that knowledge is put into practice.

Aspirational Model of LHS

- A Learning Health System (LHS) is one “in which science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the delivery process and new knowledge captured as an integral by-product of the delivery experience” (Institute of Medicine, 2007).

The LHS Feedback Loop

- This means that data from ongoing health care encounters are continuously aggregated and analyzed, and what is learned from ongoing health care is incorporated into the improvement of future care, creating a natural feedback loop.

LHS vs. Other Improvement Processes

- Friedman states that “what makes an LHS different from other cyclic improvement processes are (1) at the beginning of the cycle, establishing a multistakeholder learning community that is focused on the problem and collaboratively executes the entire cycle.

Embracing Uncertainty in LHS

(2) Embracing, at the outset, the uncertainty of how to improve against the problem by undertaking a rigorous discovery process before any implementation takes place.

Socio-Technical Infrastructure in LHS

(3) Supporting multiple co-occurring cycles with a socio-technical infrastructure to create a learning system.”

https://doi.org/10.1002/lrh2.10328

The Realities of Clinical Practice

- We get into work, nurses find us and pull us in to solving immediate problems, we are too busy to change stuff from last week, we can barely get our work done as it is.

Facing Overwhelm and Burnout

- Nothing changes except we get older, we know it’s messed up but we’re too tired to change it, but stuff keeps evolving, new diseases, drugs, procedures not to mention arbitrary policies like prior auths etc.

Embracing Discovery for Change

- Overwhelmed and burning out… OR we embrace the uncertainty of how to improve stuff by undertaking a rigorous discovery process before any implementation takes place. This is what we were taught by our mentors, take the time to do a good H&P.

Computable Biomedical Knowledge (CBK)

- CBK (computable biomedical knowledge) is the result of an analytic and/or deliberative process about human health, or affecting human health, that is explicit, and therefore can be represented and reasoned upon using logic, formal standards, and mathematical approaches.

- Guiding principles for technical infrastructure to support computable biomedical knowledge.
  - Learning Health Systems

Evolution of Clinical Decision Support

Think of this as next gen clinical decision support:

past: books, journals; static print.

currently: UpToDate, guidelines from (U.S. Preventive Services Task Force, CDC, etc.);

“Clinical practice guidelines are systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances.” (Institute of Medicine, 1990): digital editable

Real time

- Next: real-time data loop (LHS) dynamic: a complex equation updated in real-time.

The LHS Data Flow Needs

- Great, so we have a complex equation, how do we find and use it in our clinics? Possible that it's implemented in an annoying fashion.

- LHS needs
- OUT: "new knowledge captured as an integral by-product of the delivery experience"
- IN: "best practices seamlessly embedded in the delivery process"


FAMILY
PRACTICE
OFFICE
FAMILY

Fundamental Architectural Needs of Clinical Software

- These are the essential requirements that define its foundational structure and behavior.

- Let’s look at two types of information that we manage in our clinics: **clinical data and business logic.**

Clinical Data and Business Logic

- **Clinical data** pertains to a particular patient, their problems and tasks. Eg. A1C, an MRI of the cervical spine, their PHQ9 scores, problem list, past surgical history, etc.

- **Business logic**: that which pertains to the work done in the clinic eg. which room a patient is in, the number of messages between staff members in a day etc.

What is Business Logic?

- Business logic refers to the set of rules, algorithms, and procedures that govern how data is created, displayed, stored, and modified within a software application to meet the specific needs of a business.

Core Clinical Behaviors

- Since we have patients with problems and actions let's start with clinical data but we will bring business logic in shortly.

- Foundational behaviors: we will care for humans that have problems and we will have actions intended to resolve the problems. This works for all the cultural types found in ethnomedicine, it can't be broken down any further and still be clinical.

Problems and Actions in Clinics

- Problems: most often diagnoses Snomed, ICD etc.
- Problem oriented systems have been around since the 1960s <youtube: Larry Weed's 1971 Internal Medicine Grand Rounds>

- Actions: tasks, orders, referrals, prescriptions, recommendations etc.

Contemporary Medicine and Measurements

Contemporary medicine uses measurements.

Data types are evolving from

A) infrequent to real-time

B) less human to more human DNA, voice recordings.

Technical Movements in Data

- We need to understand how we technically move from measurements to problems to actions and back again to measurements and consider how our software facilitates these three fundamental types of data.

Audio as a Unique Data Type

- Let's look at audio in a little more detail due to its uniqueness and our new analytic capacity.

- Audio is turned into an electrical signal through a process called transduction, which involves converting sound waves (mechanical energy) into electrical energy using a microphone, then lots of measurements of that electrical energy gives us digital data.

Audio as Real-Time Data

- Think of audio as a type of continuous data similar to real-time arterial pressures. This can allow real-time events to be programmed such as an alarm.

- Real-time is powerful.

Patient has been started on Keflex, finished 4 days ago

(L) foot - totally, mostly improved

now (R) foot worse. Her heart rate has been elevated "felt fast to her" but denies SOB

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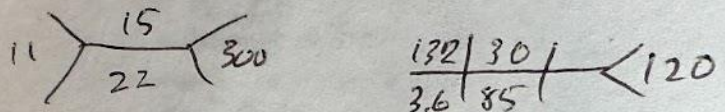


Potential of Dynamic Software Models

- While still mostly static (measurements, notes etc.) software can handle dynamic models (think of computable knowledge) and we need to take full advantage of this.

My Work with Audio Data

- multimedia audio is a common data type, clinically not so much. A/V software and performances > collecting data with my patients, “would you use it if i recoded it” and are you ok with this?”> Dartmouth, building open recording project

Natural Language Processing for Automated Annotation of Medication Mentions in Primary Care Visit Conversations
- Journal of the American Medical Informatics Association

Sharing Annotated Audio Recordings of Clinic Visits With Patients—Development of the Open Recording Automated Logging System (ORALS): Study Protocol
- Journal of Medical Internet Research

popular press publications:

The Appointment Ends. Now the Patient Is Listening.
- New York Times,

Medscape, Medical Economics, and others

Impact of Machine Learning (ML)

- Before machine learning (ML) it was not scalable to use audio recordings for much, that’s no longer the case. Processing is more powerful.

Bring back business logic

- Now we can take audio recordings and predict what is going on during our encounter with regard to the clinical problems and actions. If we allow the business logic to be automated then we can begin familiarizing ourselves with this process. See for example the Small Brain System.

EHRs and New Software Systems

- A Next Generation EHR for Primary Care: How we learned to stop worrying and love Health IT

- That is one example of a system built on the fundamental architectural needs, there are so many potential benefits yet to be derived even from this one simple implementation.

Role of Software in Clinical Practice

- The software should help us manage our patients and be of maximal value to the LHS so we can build and receive the best CBK to help the patient in the room with us. That is why problem, tasks, real time data are foundational.

Data as a Byproduct for LHS

- LHS: wants “new knowledge captured as an integral by-product of the delivery experience” this is a byproduct of managing the problems, actions, and measurements. This is what we do in real time during most appointments.

Benefits of Objective Data

- At the same time we want the byproduct of this work to be a training set that allows for appropriate automation.
- WE WANT OUR SOFTWARE TO BE LIKE A GOOD NURSE OR SECRETARY, THEY KNOW ME.

- So the data captured is of help to us because it automates business logic, AND to the LHS as it's highly objective and accurate. WIN WIN

Real-Time Best Practices

- LHS wants: “best practices seamlessly embedded in the delivery process” This will be in the context of managing problems and should be presented to us optimally in real time. If we don’t have continuous data to train on, we can’t do this in real time.

Summary of Needs

- In summary the fundamental needs are a system that can manage problems, tasks, and real-time data.

- That is what we want to keep in mind when we are considering changing software or policies.

Fast Healthcare Interoperability Resources (FHIR)

- Fast Healthcare Interoperability Resources (FHIR) is a standard for exchanging electronic health care data between different systems. It's an application programming interface (API) that allows for the representation and sharing of health information.

Granular Data Exchange with FHIR

- FHIR allows functional granular exchange.

Conclusion and Next Steps

- So here's what we should do:
- ensure research can happen (limited capacity for clinical research at Harvard/Stanford, etc., due to the IT dept. it's like the Dietitian at the hospital being responsible for pharmaceutical research).

Collaboration as a Key Element

- Part of our work as physicians is to ensure that the environmental conditions we are responsible for can provide the tools we need. COLLABORATE

Embracing Uncertainty

- “…embracing, at the outset, the uncertainty of how to improve against the problem…” Friedman

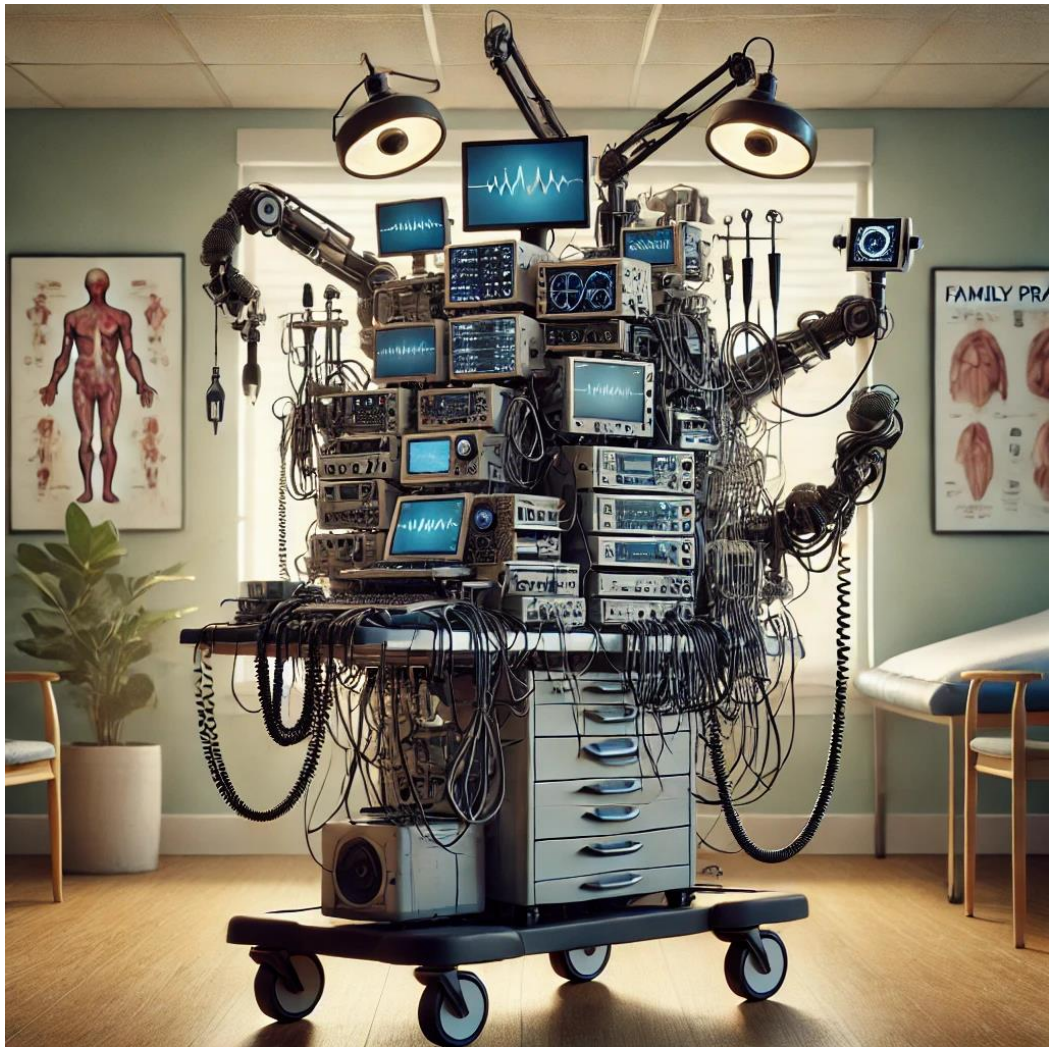
Final Recommendations

- When we are selecting products or implementing clinical workflows, think in terms of the ideological and technical ecosystems discussed above; the LHS, CBK, fundamental architectural models and FHIR.

Closing Remarks

This is too cool of an era to miss out on.

ryanjam4@msu.edu



Additional Resources

1. **Lawrence Weed's Problem-Oriented Medical Record (POMR)**:
   - **URL**:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8076203/
   - This discusses the historical and functional significance of problem-oriented medical records in clinical practice.

2. **Learning Health Systems (LHS)**:
   - **URL**: https://nam.edu/programs/value-science-driven-health-care/learning-health-system-series/
   - The **National Academy of Medicine** provides comprehensive insights into the Learning Health System framework.

3. **Multimedia in EHRs**:
   - **URL**: https://medinform.jmir.org/
   - **JMIR Medical Informatics** has numerous papers discussing the integration of multimedia and digital tools in electronic health records.

4. **Patient and Family Engagement**:
   - **URL**: https://www.healthit.gov/faq/what-patient-engagement-and-why-important
   - The **Office of the National Coordinator for Health Information Technology (ONC)** explains the critical role of patient and family engagement in health IT.

5. **Machine Learning and AI in Healthcare**:
   - **URL**: https://www.thelancet.com/journals/landig
   - **The Lancet Digital Health** features articles on how machine learning and AI improve decision-making in clinical environments.