International Clinical Analytics Summit

Smarter Hospitals
Safer Patients
Better Outcomes

Improving Safety, Quality, and Costs through Shared Innovative Analytics

Michael Howell, M.D., MPH
Associate Professor of Medicine and Associate Chief Medical Officer for Clinical Quality, The University of Chicago

April 2, 2015
7:30 a.m. – 4 p.m.
MITRE Baltimore
2275 Rolling Run Drive, Windsor Mill, MD 21244
What to worry about

How this could all go wrong, and how to avoid it

Michael D. Howell, MD MPH
Associate Chief Medical Officer
Associate Professor of Medicine
Wait, what?
Who let this guy in?
I am …

• An ICU doc who last saw patients 7 days ago
• A Chief Quality Officer
  ... with direct oversight of the operational analytics group at UChicago
• Someone who ran a research analytics shop for several years
• A healthcare delivery science researcher who routinely uses fairly large datasets (>1 x 10^8)
Now into my third decade of technology-enabled analytics

Remain spectacularly hopeful
(in spite of the talk’s title).

Have learned a few things that make me worry.
Core Resource for InSIGHT

INTEGRATION OF STANDARD INFORMATION GATHERED USING HEALTHCARE TECHNOLOGY
Computational Intelligence Methods For Processing Misaligned, Unevenly Sampled Time Series Containing Missing Data

Federico Cismondi†, André S. Fialho†
Susana M. Vieira‡, João M.C. Sousa§, Shane R. Reti‡
Michael D. Howells§ and Stan N. Finkelstein¶

†Engineering Systems Division, Massachusetts Institute of Technology,
‡7 Massachusetts Avenue, 02139 Cambridge, MA, USA. Email: cismondi@mit.edu
§MIT Portugal Program, 77 Massachusetts Avenue, E40-221, 02139 Cambridge, MA, USA
¶Technical University of Lisbon, Instituto Superior Técnico, Dept. of Mechanical Engineering,
CRISTEM – LAETA, Av. Rovisco Pais, 1049-001 Lisbon, Portugal
§Division of Clinical Informatics, Department of Medicine,
¶Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

Influence of Pre-processing Techniques on Real-World Data-based Classification

CHEST
Original Research
CRITICAL CARE
Severity of Acute Kidney Injury and Two-Year Outcomes in Critically Ill Patients

Sustained effectiveness of a primary-team–based rapid response system

Computational Intelligence Methods For Processing Misaligned, Unevenly Sampled Time Series Containing Missing Data

Predicting Laboratory Testing in Intensive Care using Fuzzy and Neural Modeling
At UChicago, we are deeply invested in becoming a smarter hospital.
Long history of excellence in cardiac arrest research

5 hospitals
269,999 patients

27-dimensions in the multivariable model ...
Splines, the whole nine yards.

AUC for cardiac arrest = 0.83
AUC for death = 0.93
8 hours of warning before a cardiac arrest
The great aim of education is not knowledge but action.

Lucky Numbers 23, 14, 21, 43, 47, 6
UChicago has invested in

- Commercial-grade enterprise services bus (TIBCO)
- Complex event processor (TIBCO)
Discovery + Real-World Deployment = Action, Not Just Knowledge

- State-of-the-art risk prediction algorithm for cardiac arrest and ICU transfer (eCART)
- Went live February 2015
What happened?

• 07:00 - Automatic notification turned on for eCART
• 08:20 – Computer pages response team for a new high-risk patient
• 08:35 – Rapid Response Team arrives at the bedside. 30ish year-old with a pneumothorax. On rounds that morning, chest tube turned to water seal.
• 15:00 – Patient deemed stable. Team signs off.
Focus on the basics

Protect Your Health.

Welcome to the University of Chicago Hand Hygiene Site

A Commitment to Patient Safety

Every Opportunity Counts. Good Hand Hygiene (HH) is everyone’s responsibility here at University of Chicago Medicine. Proper Hand Hygiene is a low-cost and well-established
UChicago has invested in

- Non-observable hand hygiene observation

- Real-time monitoring of
  - Room entry
  - Room exit
  - Hand sanitizer and soap usage

~83,000 observations per day – Spatially and temporally distinct
Genomic scale data from routine operations

<table>
<thead>
<tr>
<th>Each Column is a Hospital Room</th>
<th>Each Column is a Hospital Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each row is an hour</td>
<td>Each row is an hour</td>
</tr>
</tbody>
</table>

1 month ... ~1.1 million cells of data
Genomic scale data from routine operations

Each Column is a Hospital Room

We can now apply genomic analytic techniques to routine operational data
Why is your title so negative, then?
Three things I worry about
Next-gen analytics are obviously the right thing. Right?
Something I’ve learned, #1
The peril of doing the ‘obviously’ right thing
Critical care has learned that doing the “obviously right” thing can kill patients.
Obviously right: More data to understand how to treat shock

1970

CATHETERIZATION OF THE HEART IN MAN WITH USE OF A FLOW-DIRECTED BALLOON-TIPPED CATHETER*


Abstract

Pressures in the right side of the heart and pulmonary capillary wedge can be obtained by cardiac catheterization without the aid of fluoroscopy. A No. 5 Fr double-lumen catheter with a balloon just proximal to the tip is inserted into the right atrium under pressure monitoring. The balloon is then inflated with 0.8 ml of air. The balloon is carried by blood flow through the right side of the heart into the smaller radices of the pulmonary artery. In this position when the balloon is inflated wedge pressure is obtained. The average time for passage of the catheter from the right atrium to the pulmonary artery was 35 seconds in the first 100 passages. The frequency of premature beats was minimal, and no other arrhythmias occurred.

1980s

>40% of critically ill patients had this procedure done

1990-2000s

New studies show no benefit, and maybe increased mortality
Obviously right: Don’t let ICU patients starve – early IV nutrition!

“Late initiation of parenteral nutrition was associated with faster recovery and fewer complications, as compared with early initiation”
Obviously right: Don’t let the blood sugar get out of control!

Treat 38 ... 1 extra dies.
Something I’ve learned, #1
The peril of doing the ‘obviously’ right thing
Something I’ve learned, #2
Human factors are like gravity

You can complain about gravity all you want, but you’d better understand it before you launch your rocket.
We’ve all seen hilarious signs of bad design.
But that could never happen to us, right?
Human beings have predictable, inducible cognitive failures.
It’s amazingly easy to forget – don’t!
What’s the capital of Montana?
OK – let’s see how predictable you are.

It’s amazingly easy not to forget – don’t.

I removed your card.
Did I get it right?
Now let’s simulate something harder – a complex, cognitively intense task, like diagnosis.
Can you figure out the magic trick?
Red → Green
$150 shirt
One more thing
Something I’ve learned, #2
Human factors are like gravity

You can complain about gravity all you want, but you’d better understand it before you launch your rocket.
Something I’ve learned, #3
The road to purgatory is paved
with well-intended incentives.
Let’s use some of those genomic analytics.
Hand Hygiene Events Per Hour
Think it’s just us?
Anybody here from Cleveland?
Anybody know what the Cleveland Health Quality Choice program was?
Cleveland Health Quality Choice

• 1989

• Multi-stakeholder group wanted health reform

• Public reports:
  – Risk-adjusted mortality
  – Risk-adjusted LOS

• What happened?
  – Mortality fell dramatically
How could this possibly be a problem?

Hospital mortality for pneumonia
Conclusion. During Cleveland’s experiment with hospital report cards, deaths shifted from in hospital to the period immediately after discharge with little or no net reduction in 30-day mortality for most conditions. Hospital profiling remains an unproven strategy for improving outcomes of care for medical conditions. Using in-hospital mortality rates to monitor trends in outcomes for hospitalized patients may lead to spurious conclusions.
Something I’ve learned, #3
The road to purgatory is paved with well-intended incentives.
What do I want you to take away from this?
## What’s the point?

<table>
<thead>
<tr>
<th>Issue</th>
<th>Suggestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>The peril of doing the ‘obviously’ right thing</td>
<td>Don’t assume it will work.</td>
</tr>
<tr>
<td></td>
<td>a) Be open to the idea of unexpected harms.</td>
</tr>
<tr>
<td></td>
<td>b) Fund the evaluation</td>
</tr>
<tr>
<td></td>
<td>c) Realize that the math for telling whether it worked or not is really, really hard.</td>
</tr>
<tr>
<td>Human factors are like gravity</td>
<td>We are not one clever algorithm away from fixing US healthcare.</td>
</tr>
<tr>
<td>(You can complain about gravity all you want, but you’d better understand it before you launch your rocket.)</td>
<td>• Funding analytics without funding human factors research</td>
</tr>
<tr>
<td></td>
<td>• creates knowledge but not action.</td>
</tr>
<tr>
<td></td>
<td>• is at best wasteful and at worst dangerous.</td>
</tr>
<tr>
<td></td>
<td>When we fund new analytic investments, we should co-invest in developing the cognitive science / human factors of healthcare analytics.</td>
</tr>
<tr>
<td>The road to purgatory is paved with well-intended incentives.</td>
<td>Hire people smarter than me.</td>
</tr>
<tr>
<td></td>
<td>Getting incentives right for next-gen analytics will be difficult.</td>
</tr>
</tbody>
</table>
The great aim of education is not knowledge but action.

Lucky Numbers  23, 14, 21, 43, 47, 6