

Michael S. Avidan – 17th June 2018 Dr. Seymour and Rose T. Brown Professor of Anesthesiology



2018 CAS ANNUAL MEETING



Canadian Anesthesiologists' Société canadienne des anesthésiologistes 1943 – 2018

Advancing Anesthesiology, Excellence & Leadership

Telemedicine/AI/Machine Learning in Relation to The Future of Anesthesiology Practice

Acknowledgements

National Institute on Aging National Science Foundation National Heart, Lung and Blood Institute National Institute of General Medical Sciences McDonnell Foundation for Neuroscience Agency for Healthcare Research & Quality Institute of Clinical and Translational Science



I have no conflicts of interest to declare.





National Institute on Aging

Special Thanks













Washington University in St. Louis

School of Engineering & Applied Science



Washington University in St.Louis

Institute for Public Health



Anesthesiology Control Tower











Outline

- 1. The Challenges Facing Anesthesiology Care
- 2. The ACT Concept
- 3. Harnessing Machine Learning and Artificial Intelligence
- 4. The Future of Anesthesiology

The Challenges (in the US)

- 1. Failure of anesthesia care teams to implement evidence-based care;
- 2. Differing backgrounds and perspectives of anesthesiologists and CRNAs;
- 3. Cognitive overload and biases of operating room (OR) teams;
- 4. Inaccurate assessment of dynamic shifts in patient risk that can occur rapidly in real time;
- 5. Shortage of skilled anesthesia clinicians.

Pandemonium John Martin

Wouldn't it be nice...





3. The Clinician is in The Control Tower

Anesthesiology Control Tower







Three ACTFASTs



Feasibility: What are the barriers and enablers to implementation?

Forecasting: How can we use machine learning to predict

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Anesthesiology Control Tower (ACTFAST)					
 The safety and scientific validity of this study is the responsibility of the sponsor and investigators. Listing a study does not mean it has been evaluated by the U.S. Federal Government. Know the risks and potentimes benefits of clinical studies and talk to your health care provider before participating. Read our <u>disclaimer</u> for details. 	∍ study i <u>al</u>	ClinicalTrials.gov Recruitment Sta First Posted () : Last Update Po See <u>Contacts a</u>	Identifier: NCT028301 atus ① : Recruiting July 12, 2016 sted ① : January 9, 201 Ind Locations	8	
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4. Harnessing Machine Learning and Artificial Intelligence

Machine Learning

Machine learning addresses the question of how to build computers that improve automatically through experience. It is one of today's most rapidly growing technical fields, lying at the intersection of computer science and statistics, and at the core of artificial intelligence and data science.

Machine Learning

Machine learning is a branch of artificial intelligence research that employs a variety of statistical, probabilistic and optimization tools to "learn" from past examples and to then use that prior training to classify new data, identify new patterns or predict novel trends.

Cruz JA, Wishart DS. Applications of machine learning in cancer prediction and prognosis. Cancer Inform. 2007 Feb 11;2:59-77.

Our Goal









Postoperative Outcomes



Multi-path convolutional deep neural network (MPCNN) that can directly handle a heterogeneous dataset



Our Approach

Dataset with a total number of 109,791 unique patients in which.

We use all 44 preoperative features, containing both numerical and categorical data types.

For the in-op time series features, we delete sparse time series with many missing values and select 10 most important time series. We tested with three time series lengths, 30-min, 45-min and 60-min.

We randomly split the dataset into training set (70,000 patients), validation set (20,000 patients), and testing set (19,791 patients)



What does this mean?

Cutoff	Sensitivity (Recall)	PPV (Precision)	True Dead	False Dead
Low Sensitivity	10%	15.5%	27	147
Lowish Sensitivity	30%	12.1%	80	584
Moderate Sensitivity	50%	9.1%	134	1334
Highish Sensitivity	70%	5.2%	187	3369
High Sensitivity	90%	2.5%	241	9533

Overall Morality	Dead = 267	Total N = 19,771
1.35%		



Limitations of machine learning

Machine learning does not solve any of the fundamental problems of causal inference in observational data sets.

Algorithms may be good at predicting outcomes, but predictors are not causes.

Predicting the Future — Big Data, Machine Learning, and Clinical Medicine Ziad Obermeyer, M.D., and Ezekiel J. Emanuel, M.D., Ph.D. N Engl J Med 2016; 375:1216-1219

Disruption in Medicine

- 1. Machine learning will dramatically improve the ability of health professionals to establish a prognosis.
- 2. Machine learning will displace much of the work of radiologists and anatomical pathologists. Algorithms will also monitor and interpret streaming physiological data, replacing aspects of anesthesiology and critical care. The time scale for these disruptions is years, not decades.
- 3. Machine learning will improve diagnostic accuracy.

The Innovative ACTFASTs

- Expansion of telemedicine
- RCT design
- Machine-learning forecast algorithms
- Disruptive education
- Commitment to the academic mission

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Funding for the ACT Projects

- Institute of Clinical & Translational Sciences: Usability
- National Science Foundation: Forecasting Algorithms
- Agency for Healthcare Research and Quality: Pilot Clinical Trial
- Washington University Practice Plan: Clinician Staffing
- National Institute for Nursing Research (Applied): Pragmatic Clinical Trial











