Machine learning- what the OBGYN needs to know about this new technology and innovation

Alexis Gimovsky

At the end of this course, the participant should be able to:

• Characterize machine learning and how is it used in medicine.
• Recognize the machine learning tools available in OBGYN.
• Apply machine learning to the practice of OBGYN.

• Machine Learning definitions can be challenging to understand.
  a. McKinsey & Company: Machine learning is a form of artificial intelligence in which algorithms learn from data, with or without explicit guidance, to improve predictions or classifications of current data. An algorithm, at its simplest, is designed to accomplish a specific task, then trained on data, and revised. The process is repeated until the algorithm achieves optimal performance in terms of fit to the training data. The machine itself generates the algorithm rather than relying on external coding to direct the algorithm's construction. The ability to ingest a broader swath of variables and to explore multiple permutations offers gains over classic approaches to modeling. Deep learning is a form of machine learning that uses multiple layers of neural networks with large quantities of data to optimize a host of algorithms for performing a specific task. Machine learning has great potential for therapeutic development and healthcare, ranging from discovery to diagnosis to decision making.
  b. Wikipedia: Machine learning is the scientific study of algorithms and statistical models that computer systems use to effectively perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task. Machine learning algorithms are used in a wide variety of applications, such as email filtering, and computer vision, where it is infeasible to develop an algorithm of specific instructions for performing the task. Machine learning is closely related to computational statistics, which focuses on making predictions using computers. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a field of study within machine learning, and focuses on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is also referred to as predictive analytics.
  c. An alternative perspective for healthcare professionals: Machine learning evidence based medicine with non-linear models

• An iconic application of evidence based medicine to get oriented: The Framingham Heart Study
  a. Data: 1944, 5,209 patients, age 30-59, exam and survey q 2 yrs
     i. Primary outcome- CHD (10 year risk)
     ii. Risk factors- sex, age, education, smoking, antihypertensives, stroke, hypertensive, diabetes, cholesterol, BMI, heart rate, glucose
  b. Model
     i. Type: Logistic regression
ii. Validation: training/test set
c. Decision: Lifestyle intervention vs medication
d. Value: Longer life, pharmaceutical companies

• An obstetrics application of evidence based medicine with a linear and additive model: VBAC Calculator
  a. Data: 11,856 women, 1999-2002, vertex singleton gestation and one prior low-transverse cesarean delivery who underwent a trial of labor after 36 6/7 weeks of gestation
    i. Primary outcome: VBAC
    ii. Risk factors: age, BMI, race, recurring indication for CD, any prior svd, maximum birth weight of prior child, diabetes, other medical conditions
  b. Model
    i. Logistic regression
    ii. Validation - training and test set
    iii. Predicted probability of successful VBAC= \( \frac{\exp(w)}{1+\exp(w)} \) where \( w = 3.766 - 0.039 \text{ (age)} - 0.60 \text{ (prepregnancy BMI)} - 0.671 \text{ (African American race)} - 0.680 \text{ (Hispanic race)} + 0.888 \text{ (any prior vaginal delivery)} + 1.003 \text{ (vaginal delivery after prior cesarean)} - 0.632 \text{ (recurring indication for cesarean)} \)
    iv. Model assumes risk factors are linear and additive
  c. Decision: Offer TOLAC vs repeat CD
d. Value: Patient/neonatal morbidity, patient satisfaction, hospital length of stay

• The use of a non-linear method, Boosted Trees, in an obstetrics application of evidence based medicine: Predicting common maternal postpartum complications
    i. Hypertensive disorders, PPH, sepsis, surgical wound infection
  b. Models:
    i. Boosting tree algorithm
    ii. Training and test set
    iii. Black box method
c. Decision: Discharge patient home
d. Value: Patient morbidity, patient satisfaction, hospital length of stay
• An example of a business case as opposed to evidence based medicine: Artificial Intelligence within Ultrasound
  a. Data: Physician scans live and then identifies normal and abnormal anatomy
     i. Need to manually identify normal/abnormal
     ii. Requires real time guidance
  b. Models: Deep learning
     i. Black box method
  c. Decision: diagnosis, detection
  d. Value:
     i. Cost, higher accuracy, increased time spent in patient counseling
     ii. Product development, no EBM

• An example of an interpretable non-linear method in obstetrics using evidence based medicine: Push Prescriber
  a. Data: Consortium on Safe labor, 22,999 women, 2002-2008
     i. Term, nulliparas, singletons, vertex, epidural anesthesia who reached 10 centimeters
     ii. Primary outcome: cesarean delivery
     iii. Risk factors: Demographic data (age, weight), clinical factors (fetal position, induction), hospital factors (hospital type, delivery provider)
  b. Models:
     i. Optimal decision trees
     ii. Training and test set
  c. Decision: Continue pushing or decide to proceed with OVD/CD in the second stage
  d. Value: Patient/neonatal morbidity, patient satisfaction, hospital length of stay

• Roadblocks to usage

• References


Gimovsky, AC. et al. Pushing the bounds of second stage: when should we abandon the ambition of SVD? AJOG, Volume 220, Issue 1, S74 - S75

www.pushprescriber.com
https://www.signifyresearch.net/medical-imaging/artificial-intelligence-within-ultrasound/