Opportunities and Challenges in the use of AI and ML in Healthcare

Michael E. Matheny, MD, MS, MPH

Director, Center for Improving the Public’s Health Through Informatics
Professor, Departments of Biomedical Informatics, Medicine, and Biostatistics
Vanderbilt University Medical Center

Associate Director for Data Analytics, VINCI
Associate Director, Advanced Fellowship in Medical Informatics
Tennessee Valley Healthcare System VA

Twitter: @MichaelEMatheny
Email: michael.Matheny@va.gov, michael.Matheny@Vanderbilt.edu, michael.Matheny@vumc.org
Disclosure

- I have no conflicts of interest in the presentation of any materials, software, or algorithms presented in this presentation.

- All funding I have received in the last 3 years are research grants and contracts from VA ORD & HSR&D, NIH NHLBI & NIDDK, FDA, NIH-VA-DoD Joint funding, and a medical device public-private partnership (NESTcc [FDA U01])
Medical Knowledge Growth, Complexity, & Care Variability

Figure 1. Page Volume of National Comprehensive Cancer Network Clinical Practice Guidelines by Disease Site, 1996-2019

Page Length:
~50 in 2004
~190 in 2019

Reference Count:
~80 in 2004
~800 in 2019

Figure 2. References Cited in National Comprehensive Cancer Network Clinical Practice Guidelines by Disease Site, 1996-2019


Promise of Artificial Intelligence & Machine Learning

- Ambient AI
- Imaging Processing
- Drug Discovery
- Clinical Decision Support

In 2018, first Software as a Medical Device AI approved by FDA to not require physician interpretation.

Algorithmic Bias: Pulse Oximeter Sensitivity to Skin Tone

• University of Michigan
  – 276 Black, 1333 White Pts

• When Arterial O2 < 88% & Pulse Ox 92-96%
  – Black: 12% [9%-16%]
  – White: 4% [3%-5%]

AI/ML Are Susceptible to Data Shifts

<table>
<thead>
<tr>
<th>Model</th>
<th>Event Rate Shift</th>
<th>Association Shift</th>
<th>Case Mix Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistic regression</td>
<td>◆</td>
<td>◆</td>
<td>◆</td>
</tr>
<tr>
<td>L1 penalized regression</td>
<td>◆</td>
<td>◆</td>
<td>◆</td>
</tr>
<tr>
<td>L2 penalized regression</td>
<td>◆</td>
<td>◆</td>
<td>◆</td>
</tr>
<tr>
<td>L1-L2 penalized regression</td>
<td>◆</td>
<td>◆</td>
<td>◆</td>
</tr>
<tr>
<td>Random forest</td>
<td>◆</td>
<td>◆</td>
<td>◆</td>
</tr>
<tr>
<td>Neural network</td>
<td>◆</td>
<td>◆</td>
<td>◆</td>
</tr>
</tbody>
</table>

Susceptibility – ◆ High  ◆ Moderate  ◆ Low

ALL Models are susceptible to Event Rate Shifts

DL/NN Models were less susceptible to Case Mix Shifts

Davis SE, Lasko TA, Chen G, Matheny ME. Proceedings of the AMIA Annual Symposium. 2017
ChatGPT & Large Language Models

... are not immune to these issues!

- Limited response to queries that require information after the training data ended
- Continual evolution of LLMs create variation in accuracy.
- 10’s of thousands of hours spent in training updates to remove inappropriate, biased, and derogatory responses from ChatGPT in later versions

Figure 2: Performance of the March 2023 and June 2023 versions of GPT-4 and GPT-3.5 on eight tasks:

NAM AI/ML Modeling Lifecycle

User Centered Design

http://nikkiroda.com/user-centered-design-process/

Thadaney Israni

whicher

Ahmed

AI-Enabled National Implementation RCT: IMPROVE-AKI

Odds Ratio 0.54 for AKI Among All Cardiac Catheterization Patients


Our review also suggests that your patient is either not on a statin or the guideline-recommended intensity of statin therapy. Statin therapy in patients with ASCVD reduces the risk of recurrent cardiovascular events and mortality.

Guideline-Recommended High Intensity Statins

- Rosuvastatin 20-40mg by mouth daily
- Atorvastatin 40-80mg by mouth daily

If your patient is on statin therapy from a non-VA source, please add this statin as a non-VA medication.

****** Upcoming Primary Care Visits *****

****** LAST MENTION OF STATIN ASSOCIATED SIDE EFFECT ******

Source ~ Date ~ Title ~ Author
Note ~ 08/19/2022 ~ PRIMARY CARE NOTE ~ [Attending Name]

****** MOST RECENT QUALIFYING DIAGNOSIS ******

Date ~ Code ~ Diagnosis/Procedure
07/24/2022 ~ I25.10 ~ Atherosclerotic heart disease of native coronary artery without angina pectoris

Number needed to remind = 10
THANK YOU

Salim.virani@aku.edu
@MichaelEMatheny

For more information contact:
michael.matheny@va.gov
michael.matheny@vumc.org