Can Big Data Drive Better Care for AKI?

What is Big Data and How Can the EMR Work For You?

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Overview

• Introduction to “Big Data” as a concept

• The Big Data of the EHR

• Big Data, EHRs, and AKI Care Improvement
Big Data?

Gartner Hype Cycles provide a graphic representation of the maturity and adoption of technologies and applications, and ... give you a view of how a technology or application will evolve over time.
Big Data?

“... big data has quickly moved over the Peak of Inflated Expectations and has become prevalent in our lives ...”

“... [Big Data] is past hype ...”

“I would [no longer] consider big data to be an emerging technology”
Big Data?

- Added to Oxford English Dictionary in 2013
- Added to Miriam Webster Dictionary in 2014
- OED
  - *Big Data, n.* (also with capital initials) data of a very large size, typically to the extent that its manipulation and management present significant logistical challenges; (also) the branch of computing involving such data.
- Wikipedia
  - term for data sets that are so large or complex that traditional data processing application softwares are inadequate to deal with them. The term often refers to the use of certain advanced data analytics methods that extract value from data.
EMR and “Big Data”
The Clinical Researcher Analogy

- EMR captures data generated through the routine provision of patient care

- Clinical researchers can think of it as a database for:
  - A continuous semi-randomized, uncontrolled trial
  - Without inclusion or exclusion criteria
  - Of every therapy/intervention for every disease
  - With an indefinite follow-up period
  - Trial conducted at no cost to you
  - The database is free (sort-of) and constantly monitored by an entire department (Hello, IT!)
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It’s a gigantic prospectively populated repository of the most clinically relevant data imaginable housed within a technologically advanced interventional platform
On the inpatient side, routine clinical care at LPCH generates:

- **892** data points per patient per day
- **2000-2500** per patient per day in ICUs
- **222,000** data points per day
- **80,000,000** data points per year
- Figures don’t include outpatient care or the narrative data captured in notes
EMR-omics

**Volume:** Amount of data available
**Variety:** Different types of data available
**Velocity:** Speed at which data accumulates
EMR and “Big Data”
The Clinical Researcher Analogy
How does EMR + Big Data = Better AKI Care?

Data Generation and Accumulation
Care Delivery
# AKI Care Improvement: Identification

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<th>Chloride, WB</th>
<th>Glucose, WB</th>
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</tr>
</tbody>
</table>

* denotes a value outside the normal range.
Creatinidine increases by 0.43mg/dL over 25 hours and one minute.
AKI Care Improvement
AKI Care Improvement

Creatinine increases by 0.43mg/dL over 25 hours and one minute
Progression of Acute Kidney Injury

- Pre-disease state
- No AKI
- Early AKI (Stage 1, Risk)
- AKI

Prediction and Risk Assessment

Bruce Ling, Ph.D.
AKI Care Improvement

- Once you’ve identified the AKI and non-AKI patients
  - Look for patterns in the EMR data that predict AKI
  - Use machine learning or “unsupervised” techniques to identify predictors

- Amount of data in the EMR has become uninterpretable
  - Use high-content, high-throughput predictive analytics (computer modeling) to interpret it
  - Identify currently available but as of yet unknown “biomarkers”
AKI Care Improvement

• **Goal** = heighten awareness and identify cases earlier
  – Allows a practitioner to modify care
  – Sounds super amazing, right?

• **Alerts can work**
  – ADQI conference reviewed the existing data and found that of the 14 which reviewed outcomes, 11 showed benefit and 3 did not.
  – Two RCTs offered conflicting results

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AKI Care Improvement

• Alerts don’t work universally
  – Need to be appropriately targeted
  – Need to be well integrated into processes
  – Need to offer actionable decision support
  – Getting the whole enchilada correct is very, very challenging

• We’re really limited by our lack of interventions
  – Optimize fluids and hemodynamics, minimize nephrotoxins and insults
  – No treatment for AKI once it develops
  – One more reason to love prediction 😊

AKI Care Improvement

• AKI is associated with non-transient long-term morbidity.

• However, patients are not well followed and tracked
  – Only 66% of children with AKI in the ICU have creatinine checked between transfer to the floor and discharge
  – 4% of children who develop AKI after cardiac surgery see a nephrologist in follow up
  – 8.5% of adults with AKI see a nephrologist for follow up care
AKI Care Improvement

- Accurate diagnosis allows patients to be "tagged"

- Can be followed at
  - Patient level – direct into appropriate follow up clinics
  - Population level – across institutions or administrative databases
AKI Care Improvement: Summary