BIG DATA IN CRITICAL CARE

Chairs: Lara Shekerdemian & Peter Laussen

Mark Peters: Framing the problem

Need: Bringing order to chaos. Information is power.

Data without context is useless. Aim: transforming data to information to knowledge and ultimately to attain wisdom.

Problem 1: Huge quantities of data generated. We waste data, yet increasingly accessible

Problem 2: We (humans/clinicians) are poor at looking at patterns, interpretation typically subjective. Need to establish "normal" centiles for physiologic variables in critical illness. Overcome confirmation bias: we tend to accept the data that supports our belief and contention and "over think". The data we have to integrate can overwhelm us.

Danny Eyton: It's all in the modelling. Biological systems complex, multiple levels of organization, nonlinear interactions, variable phenotypes, multiple feedback loops. Everything we do is based on modelling. Answering questions through mathematical models: most models in healthcare are directed at pattern recognition and machine learning to be predictive. Mechanistic dynamical models enable understanding of the dynamics of the systems and physiologic state / biological systems; provide the insight as to cause. Iteratively utilize change over time: time is an ally for physiologic modelling.

Problem 1: Needs to be simple enough but captures the essence of the system.

Problem 2: Differences and transitions between the measurement space (the data we measure, see and interpret) and the "state" space (change in trajectory over time).

Mel Almodovar: Data visualization; "seeing is believing". ICUs are dynamic, complex and data rich environments; usually from disparate sources that are poorly integrated. Enhanced visualization to enable interactions and see the evolving physiologic clinical picture; depict patterns and connections that matter and "tell the story". What we see must enhance understanding and guide decisions; must be enlightening and attention-holding. Should make sense, user-friendly and interactive, real time and scalable.

Heather Duncan: Implementing big data into daily critical care and utilizing this to guide day to day decision-making. Some challenges include data consistency, data being asynchronous with non-identical time stamps. Key questions to understand: what do you want to collect (static and streamlined data), what do you want to know and achieve, and what do you plan to do with the data (trends, targets and response)? Static large databases (of huge amounts of aggregated data around a specific disease for example) can be used to model and predict admission, discharge and length of stay, and be used to predict events such as cardiac arrest. Implementing streamed data, i.e., not visible with bedside monitoring but could predict deviation / event in the future. Advantage and utilization: PICU early warning system.

Michael Gaies: Collect, store and share. Collaboration between clinicians, institutions and non-clinical data scientists are essential for discovery and understanding management practices and variability. Hard part is perhaps not to collect the data or to share it, but rather to understand the how results are utilized. Considerations for an ideal data infrastructure:

1. Data integration and analytic infrastructure: merged critical care data from complementary data sets (including clinical registries). Value: the rigor, governance and data integrity of the data are typically built into registry data.
2. "Burden of proof": Need to really prove that an early warning system is truly "early". When did the team at the bedside interpret or understand what the algorithm or model was trying to indicate? Call us the bedside before we need to be there! Minimize the experience gradient, particularly important as medical training changes.
3. Understand barriers to success and potential risks: more than just the data science, but have to be aware of barriers to implementation, inability to change clinician behavior and problem of alert fatigue. Simply can't build another widget!

Trial within a registry: uses the registry as the platform for trial implementation. New methodology, utilize the existing infrastructure; a model for big data in critical care.