Machine Learning in Healthcare

Ioana Singurreanu,
Chief Innovation Officer, Book Zurman
HL7 Conformance co-chair
Definitions are necessary but not sufficient

• Sometimes “AI” is used to describe things that are not AI:
  • Anything “new” and “cool” to do with a computers system or product
  • Visualization and other “wow” things
  • Business logic programmed explicitly is not AI

• Literally, the computer appears to be intelligent (the Turing test)
  • “thinking”, “reasoning”, the user can’t tell in 5 minutes whether it’s a human or not

• Humans are necessary to train, validate, apply trusted AI models

• AI increases the collective intelligence of the enterprise
  • Computer + human/user working together more effectively than before…
  • “Learning EHR”…that can learn from best-practice, PubMed, patient records
AI and us

**AI does not replace humans; it augments human intelligence**
May eliminate some repetitive tasks but it does not replace high-level decision maker from clinicians or direct care, reduces burden

**The Learned Intermediary Doctrine (LOD)**
Due to the risks associated with inaccurate prediction we use the same legal framework associate with medication safety
AI in Healthcare means...

• Clinicians and computers working together to achieve better outcomes for patients
  • Computer tools that are able to auto-complete
    • Word processor, IDEs, smart phones
  • Assistants suggest a solution
    • Chatbots, clinical decision support, AI voice assistance, MedKnowts
  • Peers
    • Complete a task and then refer to a human for valuation or to complete the process
  • Manager
    • Break a workflow up into tasks that can be completed or validated by humans

• Is a problem suitable for an AI model?
  • Watson tried to do too much
Strategic advantage of AI

1. Cost leadership (being the low-cost producer)
   • Improve operations

2. Differentiation (being unique on dimensions that customers value, such as quality)
   • Better products

3. Focus (tailoring products to a narrow segment of customers)
   • Address niche needs

   • AI may require a new strategy for the enterprise

• Robotic Process Automation
  • Robotic phlebotomist
  • Laboratory automation
  • Workflow must be well defined

• Machine Learning (Supervised and Deep)
  • Algorithm is the result of training rather than programming
  • Pathology detecting diseased tissue using deep learning
  • Diagnostic imaging detection of specific problems (e.g. dense fibrous tissue) in a consistent way

• Natural Language Processing (NLP)
  • Extracting findings from text
  • Analyzing medical literature
AI ML suitability question re: healthcare

• 1. Are there patterns in the data such that you can devise specific **features** and **labels** to train a machine and make predictions?
  - Terse “medical” narrative
  - Structured, standard data
  - What to do about

• 2. Is there access to sufficient amounts of training data?
  - Since MU2 we have developed standards for exporting info (e.g. C-CDA, V2)
  - We need examples of data sets that meet specific

• 3. Do you have the necessary information and resources to accurately annotate and label your data?
  - Interoperable data is the most likely to be “sufficient” for annotation

• 4. Is your evaluation setup reflective of the real-life use case?
  - Contrived/manually-generated content or lack examples of “ideal”
  - For example, existing “mappings” may be used to train the software to create proposed/future
  - Recording symptoms in real time, at home may improve the way patients formulate and describe” chief complaints”

• 5. Are there any potential biases in the data?
  - “Representative” vs. “fair” representation
Natural Language Processing (NLP)

• Not “speech-to-text” but meaning

• Failure if you try to do too much
  • $60 million attempt to look for cancer treatment in literature based on medical records and pathology reports using IBM Watson
    • Complex medical content with nuanced meaning that AI may be able to extract
    • Growing body of literature and research (PubMed from NLM)
      • Genetically-based conditions

• Annotated data
  • Annotated reports needed to train the ML; subsequent iteration of the algorithms applied and the resulting annotated
  • Retraining and refining the algorithm follows, iteratively, the model is refined
Interpretability and trust are a must

- **Interpretability**
  - Self-describing
  - All stakeholders must understand how a prediction was made, what information was considered
    - Hearing loss doesn’t cause an amputation, but military service may explain both

- **Consistent with medical science/best practices**

- **Trust**
  - Evaluated on the basis of an algorithm making accurate predictions for the patient being treated
Challenges in healthcare

• We need data to train AI models
  • Annotation/labeling
  • Features and patterns are used to create the model

• We need interpretability
  • Deep Learning is too complex to be self-describing, “black box” to clinicians

• We need to involve experts in data curation and preparation
  • Otherwise, we get erroneous predictions
    • Using payment data to make clinical predictions/risk-factors
    • Google’s first attempt at a personal medical record
Opportunities for HL7

• Annotated data using standard terminology
  • To enable data extraction and analysis
  • Features of the data used for training

• Patterns based on standard structures
  • Structured data and rich narrative (CDA Level 1 - 3)
  • Computable data pattern used by ML

• Workflows standardization

• Guidance regarding the need for interpretability, consistency, and trust