Big Data, AI and Deep Learning in Sepsis

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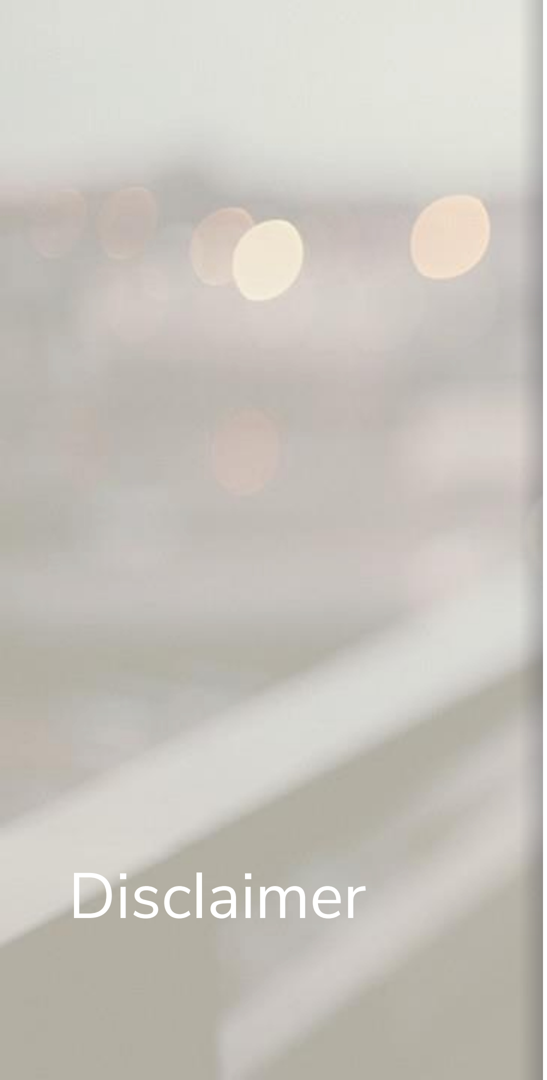
Objectives

"Even though there are no ways of knowing for sure, there are ways of knowing for pretty sure."
– **Lemony Snicket**

1. Why Sepsis and big data?
2. First steps
   a. Few insights
   b. Implications
3. Cautions



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I claim to know everything, but even my children doubt that. I am not a scientist, just a physician who does a bit of everything including research.

No one has been naive enough to sponsor me to present these findings

So Sepsis!

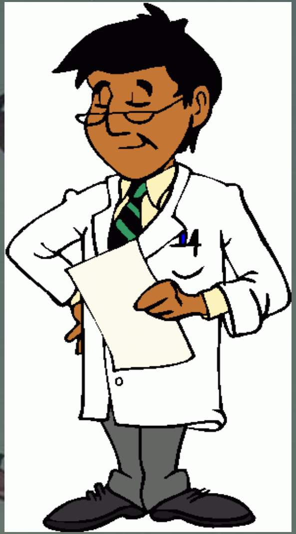
Where we are at with Sepsis?

Infection, Organ dysfn

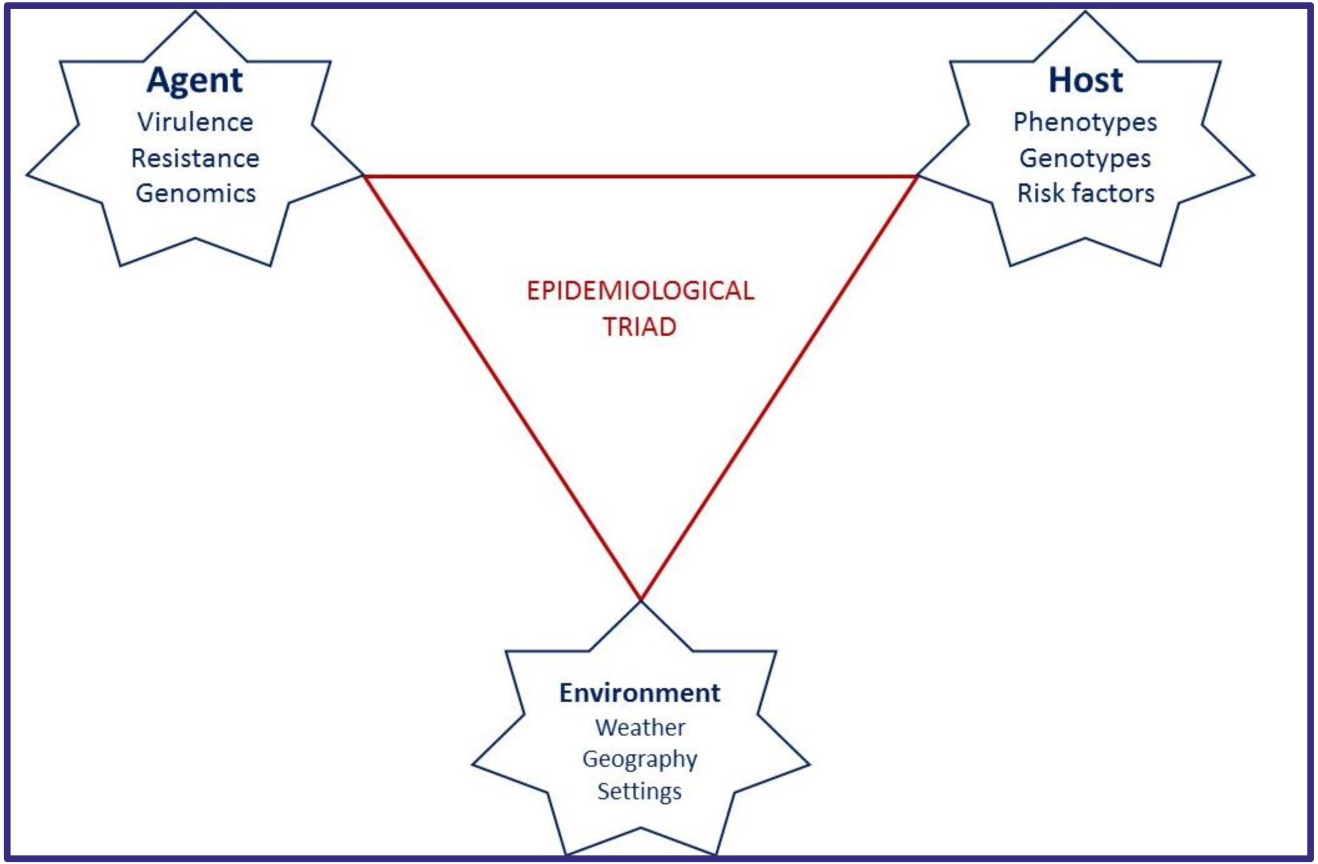
SIRS, Severe sepsis, Sepsis

Antibiotics, Fluids, Steroids, EGDT…

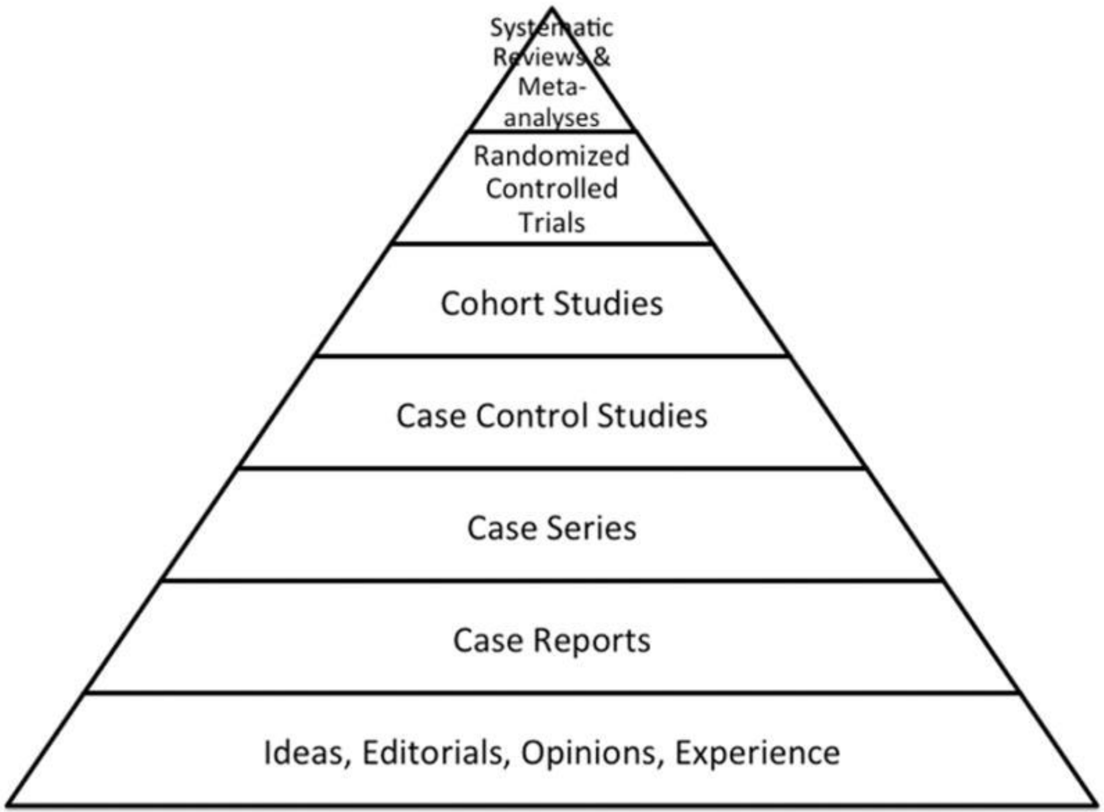
AMS, Overuse, Incidents



Outcomes of infection



Hierarchy of Research design



Lobo, Michele A et al. “Research Design Options for Intervention Studies” Pediatric physical therapy : the official publication of the Section on Pediatrics of the American Physical Therapy Association vol. 29 Suppl 3,Suppl 3 IV STEP 2016 CONFERENCE PROCEEDINGS (2017): S57-S63.

Traditional Research Methods

- Screening algorithms – derivation of variables and thresholds from patients with adverse outcomes
- Validation of logistic models based severity scores – transferability
- The double blind randomised controlled therapeutic trial challenge for sepsis
- Timelines of infection, sepsis, septic shock and adverse outcomes – Triage is not T0

Research mainly designed around interventions and causality and inference usually derived in retrospect.

EM in Sepsis

Screening
Stratification
Diagnosis
Management
Disposition

- Personalizing of Screening algorithms - variability
- Static nature of variable thresholds – demographic SIRS variations
- ‘Diagnosis’ of Sepsis???
- Management
  - Antibiotics
  - Fluids
  - Adjuvants
- Safe discharge

WHEN IS IT SAFE, WHEN NOT TO DO, BALANCING RISK BENEFITS…

? ? ? ? ? ?

CAN WE DO ANY BETTER?

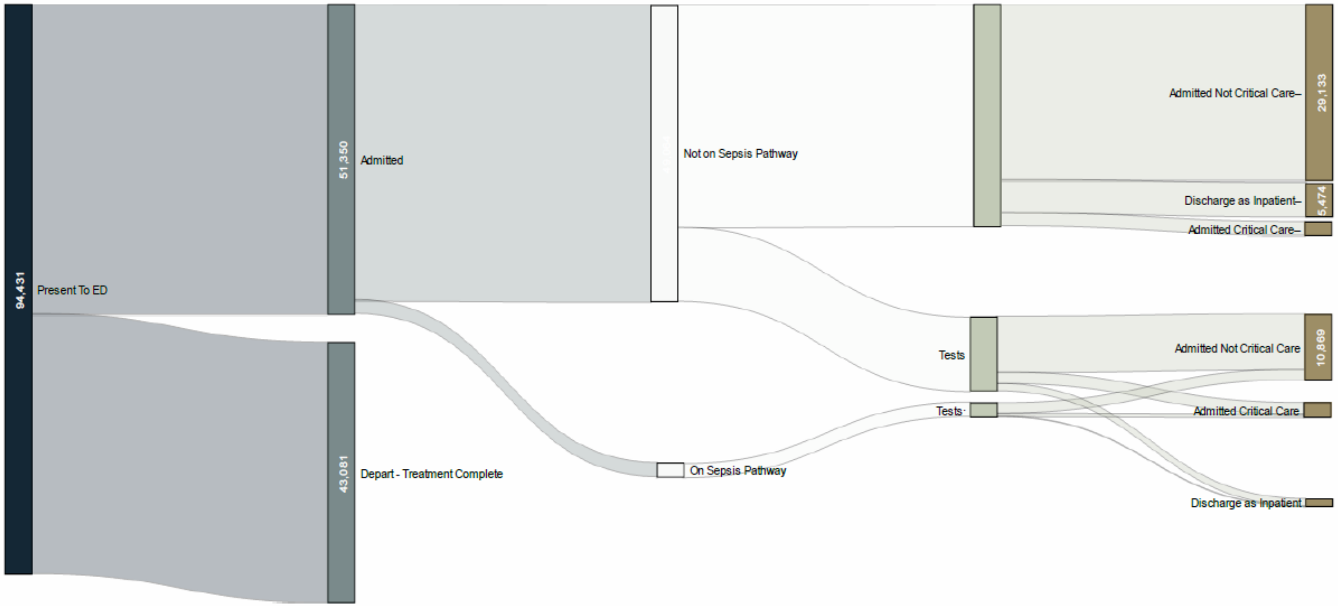
Big Data

Is big data, augmented intelligence, artificial intelligence or deep learning the magic pill?

Small Big data pilot

Preliminary findings

- *Retrospective data linkage ED presentations n=94491 (2014-2015)*
- *Linked to blood gas results for all patients during time period n=35821*
- *In-hospital outcomes from inpatient admin CIS n=68138*
- *Sepsis pathway patients with linked pathology/ microbiology results n=4544*

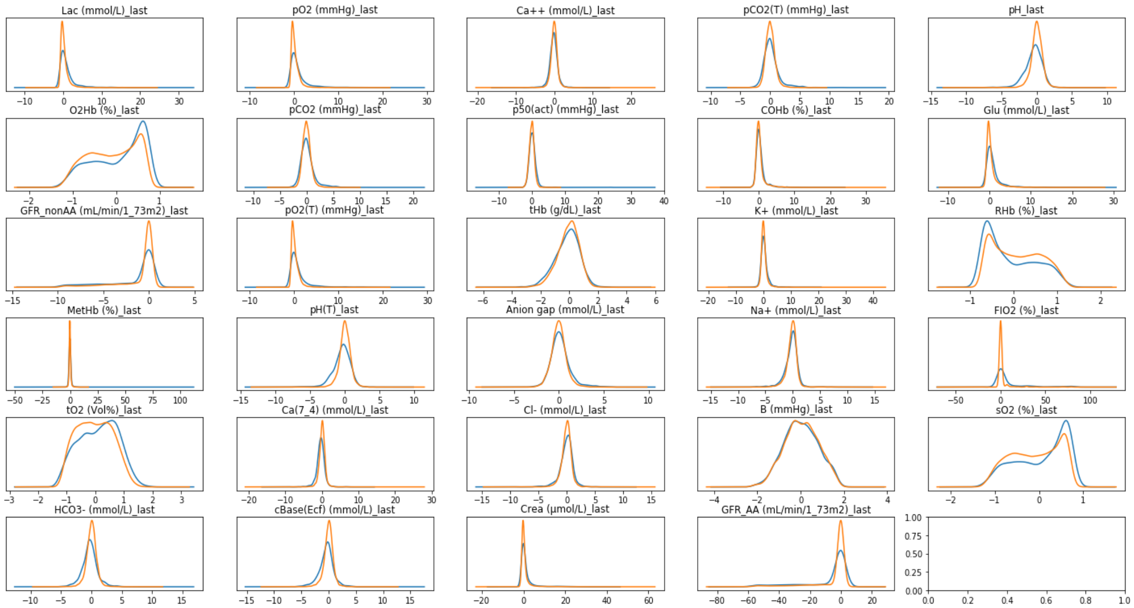


Analysis Environment

- The data analysis was performed using Jupyter notebooks (python) and scikit-learn libraries

- Calan Holmes – Master of Data Science, School of Engineering IT, Sydney University
- Dr Aldo Saavedra - Senior Research Fellow,
  Centre for Translational Data Science, Sydney University
  Faculty of Health, Sydney University.
  eHealth NSW

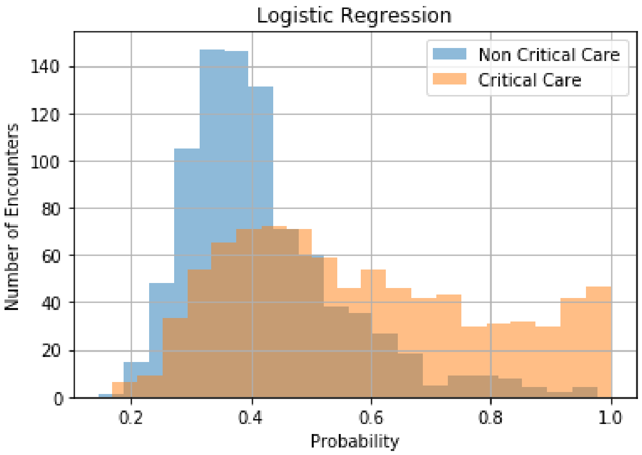
Overview of data



Critical care

Non Critical care

Model Predictions



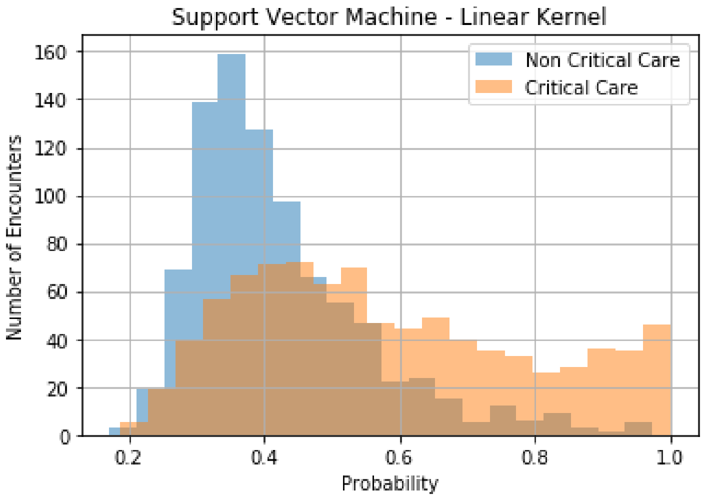
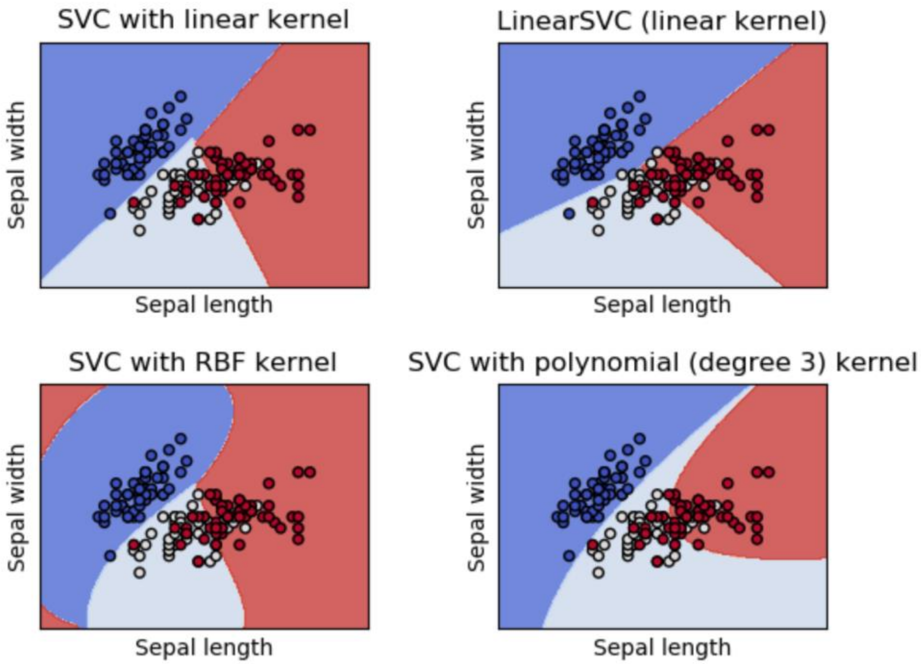
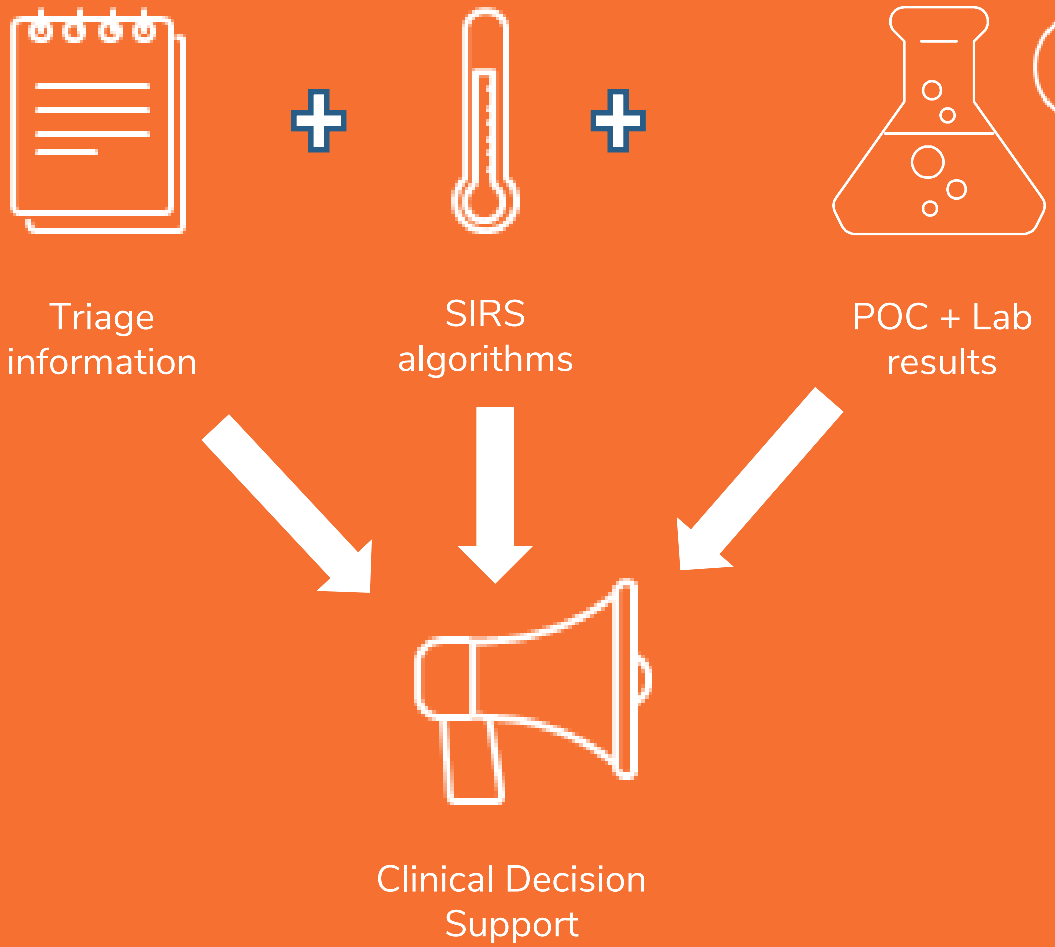


Illustration of boundaries defined by SVM models



Well known dataset with entries showing the width and length of sepals in flowers.

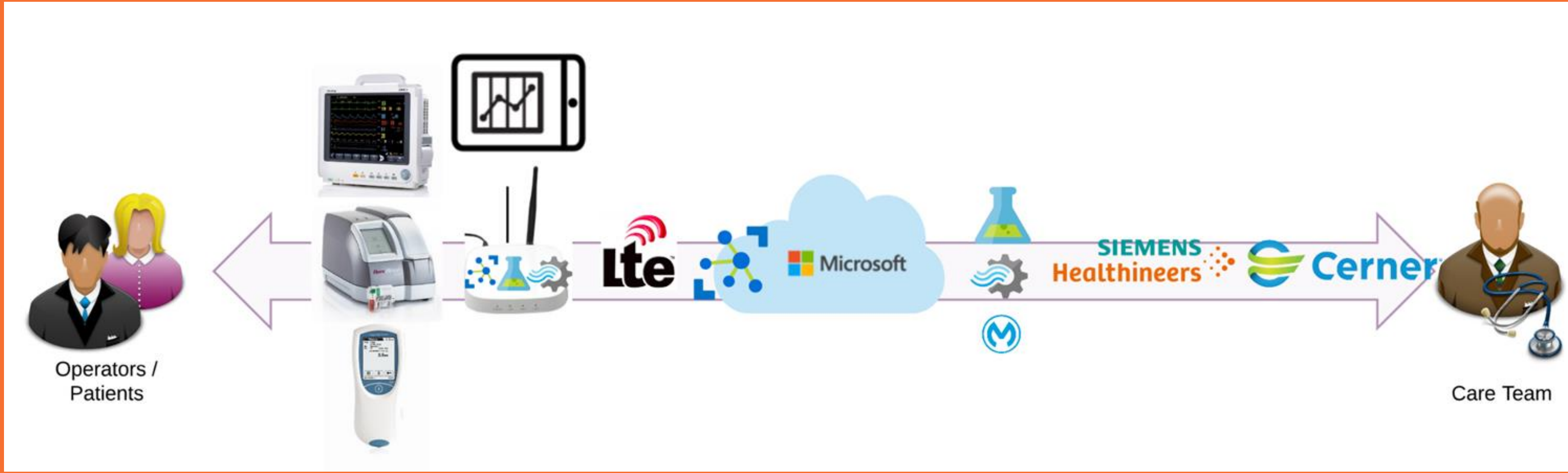


CLINICAL DECISION SUPPORT

- 78 of 160 possible triage presenting problems
- Algorithms with SEPSIS KILLS static SIRS thresholds
- POC tests – lactate
- Lab tests – CRP, PCT, BC, viral testing
- Dual threshold alerts
- Clinician validation versus automation

LEARNING SYSTEMS

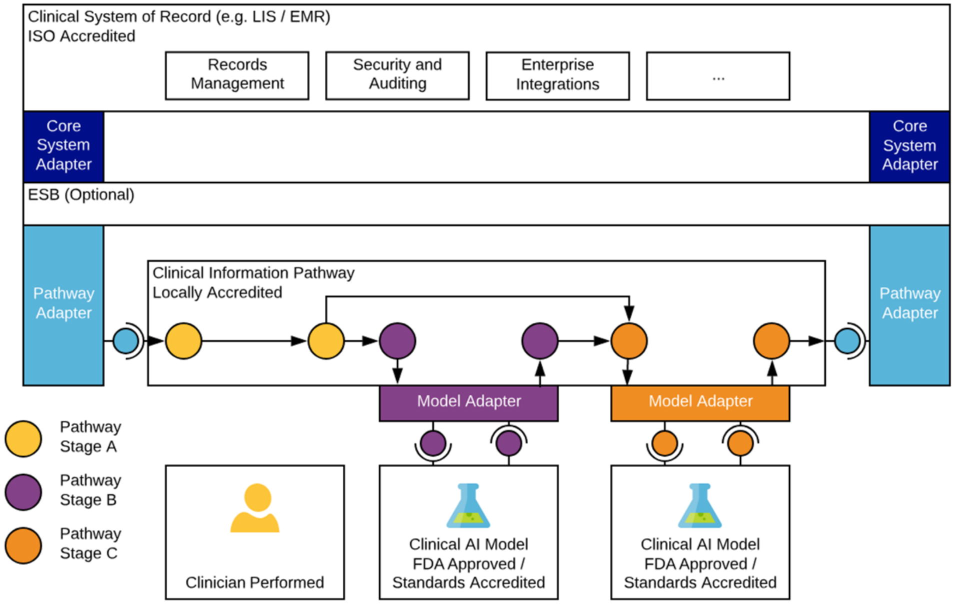
Leveraging Existing architecture...



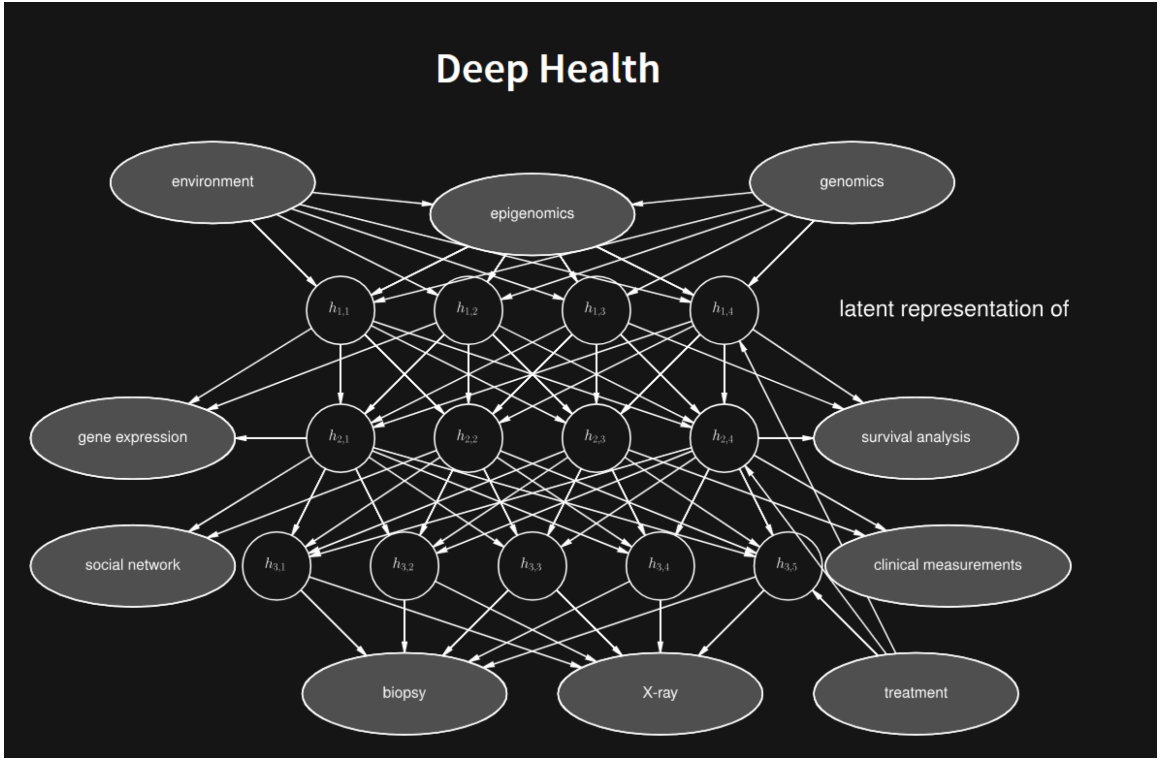
Unlocking the EMR dependencies...

Future directions

- *Replication of pathways at Westmead precinct sites – age-specific thresholds – MRFF SHP seed grant*
- *Alert based data-mapping and live datastream learning exercises*



Learning networks



- Replicating health data and process networks to capture predictors and interventions

Steele, Scott et al. "Using machine-learned bayesian belief networks to predict perioperative risk of clostridium difficile infection following colon surgery" Interactive journal of medical research vol. 1,2 e6. 19 Sep. 2012, doi:10.2196/ijmr.2131

Machine learning and Deep learning

Machine learning

Machine learning uses algorithms to parse data, learn from that data, and make informed decisions based on what it has learned

Deep learning

Deep learning structures algorithms in layers to create an “artificial neural network” that can learn and make intelligent decisions on its own

Deep learning is a subfield of machine learning. Deep learning is what powers the most human-like artificial intelligence

Collaborative team led design of future health infrastructure and health IT architecture is key to delivering solutions.

“

To develop artificial intelligence networks in our clinical systems, we will first need to learn what intelligence in healthcare really means…

Thank you very much for your time

Discussion