AI and Machine Learning

Health TechNet, Joe Bormel, MD, MPH — JBormel@gmail.com

Friday March 15, 2019

Simply Fully

seeing things simply 50%

seeing things fully 50%
Moderators Introduction

Meeting Announcement:

This meeting of Health TechNet is being held Friday, March 15, 2019 from noon to 2 pm at Nelson Mullins’ offices on Capital Hill in Washington, D.C.

Our feature topic is **AI and machine learning**: both a summary of the concept and issues it presents, as well as some new concerns relating to security that it engenders.

The discussion will be moderated by **Joe Bormel, MD, MPH**; and the primary speaker will be **Leo Scanlon**, CISSP, and we expect to have other speakers and commenters as well. Leo is currently employed by DHHS as a cybersecurity expert and has headed a number of risk management initiatives at federal agencies. He will provide a basic set of definitions that clarify the terms AI, Machine Learning, etc., and how they differ; provide a quick review of the identified limitations (bias issues) in AI modeling; and then go through the basic types of attacks that can be made on these systems and models.
AI, present in many industries outside of health, is **essential** to making IT work effectively, achieving these goals:

1. fast
2. easy
3. safe (ensure good things happen), and
4. avoiding hazards

**Requirements / Incentives:**
- commitment to abandon magical thinking about core info
- necessary context (e.g. intent)
- clinical content
- trust & culture (think PSO)
- complicated by legit. privacy and confidentiality issues

**Missing technologies**
- computational, voice, immersiveness,
- suitable summary displays
- documentation support linked with quality measurement and workflow grounded in standards, aligned with payer models for VBP
“Absent information” is ubiquitous, so that AI notions like applying NLP to clinical data will “unlock” huge value and lead to new cures is not only magical thinking, it’s misguided although not entirely wrong.

AI needs to be able to read relevant data, that is “fit for purpose”, surface critical missing data, and intelligently summarize what is vital. (e.g. 911 to fire team)

Core to data limitations:
- What gets said by patient
- What gets heard and documented by provider
- How hard is it to document
- How safe is it to document
  e.g. “Suicide Attempt” versus “Intentional Overdose”

Other important factors
- Provenance of the information
- How aligned is information with what is required for decision making

see: Availability Heuristic
Simply

Types of information

Descriptive
Seeking to describe

Predictive
Predicts an event or result

Prescriptive
Tells you what or how to do something

AI needs to be able to see relevant data, that is fit for these purposes:

Descriptive/Predictive/Prescriptive

If the “Big Data” is suitable to describe the patient, that’s fine.

Do not, however, imagine that means the data can predict causation (the past), or prognosis (the future).

Especially without outcomes data with end-points, which are often missing.

Further, the data usually cannot reveal the cure. Looking at a picture of a Rubik’s cube does not reveal the efficient algorithm for solving it.

That information is not in the picture, not in the data.
Types of information

Descriptive
Seeking to describe

Predictive
Predicts an event or result

Prescriptive
Tells you what or how to do something

Descriptive:
60yo WM c bx + adenocarcinoma of 4 x 5 cm mass in body of pancreas, with metastatic spread to lungs and abdomen

Predictive:
For patients with stage 4 pancreatic cancer, the five-year survival rate is 3 percent

Prescriptive:
STEP 2: First-line Chemo: Gemcitabine (Gemzar)
STEP 3: Search https://clinicaltrials.gov/
STEP 4: Second-line options:
- Targeted Antibodies
- Cancer Vaccines
- Adoptive Cell Therapy
- Immunomodulators (including CAR-T)
- Oncolytic Virus Therapy
Simply

DHHS / CMS, through a contract called QSRS, did some vitally important NLP expectation-setting work

Human language is deliberately ambiguous

Expressive narratives do not reduce cleanly and completely to codes

Story telling is not photography

Many words and grammatical elements are ambiguous. 

75 words are their own opposites. 

Called “Janus words.”

Examples:

40. **Overlook**: To supervise, or to neglect

41. **Oversight**: Monitoring, or failing to oversee, …

73. **Weather**: To withstand, or to wear away

74. **Wind up**: To end, or to start up

75. **With**: Alongside, or against

Use of copy/paste is extensive and error prone.

Punctuation including commas and periods (e.g. Oxford comma) frustrate NLP.

Enunciation/Intonation changes meaning:

“I never said she stole my money”

Note: Think of sarcasm in an email

https://www.dailywritingtips.com/75-contronyms-words-with-contradictory-meanings/
Properly deployed, Artificial Intelligence and Machine Learning are our best hopes to improvement:

- **improve fidelity** by *dynamically surfacing and closing* the quality gaps
- making HIT better, easier to use and safer

These slides elaborate some of the issues that make AI and Machine Learning both powerful and challenging, in the context of today’s deployments of HIT.

At HIMSS 2019, in 338 educational sessions, **148 (44%) explicitly called out AI** as vital to health improvement.

Focusing on the appropriate use and soci-technical-cultural issues of implementation are vital to improving the quality, cost and access to better health and effective healthcare.
These AI algorithms illustrate that they are informed by their training data and entirely literal (i.e. the intelligence is artificial).

King    - Man + Woman = Queen

Doctor - Man + Woman = Nurse

represents an understandable association that is wrong.

Take Homes:
1. Results may only be directionally useful.
2. It is best for surfacing possibilities and connections.
3. Independent validation and verification are critical; challenge will persist post go-live. Set expectations.

The word2vec model trained by Google on the Google News dataset, on about 100 billion words:
https://rare-technologies.com/word2vec-tutorial/
Example: Improving Risk Adjustment for Medicare Advantage and other VBPPs

- Chronic Kidney Failure
- Concept

Concept Attributes:
- Semantic Type: Disease State or Syndrome

Medical Name:
- Chronic Renal Failure

Medical Codes:
- ICD9: 585
- ICD10: N18
- SNOMEDCT: 155856009/197654000
- MedDRA: 10064848
- MeSH: D007676

Acronyms / Synonyms:
- CKD - Chronic Kidney Disease
- CRF - Chronic Renal Failure
- Chronic Kidney Failure
- Chronic Kidney Disease

Risk Factors:
- Type II Diabetes
- Hypertension
- Chronic NSAID use
- Smoking
- Obesity
- Family History

Diet:
- Protein-Restricted
- Sodium-Restricted

Treatments:
- Erythropoietin Therapy
- Kidney Transplantation
- Hemodialysis

Complications:
- Anemia
- Brittle Bones

Drug Categories:
- ACE Inhibitors
- Diuretics
- Soy Protein
- Nutritional Supplements

Children Concepts:
- N18.1 (ICD10 code)
  - CKD, Stage 1
- N18.2 (ICD10 code)
  - CKD, Stage 2 (mild)
- N18.3 (ICD10 code)
  - CKD, Stage 3 (moderate)
- N18.4 (ICD10 code)
  - CKD, Stage 4 (severe)

Drugs:
- Hectorol
- Doxercalciferol
- Renagel

Symptoms:
- Abnormal Heart Rhythm (Arrhythmias)
- Fatigue/Weakness
- Hypertension (High Blood Pressure)
- Swelling in Extremities
- Red or Brown Urine

BMP (Basal Metabolic Panel):
- GFR (Glomerular Filtration Rate)
- BUN (Blood Urea Nitrogen)

Kidney Scan/Biopsy

Cordyceps

https://www.talix.com/

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Example: Improving Risk Adjustment for Medicare Advantage and other VBPPs

The patient came in today with ongoing issues with diabetic control. We have been fairly aggressively adjusting her insulin. The patient has been on insulin for a long time. Despite frequent increases in her insulin regimen, she continues to have somewhat high blood glucose, most notably in the evening.

The patient underwent an ultrasound-guided core needle biopsy with clip placement of the 2.3cm mass in the upper outer quadrant of the right breast.

Therefore, the patient was found to have T2N2MX, stage IIIA breast cancer.

Condition/Finding

Diabetes

Labs

High blood glucose

Medications

Insulin, Long term (current) use of Insulin

Diagnostic Procedure

Ultrasound-guided core needle biopsy: clip placement of 2.3cm mass in the upper outer quadrant of the right breast

Condition/Finding

Stage IIIA Breast Cancer

ICD-9: 250.02
ICD-10: E11.65
HCC: 19

ICD-9: V58.67
ICD-10: Z79.4
HCC: 19

ICD-9: 174.4
ICD-10: C50.411
HCC: 12
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Thank You

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