Advisory Board | Health Care IT Advisor

Who Watches The Machines?

Responsible Deployment of Decision Technologies in Healthcare

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Greg Kuhnen
Senior Research Director
kuhneng@advisory.com

1 The Data Dilemma

2 AI and the New Machine Age

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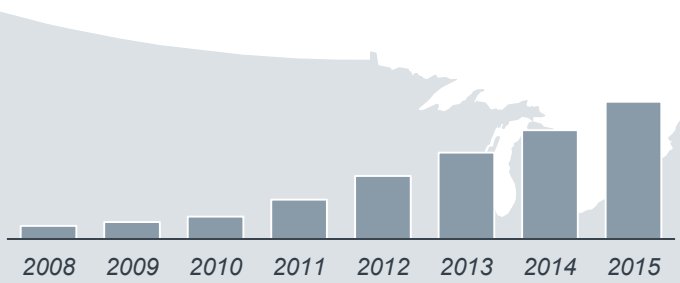
The Rapid Rise of EHRs

Basic EHR Adoption 2008–2015



	2008	2009	2010	2011	2012	2013	2014	2015
Percentage	9%	12%	16%	28%	44%	59%	76%	84%

MU CDS Requirements by Stage

Stage 1

2011–2014

- One CDS rule
- Drug-drug/drug-allergy interaction checking

Stage 2 and Modified Stage 2

2014–2018

- Retain Stage 1 requirements[1]
- Increase number of CDS rules to 5

Stage 3

Begins 2019[2]

- CDS removed as a specific requirement[1]; CMS expects functionality enabled regardless

1) CDS removed from Meaningful Use (MU) for Medicare hospitals effective CY 2017; remains a requirement for Medicaid MU program.
2) Stage 3 is optional in 2017 and 2018, and proposed to be required in 2019.

Sources: CMS; ONC Health IT Dashboard Figure 1, https://dashboard.healthit.gov/evaluations/data-briefs/non-federal-acute-care-hospital-ehr-adoption-2008-2015.php; Advisory Board research and analysis.

Pockets of Success with Clinical Decision Support

Mercy, St. Louis: Automated Clinical Pathway for Heart Failure

Care standardization the target; bundled payment environment

Heart failure: mortality rate of 6%

Metrics targeted: HF[1] mortality, time to diuretic, reduce variable costs per case

Designed and optimized with analytics vendor platform based on Mercy data, practice, populations; driven from problem list, signs, and symptoms

Default orders–nursing: define daily diuresis goal; CDS-supported medication selection and dosing including Now dosing

Epic

HIMSS Enterprise Davies Award, 2016

1
Hour reduced in door-to-diuretics time under baseline

<2%
HF mortality compared with national average 5%

$800
Variable cost reduction per HF patient

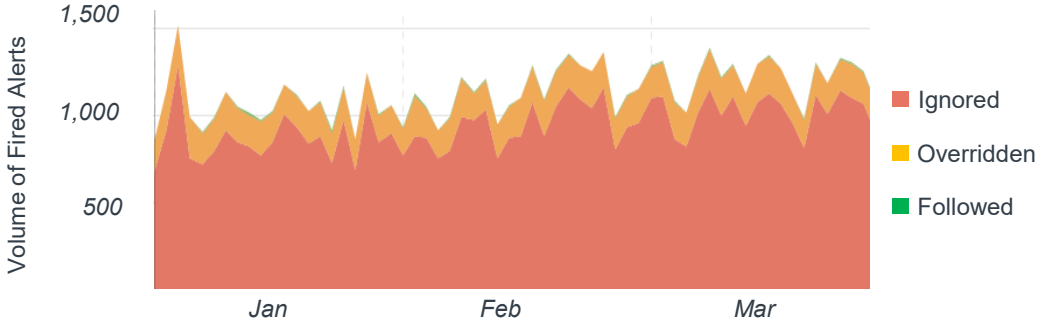
$28M
Direct variable cost savings across 40 pathways in 2 years

1) HF = Heart failure.

Sources: HIMSS Enterprise Davies Award Recipients, http://www.himss.org/himss-enterprise-davies-award-recipients; Advisory Board research and analysis.

… and a Bad Case of Alert Fatigue

Example: ED[1] Sepsis Detection Alert at Anders Health System[2]



With Alert Fatigue, Overrides and Frustrations Abound

6,000+ Alerts Fired Per Month

0.3% Alerts Followed

> "They twisted their knee and I get a sepsis alert. It is no wonder these are ignored. They wear you out with alerts! Waste of time and fatigue the staff!!!"

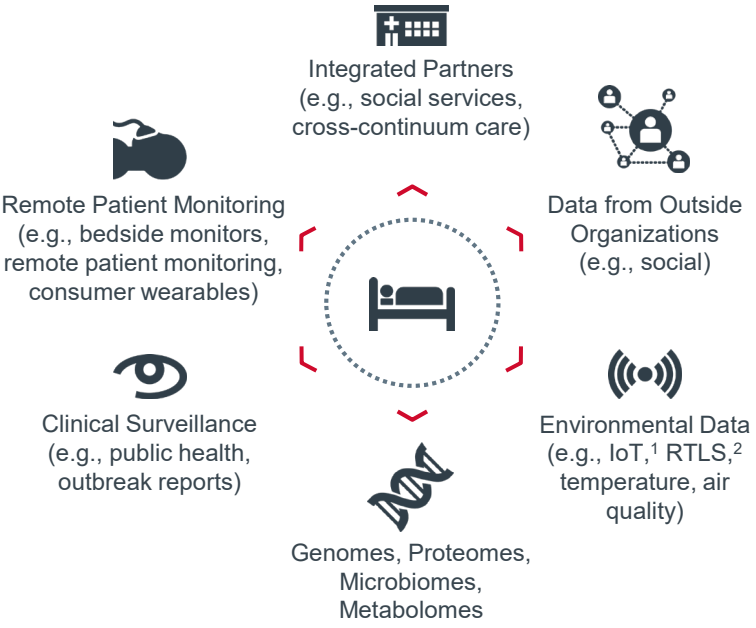
1) ED = Emergency department.
2) Pseudonym.

Sources: Electronic Medical Record Adoption Model, HIMSS Analytics, http://www.himssanalytics.org/provider-solutions; Gregg H, "Survey: Providers Investing Heavily in EHRs, But Dissatisfied With Purchase," *Becker's Hospital Review*, June 2, 2104, http://www.beckershospitalreview.com/healthcare-information-technology/survey-providers-investing-heavily-in-ehrs-but-dissatisfied-with-purchase.html; Verdon D, "Physician outcry on EHR functionality, cost will shake the health information technology sector," *Modern Medicine Network*, February 10, 2014, http://medicaleconomics.modernmedicine.com/medical-economics/content/tags/ehr/physician-outcry-ehr-functionality-cost-will-shake-health-informa; Advisory Board research and analysis.

Technology is Delivering a Flood of New Data

Smartphones, and Genomes, and Sensors, Oh My!

A Sampling of New Data Sources



Common Barriers to Adoption of New Sources

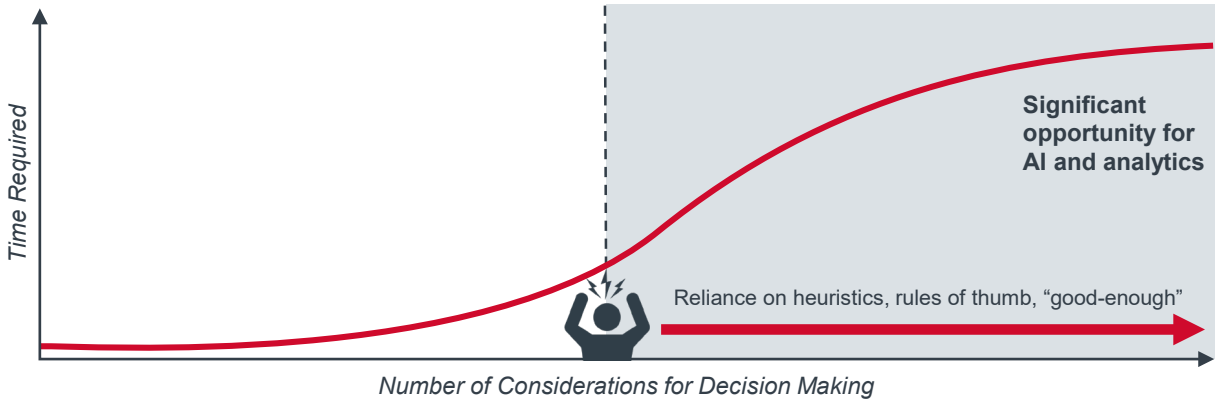
- Privacy / security concerns
- Immature technology
- Lack of budget
- Unclear benefit / ROI[3]
- **Staff already overwhelmed with data**

1) IoT = Internet of things.
2) RTLS = Real-time locating system.
3) ROI = Return on investment.

Source: Health Care IT Advisor research and analysis.

Cognitive Overload and Clinician Burnout

Augmented Intelligence Reduces Cognitive Burden



> "Medical thinking has become vastly more complex, mirroring changes in our patients, our health care system, and medical science. The complexity of medicine now **exceeds the capacity of the human mind**.[1]"
>
> *Ziad Obermeyer, M.D. and Thomas Lee, M.D.*

1) Obermeyer Z, Lee T, "Lost in Thought – The Limits of the Human Mind and the Future of Medicine," *N Engl J Med*; 377, no. 13; (2017):1209-1211.

Sources: Millett D, Exclusive: "Three GPs a day seeking help for burnout, official data show," *GP*, Jan 2018; Health Care IT Advisor research and analysis.

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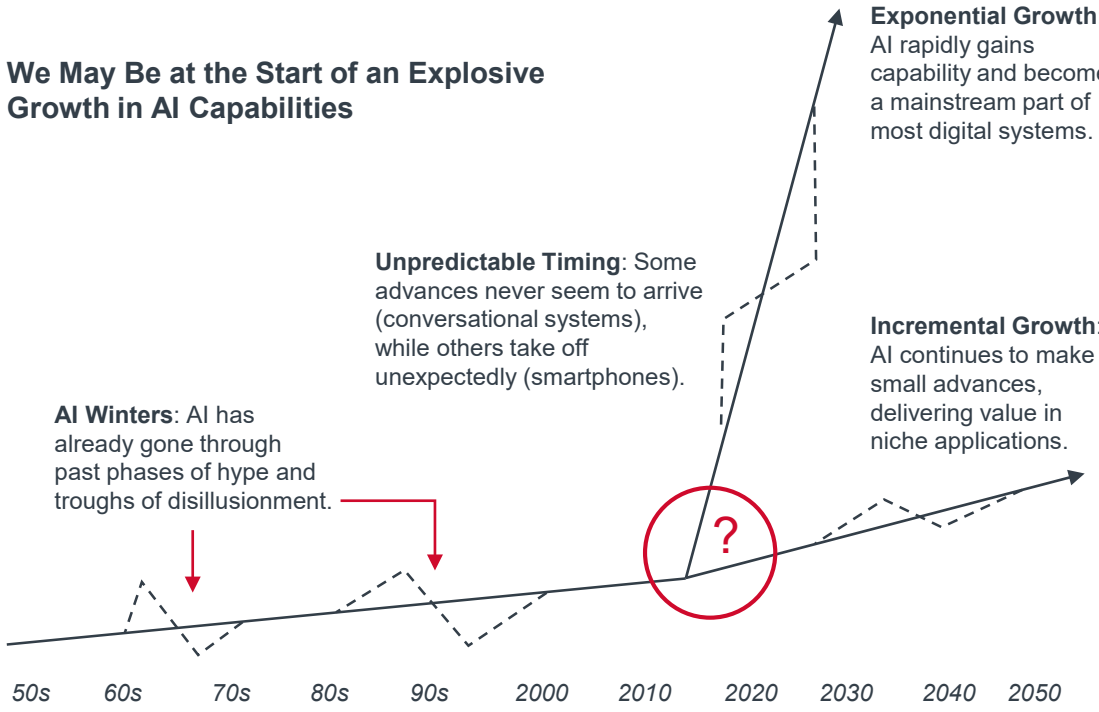
AI: Are We There Yet?

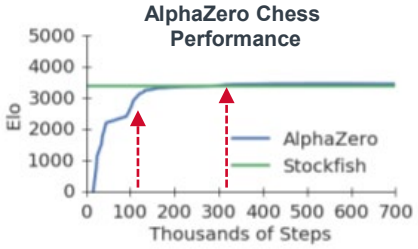
And if Not, When?



Source: Health Care IT Advisor research and analysis.

Novice to Superhuman in Just Four Hours

DeepMind's AlphaZero Uses 'Zero Human Knowledge'



AlphaZero outperformed chess world-champion, Stockfish,[1] in just **4 hours (300k steps)**

> By not using this human data, by not using human features or human expertise in any fashion, we've actually removed the constraints of human knowledge. **It's able to therefore create knowledge for itself**."
>
> David Silver, Lead Programmer
>
> DEEPMIND

DeepMind's AlphaZero

- AI product of Google subsidiary, DeepMind
- Provided no prior knowledge of the game; given only basic game rules and an objective (win)
- Learns through self-play at an accelerated pace ('reinforced learning'); searches 80 thousand positions per second
- Variants of AlphaZero also defeated world champion Go and Shogi systems

1) Stockfish is the 2016 Top Chess Engine Championship (TCEC) world-champion.

Sources: Vincent J, "DeepMind's AI became a superhuman chess player in a few hours, just for fun," *The Verge*, December 6, 2017; Gershgorn D, "DeepMind wants to find the next miracle material—experts just don't know they'll pull it off," *Quartz*, October 25, 2017; Health Care IT Advisor research and analysis.

Need a Radiologist?

There's an App for That

Case in Brief: Stanford University[1] CheXNet Algorithm

- Algorithm developed by researchers at Stanford University in the US can diagnose 14 common pathologies in chest x-rays
- Trained on ChestX-ray14, a public data set released by the NIH[2] containing 112,120 frontal-view chest x-ray images labelled with the 14 possible pathologies
- Outperforms previous models from the same data set for all 14 conditions and diagnoses pneumonia at an accuracy exceeding the performance of four control radiologists
- Produces heatmaps that visualize the areas of an image most indicative of disease

"I treat the model as a lazy resident. They're not dumb, they'll just use every trick they can find to avoid doing hard work."

Dr. Matthew Lungren, Radiologist
Stanford University Medical Center

Development of CheXNet

Sept. 26, 2017

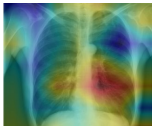
ChestX-ray14 data set released along with a preliminary algorithm that could detect the labelled conditions

≈ One month later

CheXNet surpassed best published results for all 14 pathologies and outperformed Stanford radiologists in detecting pneumonia

≈ One week later

CheXNet could diagnose 10 of the 14 pathologies more accurately than all previous algorithms



1) Stanford University Medical Center.
2) NIH = National Institutes of Health.

Sources: Kubota T, "Stanford algorithm can diagnose pneumonia better than radiologists," *Stanford News*, Nov 2017; Health Care IT Advisor research and analysis.

Applicants Like You Liked This Job

Predictive Models Reduce Turnover, Improve Engagement

MultiCare's Hiring Process

Applicant completes a 15-20 minute assessment process on Arena's platform

Algorithms predict the likelihood the applicant will be retained and engaged in the target role and send that information to the recruiter

Recruiters determine whether or not to send the candidate along to hiring managers

Hiring managers use Arena's recommendation as an optional factor in the hiring decision

Case in Brief: MultiCare Health System

- Non-profit system based in Tacoma, WA with 16,000 employees
- Partnered with Arena, a cloud-based HR solution, to predict the likelihood that a candidate will be retained in a role
- Arena's machine learning algorithms evaluate applicant submissions, digital interactions, and externally sourced data on the organization (e.g., employer review sites)
- Achieved a **40% reduction** in RN turnover at 180 days and a **28% reduction** in overall turnover at 180 days

Realized Benefits

- ☑ Reduced recruiting expenses
- ☑ More predictable staffing levels
- ☑ More experienced staff

Source: Health Care IT Advisor research and analysis.

Black Boxes, Shades of Grey

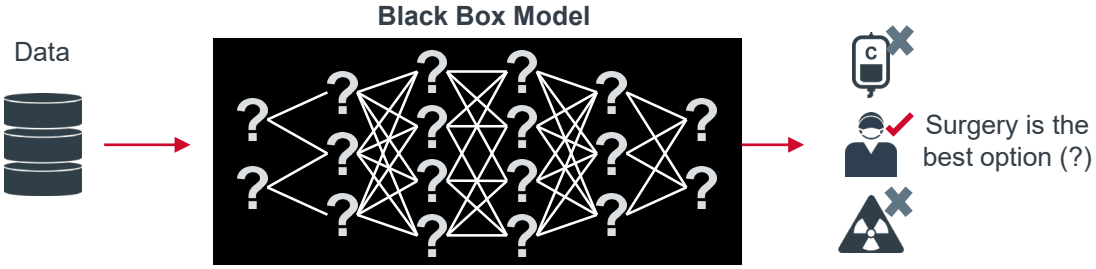
Differing Views on the Importance of Explainability

"The opaqueness of black-box models is really scary. When we can't tell a clinician why a patient won't do well on a certain medication, that can be a **tough thing to blindly trust from a clinical perspective**. We want to reach a place where we **augment our practice through AI**, rather than dictating."

Mike Wall, PharmD, MBA
Chief Analytics Officer
The University of Chicago Medicine

"I am pushing to evaluate these models via a similar set of mechanisms as RCT[1] or A/B testing. We should evaluate against the current status-quo and do a before/after study…We have to convince ourselves of the utility of these models. **We should focus on utility before explainability**."

Nigam Shah, MBBS, PhD
Associate Professor of Medicine
(Biomedical Informatics)
Stanford University



1) RCT = Randomized controlled trial.

Source: Health Care IT Advisor research and analysis.

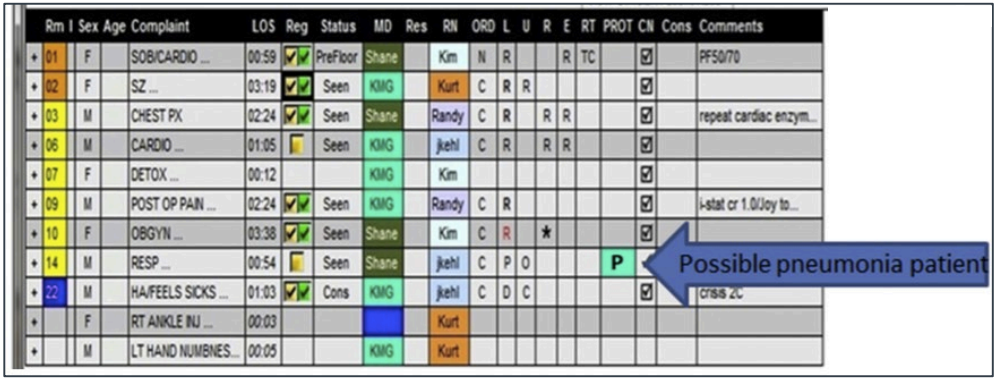
Accelerate Clinical Standardization

Improve Outcomes Through Embedded Decision Support

Case in Brief: Intermountain Healthcare

- 2,781-bed, 22-hospital system based in Salt Lake City, UT
- Long history of formal care process modeling and standardization, dating back to 1986
- Pneumonia protocol evaluates labs, vitals, and free text radiology reports in real time and can visually flag high-risk patients in the EHR
- Integrated, dynamic guidelines recommend an appropriate care setting, additional lab orders, and antibiotic selection based on risk and medical history

Predictive + Prescriptive Clinical Decision Support



Sources: Dean, Nathan C. et al., "Impact of an Electronic Clinical Decision Support Tool for Emergency Department Patients With Pneumonia," *Annals of Emergency Medicine*, 66, no. 5 (2015): 511-520; Advisory Board interviews and analysis.

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Driving the Decision Machine

Hint: The Analytics is Often the Easy Part

Begin with:

- Explicit leadership agreement on outcome goals, expected benefit mechanisms
- Participation from empowered representatives of impacted process
- External experience—learn from others

Frequently Neglected

1	2	3	4
Acquire Data	**Train or Refine the Model**	**Redesign or Adapt Workflow**	**Monitor Performance and Revisit**
• The more the better, but… • High-quality, well-governed data pay enormous dividends • Diverse, cross-continuum sources improve predictions and robustness of models	• Decide what features are important (e.g., explainability) • Apply practical and ethical constraints • Evaluate under realistic conditions (silent mode, real-time, incomplete data)	• Embed insights directly into applications at key decision points • Reengineer processes as warranted • Consider the “5 rights” of decision support	• Ensure all models have a sponsor and regular evaluation against goals • All models require tune-ups as the environment changes.

Source: Health Care IT Advisor research and analysis.

Stanford: BPA Request Form

Requestor:
Team members:
Sponsor:

BPA Request: *Dexmedetomidine ASO BPA*
- All sections on this page to be completed by requestor -

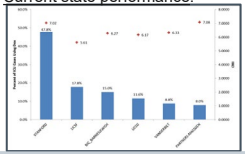
Date submitted: 03/08/2017
Last updated: mm/dd/yy

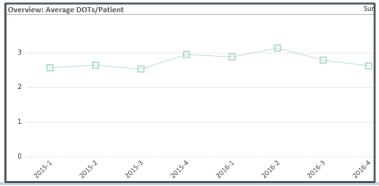
Clinical Goal for Improvement:

1. Overall clinical goal: Decrease unnecessary/prolonged use of dexmedetomidine by implementing 48-hour automatic stop order
2. Objective of BPA: Notify MD, APP, RNs of automatic stop order at 48 hours to ensure that weaning and/or transition plan is created prior to expiration of order
3. Owner: Drug Utilization MGT:
4. Anticipated benefits: Safety: BPA intended to promote early transition planning to avoid unplanned/unanticipated discontinuation of therapy

Baseline:

1. Current state performance:





Problem:

1. Efforts: P&T-approved guidelines for appropriate dexmedetomidine use have been implemented. One of the restrictions is that use should not exceed 48 hours. Extensive communication and education have been provided to MDs, APPs, RNs, and PharmDs in all areas where dexmedetomidine is prescribed and administered.

2. Problem: The FDA-approved duration of therapy for dexmedetomidine is 24 hours. SHC's use consistently exceeds this. Non-EPIC interventions have not been successful in decreasing duration of therapy as the average DOT per patient is 2.5-3 days. Primarily due to SHC culture, dexmedetomidine is typically being used as a 1st line agent for sedation, regardless of expected duration of sedation. Culture is difficult to change without some hard-coded support.

3. Urgency: Go-live for the BPA was determined to be Monday, March 13 at the Drug Utilization MGT based on timeline estimates obtained by EPIC. Education and messaging to all stakeholders has been completed and all are prepared for this go-live. It would be a lot of confusion and re-work to have to postpone/delay this. Additionally, this is a significant piece of the overall dexmedetomidine cost savings initiative with an estimated $2.5M impact to the organization.

Alert Language and Structure:

1. Target audience: Inpatient, ED RNs and MDs
2. Trigger event: Opening chart
3. Alert Criteria: Patients with active dexmedetomidine orders that started 24 and 36 hrs. ago.
4. Message:
   - **MD/APP:**
     - 24 hr BPA: "You have 24 hours remaining until the dexmedetomidine order will automatically be discontinued. Consider weaning or transition to another agent now."
     - 36 hr BPA: "You have 12 hours remaining until the dexmedetomidine order will automatically be discontinued. If not already started, begin to wean or to transition to an alternative agent if sedation is still required."
   - **Nurses:**
     - 24 hr BPA: "You have 24 hours remaining until the dexmedetomidine order will automatically be discontinued. Please discuss with the primary team."
     - 36 hr BPA: "You have 12 hours remaining until the dexmedetomidine order will automatically be discontinued. Contact the MD to plan for weaning or transitioning to an alternative agent."

1. User Action: Acknowledgement
2. Reference link: Lexicomp (Guidelines pending post to intranet)

Sustain Results:

1. Ongoing/future interventions: Weekly metrics are posted in D1, E2, E29 for visibility into utilization & sustainability of progress.
2. Metrics and targets: 75% decrease in utilization when compared to FY16
3. Possible unintended consequences: None
4. Revision / removal owner:

Next Steps:

1. When the above is completed to the best of your ability, please submit email as an attachment to the SHC HelpDesk at shcservicedesk@accenture.com
2. An informaticist will contact you to review details and prepare for presentation to the Clinical Decision Support Committee within 2 weeks; you are strongly encouraged to attend or send a delegate

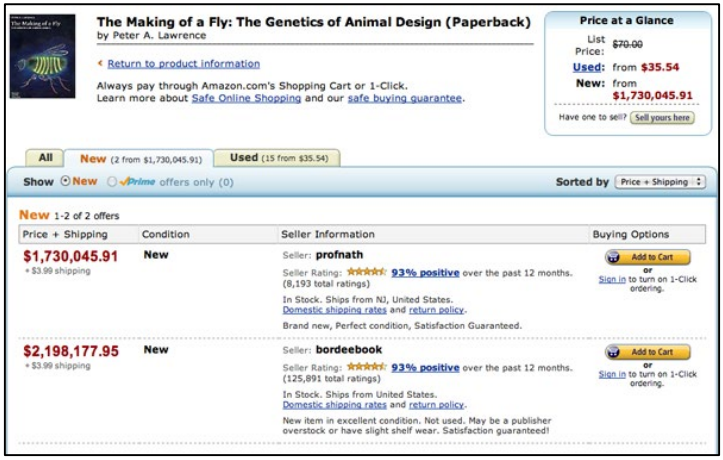
Source: Advisory Board research and analysis.

Who Watches the Machines?

"To Err Is Human, To Really Foul Things Up Requires a Computer"

- Automated processes need human oversight
- Governance is focused on quantifiable target outcomes
- Periodically evaluate processes against goals
- "Circuit breaker" rules to limit potential harm

Algorithms Gone Wild



MICHAEL EISEN

Sources: Michael Eisen, "Amazon's $23,698,655.93 book about flies," http://www.michaeleisen.org/blog/?p=358, April 22, 2011; Titie quote: William E. Vaughan; Advisory Board research and analysis.

Unique Challenges to AI in Health Care

Business Challenges

Complexity: Medical issues do not appear in isolation and coordination of care is difficult.

Threat to Human Jobs: Strong fear associated with technology displacing human workers.

Cost: The high costs for developing, testing, certifying, and implementing can be a barrier.

Workflow: How do AI solutions fit into existing workflows? How much effort is required to use it? Does it interfere or annoy unnecessarily?

Competing Priorities: We are still in the midst of installing basic and foundational systems (e.g., EMRs) while addressing regulatory and other pressing PHM initiatives.

Legal and Ethical Challenges

Regulation: Health IT regulations are hotly debated at the national level. Finding the right balance of public health protection and fostering innovation are key.

Legal: Juries still award large sums when health care is not applied properly or expected outcomes are not achieved.

Liability: How do we deal with computer failings? Even if AI approaches are statistically better, there may be liability when it fails.

Human Touch: How will we interact with AI? How strongly will we require the human touch and human compassion in health care?

Source: Health Care IT Advisor research and analysis.

Health Care IT Advisor

Research Director

Greg Kuhnen

kuhneng@advisory.com

Research Team

Jacqueline Beltejar

Bethany Jones

Nouran Ragaban

Sophie Ranen

Andrew Rebhan

Program Leadership

Jim Adams

Design Consultant

Kevin Matovich