Artificial Intelligence in Healthcare - Improving Health Outcomes on the Last Mile of a Learning Healthcare System

The Importance of Leading with Statistics

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ABSTRACT

Biostatisticians routinely perform important work in analyzing healthcare data and creating predictive models.

Although this work often leads to publications in medical research journals, the findings seldom lead to improved, sustainable health outcomes.

When findings are applied, average lag time from discovery to practice is 17 years.

To overcome these problems we created a Learning Healthcare System Platform.

Using this infrastructure, we successfully completed several large randomized pragmatic trials of:

1) daily chlorhexidine bathing of ICU patients (n=9,340);
2) a comparison of 0.9% saline vs. balanced fluids (n=29,149);
3) the effectiveness of a post-discharge phone call on hospital readmissions (n=2,738).

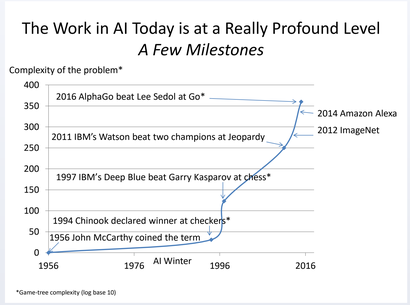
We have also tested whether real-time predictive models incorporated into the electronic health record can be used to focus prevention and improve outcomes in randomized controlled trials.

We have demonstrated that it is possible to implement rigorous, randomized controlled trials in a hospital setting. As well as describing the infrastructure and processes, we discuss the initial concerns, previous obstacles, and the remaining challenges.

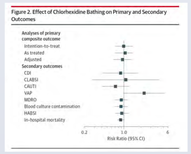
Biostatistical Contributions

Weekly Learning Healthcare System workshops
Teaching/Mentoring (Biostatistics, Medical Writing)
Clinical and Translational Research Studios
Biostatistics Clinics (free drop-in sessions every weekday)
Study design consultation
- **Sample size and power**
- **Intention to treat**
- **Regression to the mean**
- **Randomization**

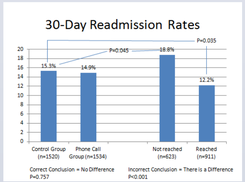
Electronic health record data management
Statistical analysis/reproducible research and reporting
Graphics/data visualization
Predictive modeling with rigorous validation
Medical writing and publishing

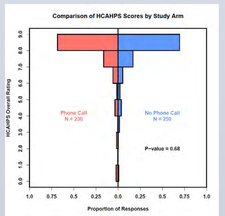


1) Chlorhexidine Study

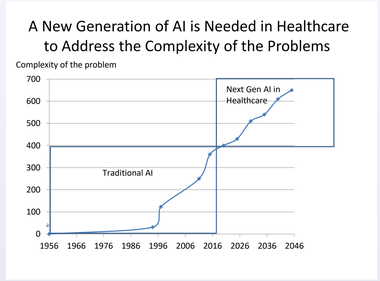


3) Phone Call Study



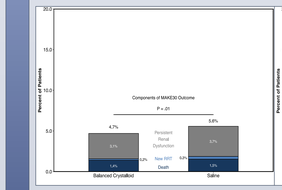


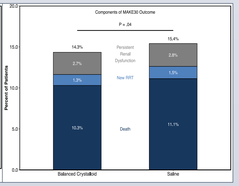
2) SALT-ED & SMART

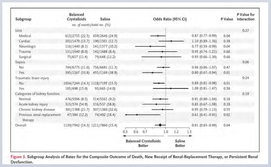


SALT-ED

SMART



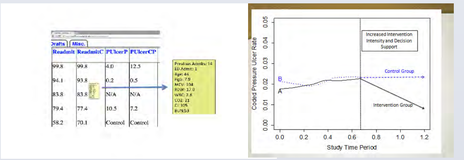




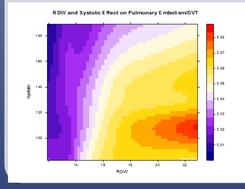
Challenges in Healthcare

Traditional AI worked in these settings:	Next Gen AI is needed to work in the healthcare setting:
Simple rules (chess)	Very complex rules (human body)
Facts (Jeopardy!)	Fewer facts (medical and scientific debates)
High signal:noise (Go)	Low signal:noise (electronic health record, PubMed)
Unbiased data (rules, facts, winners and losers)	Biased data (intervention bias, publication bias)
Stakes are low (games)	Stakes are high (lives depend on the answer)
Easy to implement AI into a competition	Complex to implement AI in a randomized controlled trial in a learning healthcare system

Cornelius



Cornelius is a Vanderbilt project to assess whether real-time predictive models embedded in the electronic health record can be used to focus prevention and improve patients outcomes in randomized controlled trials.



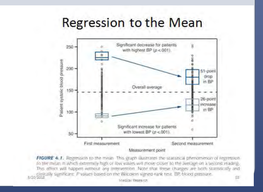


FIGURE 6.1. Regression to the mean. This graph illustrates the statistical phenomenon of regression to the mean in which extremely high or low values are more closest to the average on a second reading. This effect will happen without any intervention. Note that these changes are both statistically and clinically significant. If values based on the 95%ctile regression rank rms. BP. Focus pretreat.

10 Steps to Overcome the Challenges of Implementing AI in Healthcare

1. **Be realistic** about how hard it will be to use AI in healthcare.
2. Address the many **concerns** about using AI in healthcare.
3. Improve the level of **teamwork** among groups that do not normally work together.
4. Help all involved become comfortable with **randomization**.
5. Focus on improving health **outcomes** that are important to patients.
6. Change the **financial and career promotion incentives** in healthcare and the AI industry to be aligned with using AI to improve health outcomes.
7. Keep an **open mind** to various AI techniques and avoid falling in love with one method.
8. Raise the bar with **rigorous evaluations** regarding what is a successful implementation of AI.
9. Hire excellent **project managers** to create forward progress and avoid Brownian motion that can stall these projects
10. Put the **scientists in front** and have marketing and sales people limit their claims to what researchers have proven – tone down the hype.

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