Duke Health AI Journey

Suresh Balu

May 2024

A Duke Institute for Health Innovation Presentation

AMS
advancing innovative healthcare
with compassion at its core

AI

A field of computer science focused on creating intelligent agents that can learn from data and experience. These agents achieve this by processing massive datasets and identifying patterns or relationships. The learned patterns allow AI to perform tasks typically requiring human intelligence, such as diagnosis, decision-making, or creative problem-solving.

Duke Institute for Health Innovation

mission: Catalyze innovations at Duke

Catalyze transformative innovation in health and healthcare through high-impact research, leadership development and workforce training and the cultivation of a community of entrepreneurship

approach: Innovation by design

Understand user workflow, desired outcomes and problems (needs) and then collaboratively develop concepts and prototypes, and iterate through to finalize solution

Domains Catalyzing and Sustaining Innovations

Implementation & Health Delivery Science

- Catalyzing multidisciplinary teamwork for value creation
- Creating new care models
- Structured interface to Duke Health
- Living laboratory to incubate, refine, validate, and scale new ideas

Health Technology Innovation

- Leveraging a growing health data infrastructure
- Creating a connected digital health ecosystem
- Collaborating and co-developing advanced technologies
- Responsible development of data science solutions

Leadership & Workforce Development

- Training current and future leaders across health care :
  - Leadership
  - Management
  - Innovation
  - Quantitative health sciences
- Amplifying & developing the workforce of the future

Best Practices Development & Dissemination

- Disseminating best practices derived through internal R&D to elevate health innovation across ecosystem
- Convening stakeholders across settings to address common challenges in health innovation
- Fostering a Practice Network

Industry best-practice approach in catalyzing innovations

RFA

Structured

DIHI RFA

"Top-down + Bottom-Up" approach

- Annual strategic theme for RFA developed.
- Operational lead engaged very early stage.
- Metrics: clinical utility, economic utility, health equity, access, IP and academic outputs.

11 Years Catalyzing Innovation

90+ Innovation Projects

740+ Proposals

IJ

Unstructured

DIHI Innovation Jam

A Health focused Shark Tank at Duke

- Source high-potential innovations ready for commercialization in 12 months.
- Duke Leadership as dolphins.
- Internal syndicated investments.
- Proceeds for entrepreneurship and product/service development.

6 Years of Jamming

30+ Pitches

12 Companies Incubated

Our Strategic Approach

- Explore the horizon
- Enable operating at the horizon
- Expand and help define the next horizon

- **Up-to-date representation of health status** of all patients and prediction of change in health status at all moments
  - Complete continuum of care coverage for patients in any DUHS or DUHS partner setting

- **Innovation as self-service model** – anyone at Duke can use DIHI products and services to implement and evaluate changes in their clinical practice
  - Seamless A/B testing for rapid iteration of new care models using integrated technology

Guiding Principles

Build to show value

- Work on the right problem
- Align front-line staff and organizational leaders
- Start building minimal viable solutions

Build to integrate

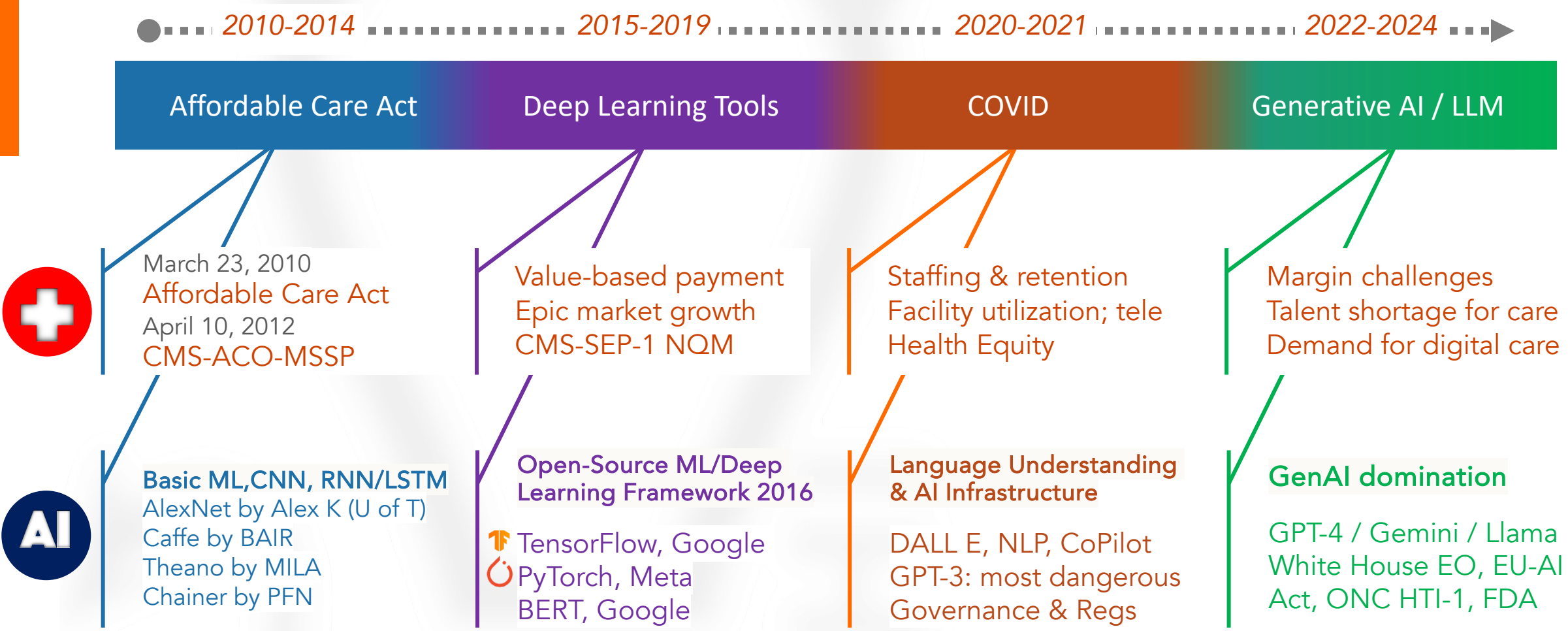
- Create interfaces for trans-disciplinary innovation
- Staff projects to move quickly
- Adapt workflows, roles, and organization

Build to scale

- Targeted and sustained innovator engagement
- Build modular infrastructure to support many projects
- Build organizational capabilities and capacity

Build responsibly

Eras Tour: Healthcare Data Science and AI



Era :: Affordable Care…

2010-2014

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

Mobile Health, Machine Learning

2010-2014

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

- Population Health and Analytics (4)
- Reducing Medical Complications and Improving Care Transitions (3)
- Primary Care (2)

Integrating Remote Wireless Technology to Reduce CHF & COPD Readmissions *(Nicholas Wysham, MD, Jacob Kelley, MD, Zubin Eapen, MD & Christopher Cox, MD)*

Machine Learning for Assessing & Managing Surgical Outcomes *(Eric Huang, MD, Chris Mantyh, MD, Julie Thacker, MD, Katherine Heller, PhD, Joseph Futoma)*

Duke Connected Care Chronic Kidney Disease Care Improvement Project *(Genie Komives, MD, Dev Sangvai, MD, Christina Crosby, Daniel Costello, MPA, Todd Turnbill)*

A Novel Mobile Health Intervention to Improve Health and Quality of Life Outcomes for Patients with Sickle Cell Disease *(Nirmish Shah, MD, Lindsay Anderson, MA & Sarah Leonard, MD)*

Healthcare Utilization Monitoring

2010-2014

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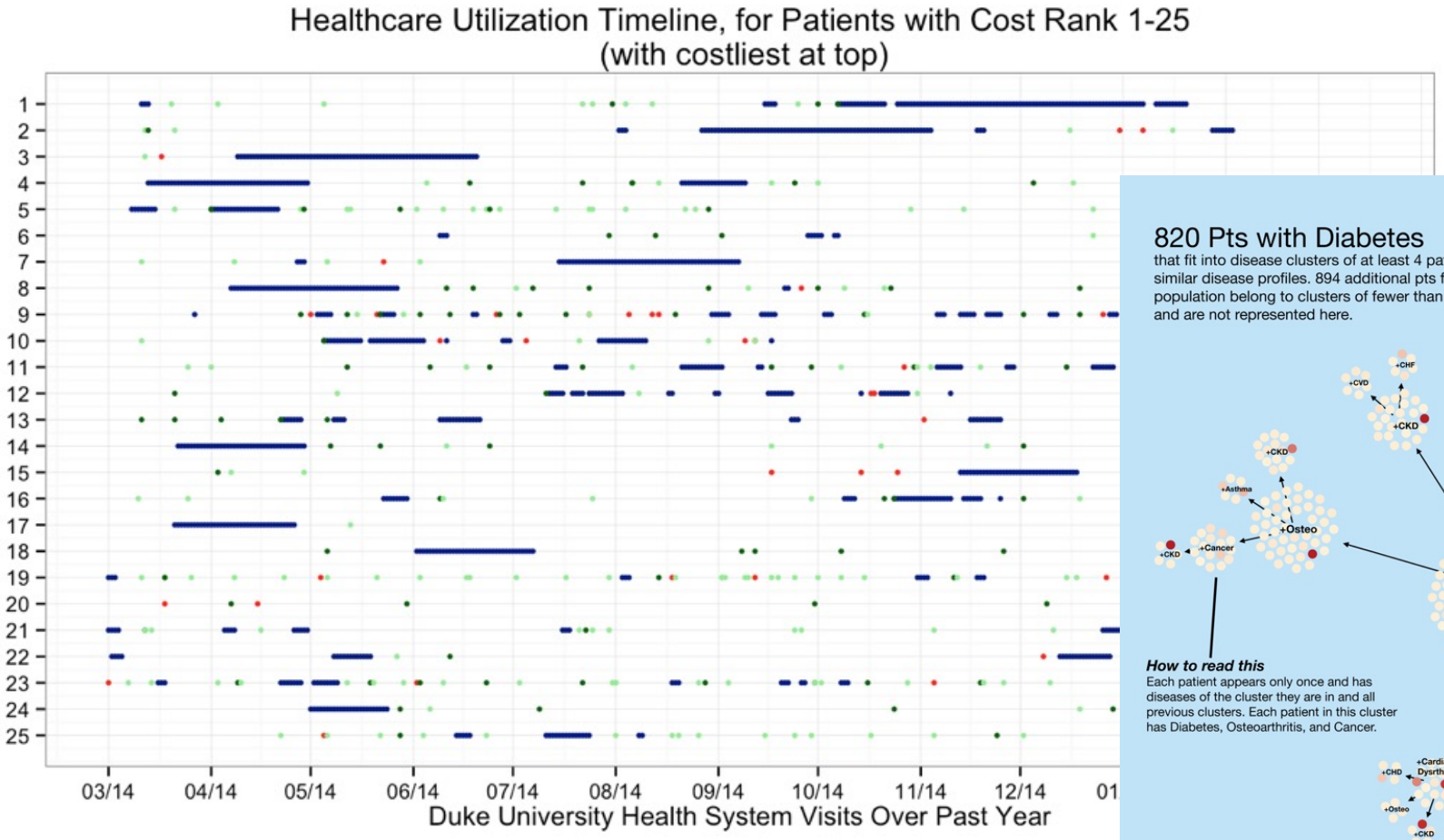

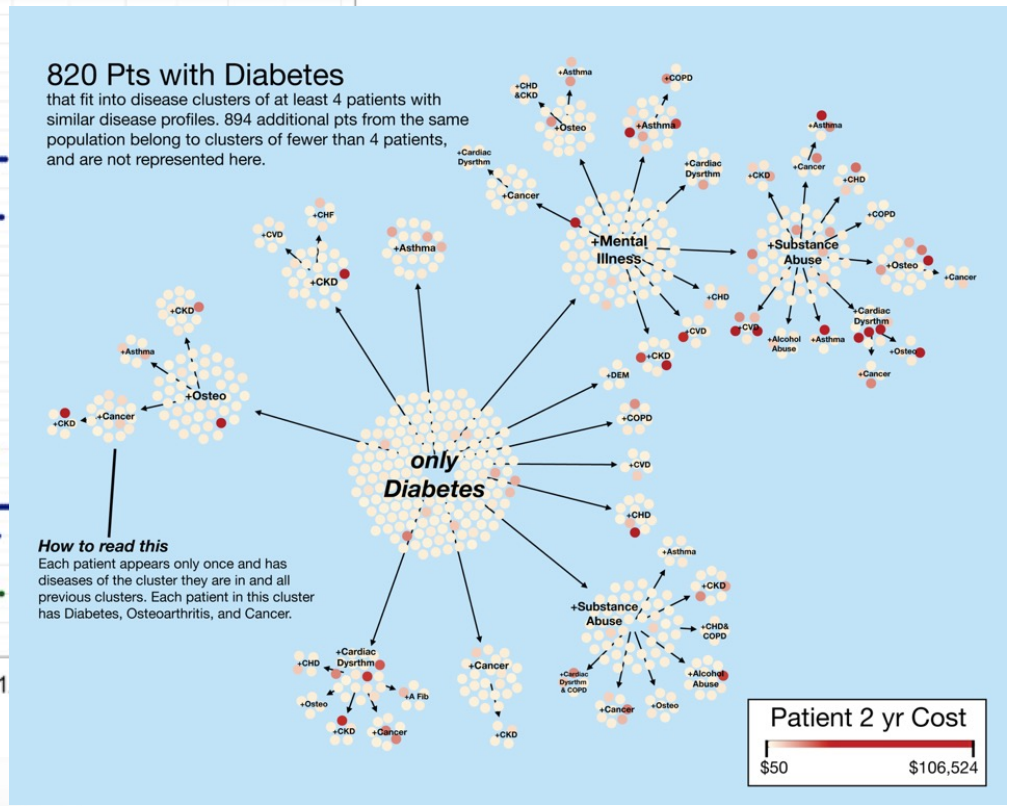

Population Rounding™ for CKD

2010-2014

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- Problem: Chronic kidney disease (CKD) is a complex chronic condition resulting in poor health outcomes and high costs. Timely and accurate diagnosis of CKD and estimation of risk for progression to ESRD enables care coordination that is necessary to reduce disease progression and complications across populations.
- Solution: Population Rounding™ augmented by predictive risk models. Virtual rounds to close gaps in care for patients with Chronic Kidney Disease (CKD)

Population Rounding™ for CKD

2010-2014

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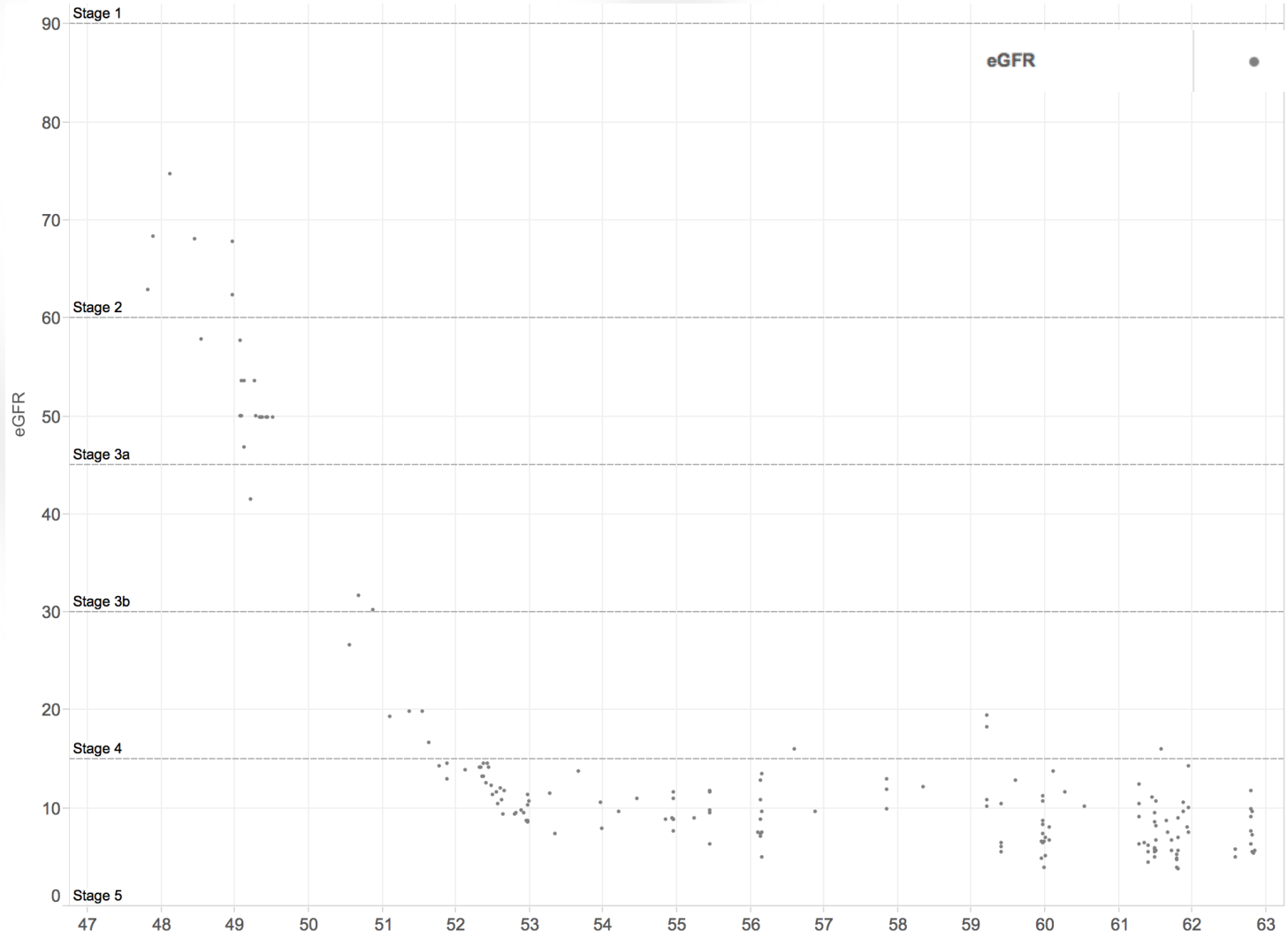

Population Rounding™ for CKD

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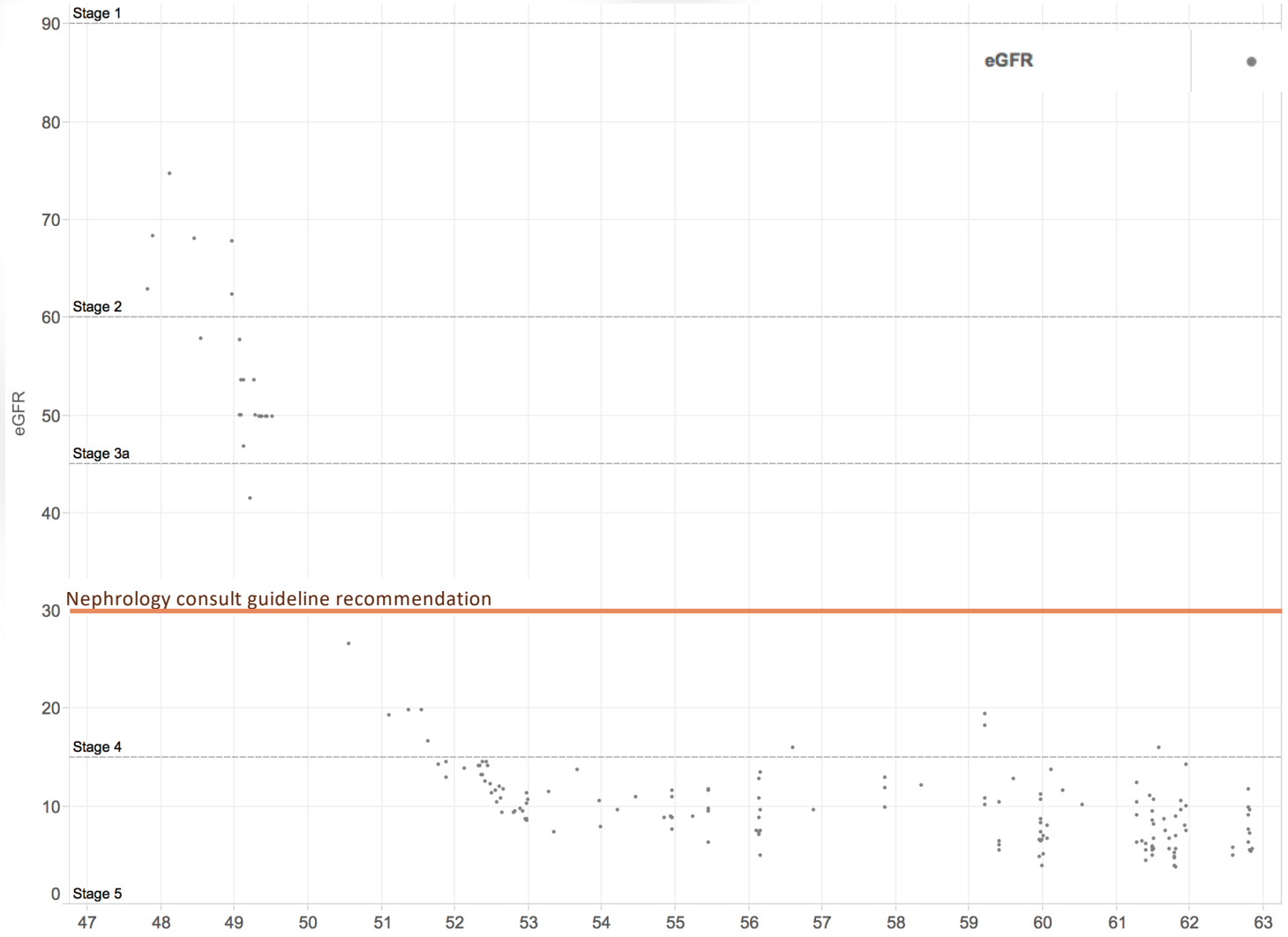

Population Rounding™ for CKD

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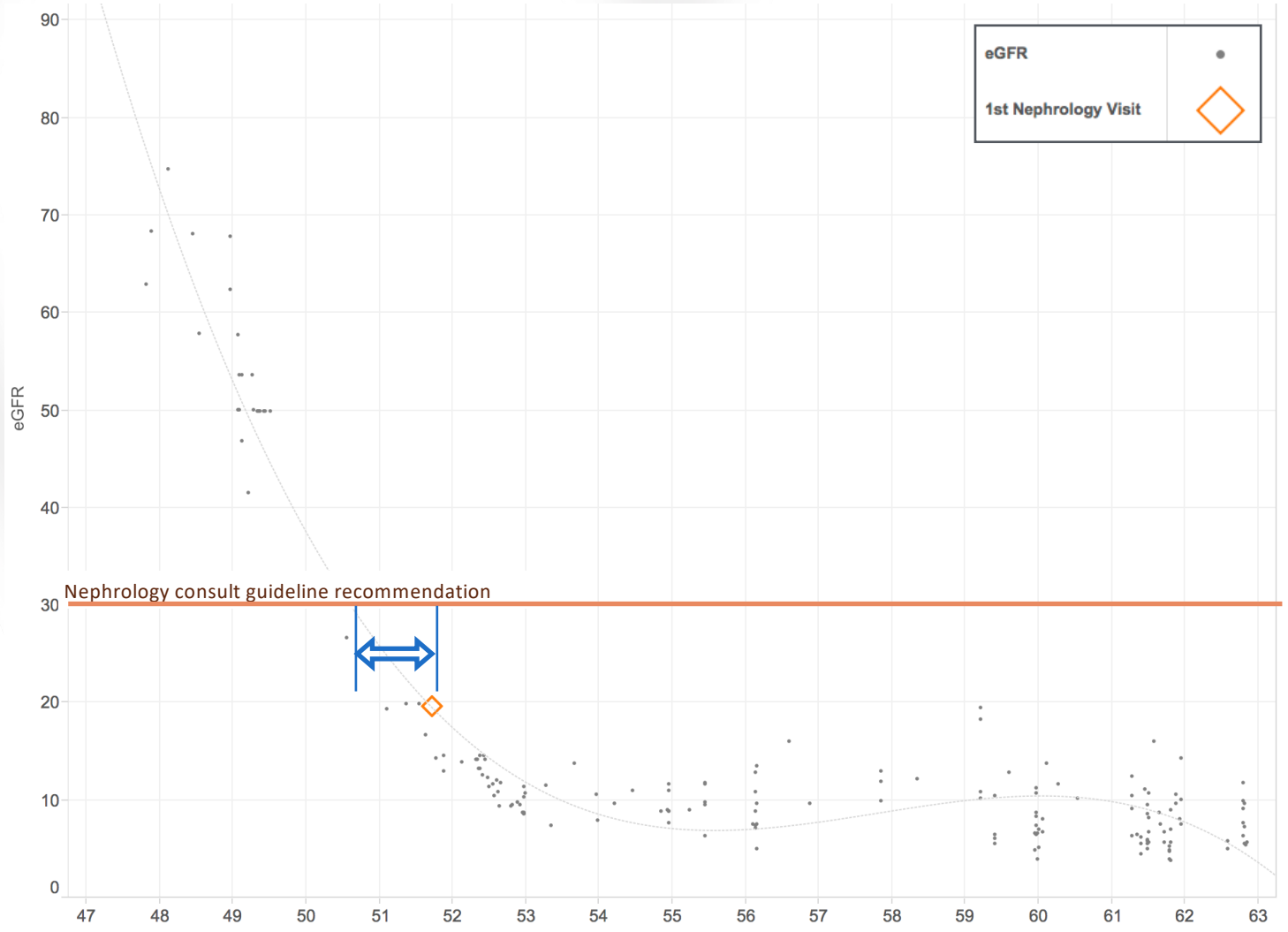

Population Rounding™ for CKD

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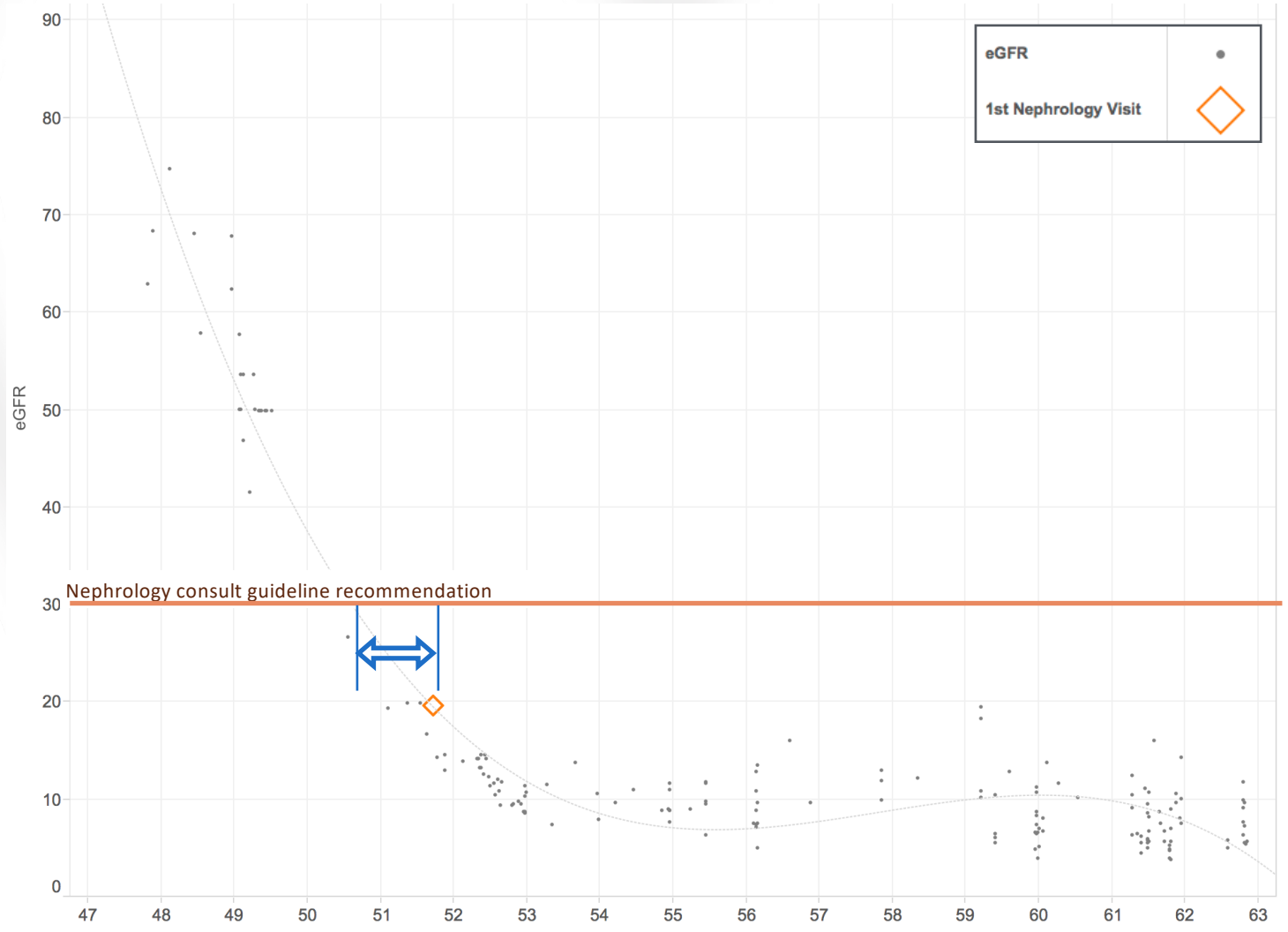

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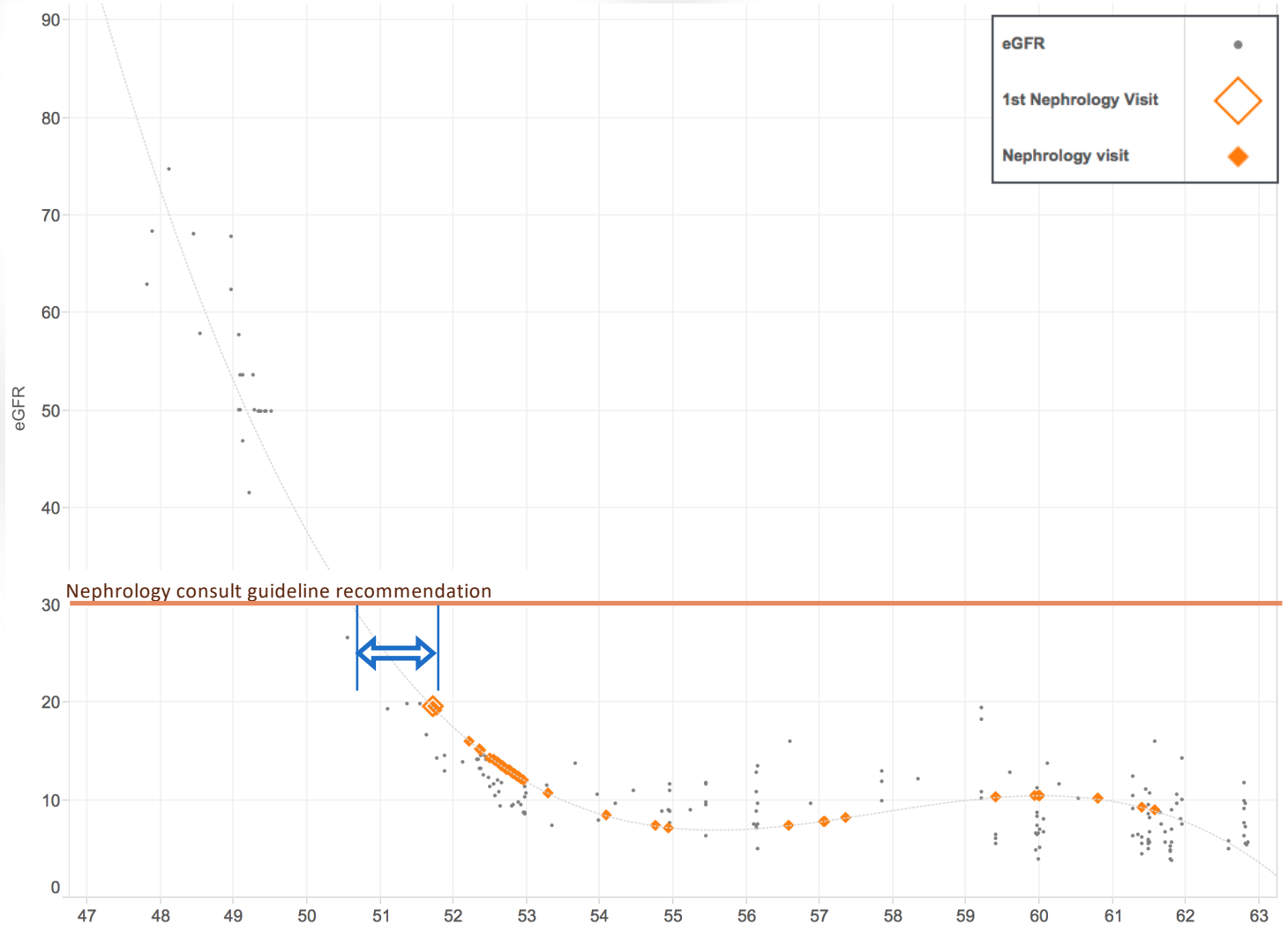

Population Rounding™ for CKD

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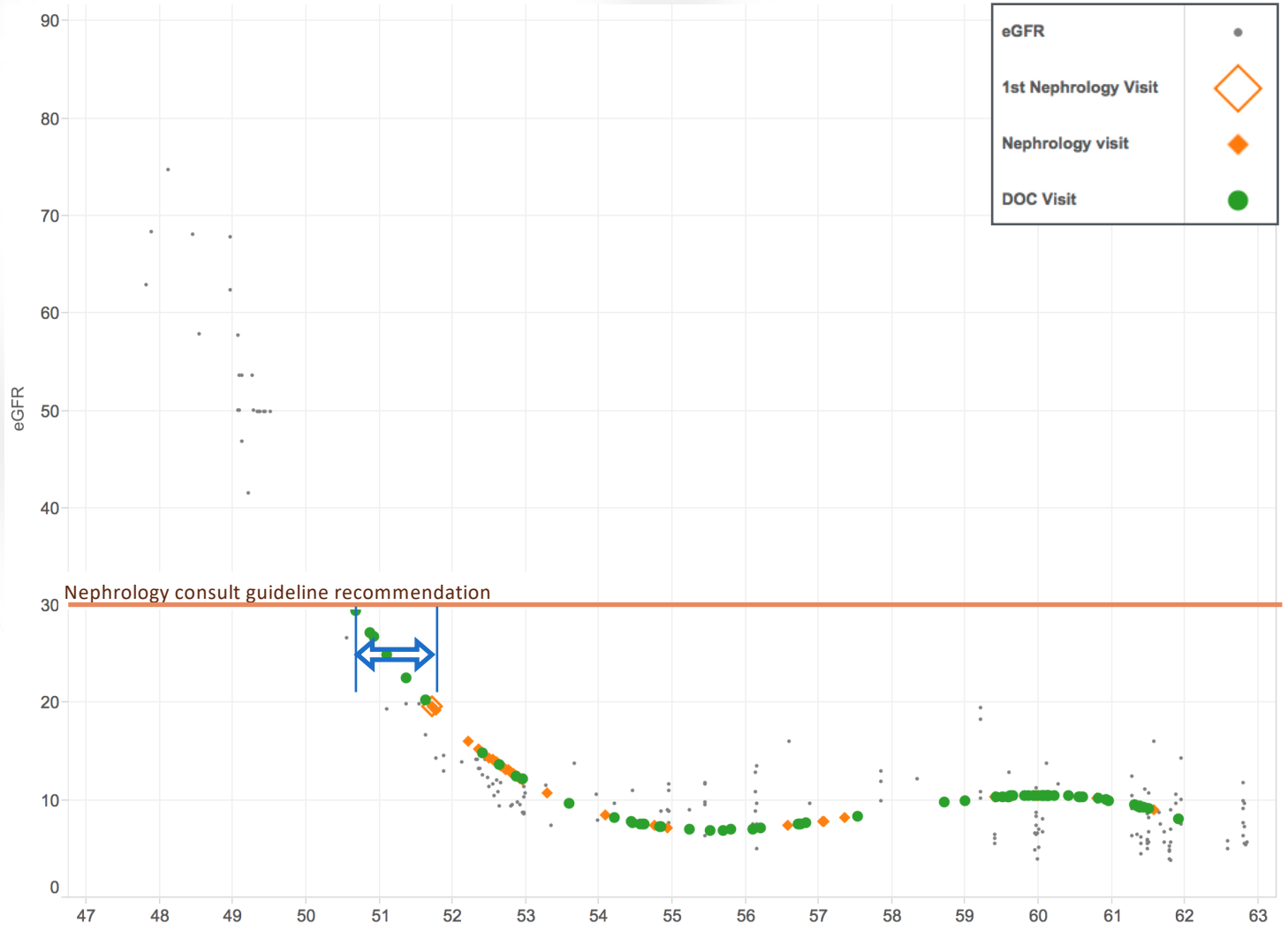

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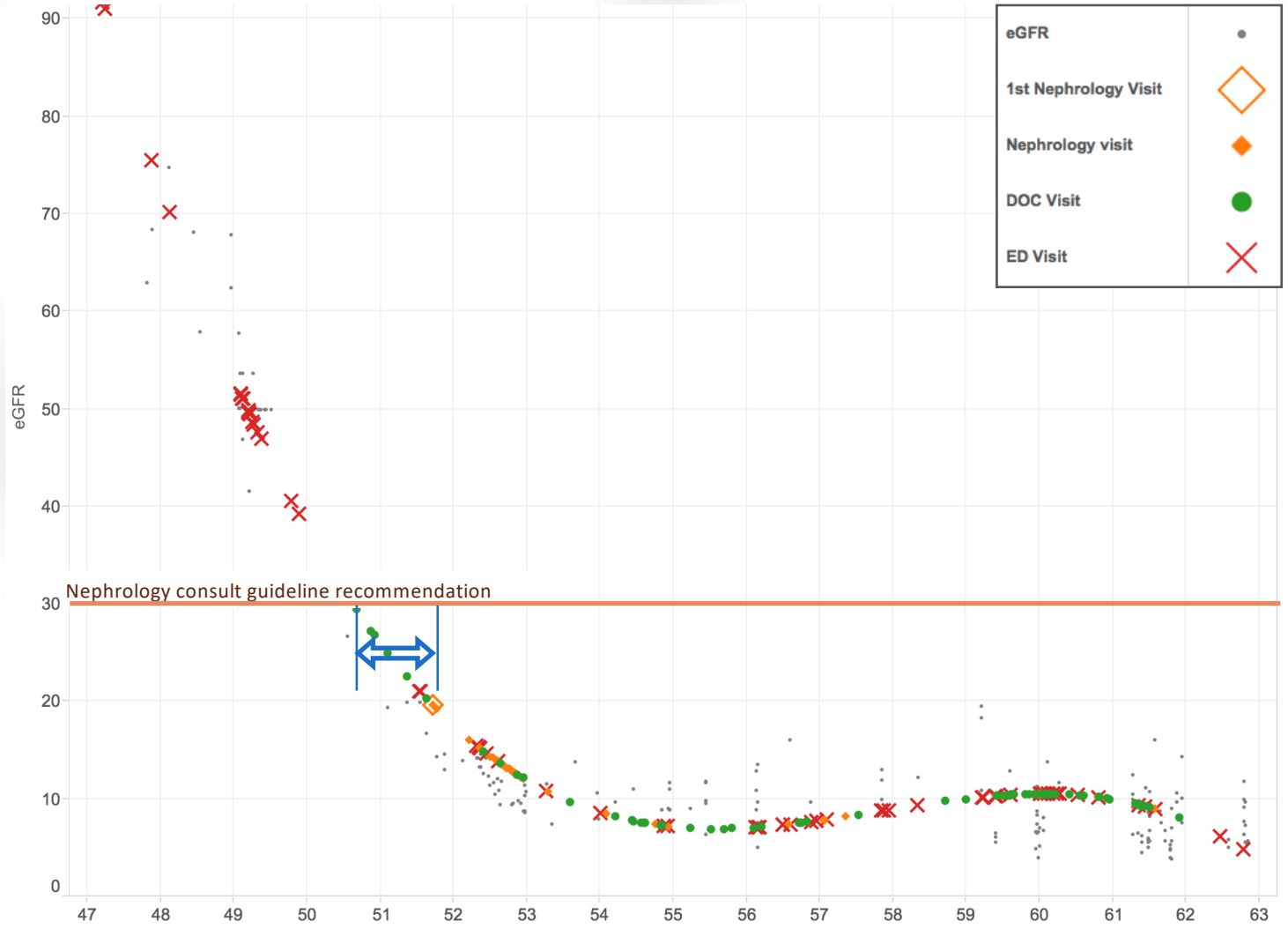

Population Rounding™ for CKD

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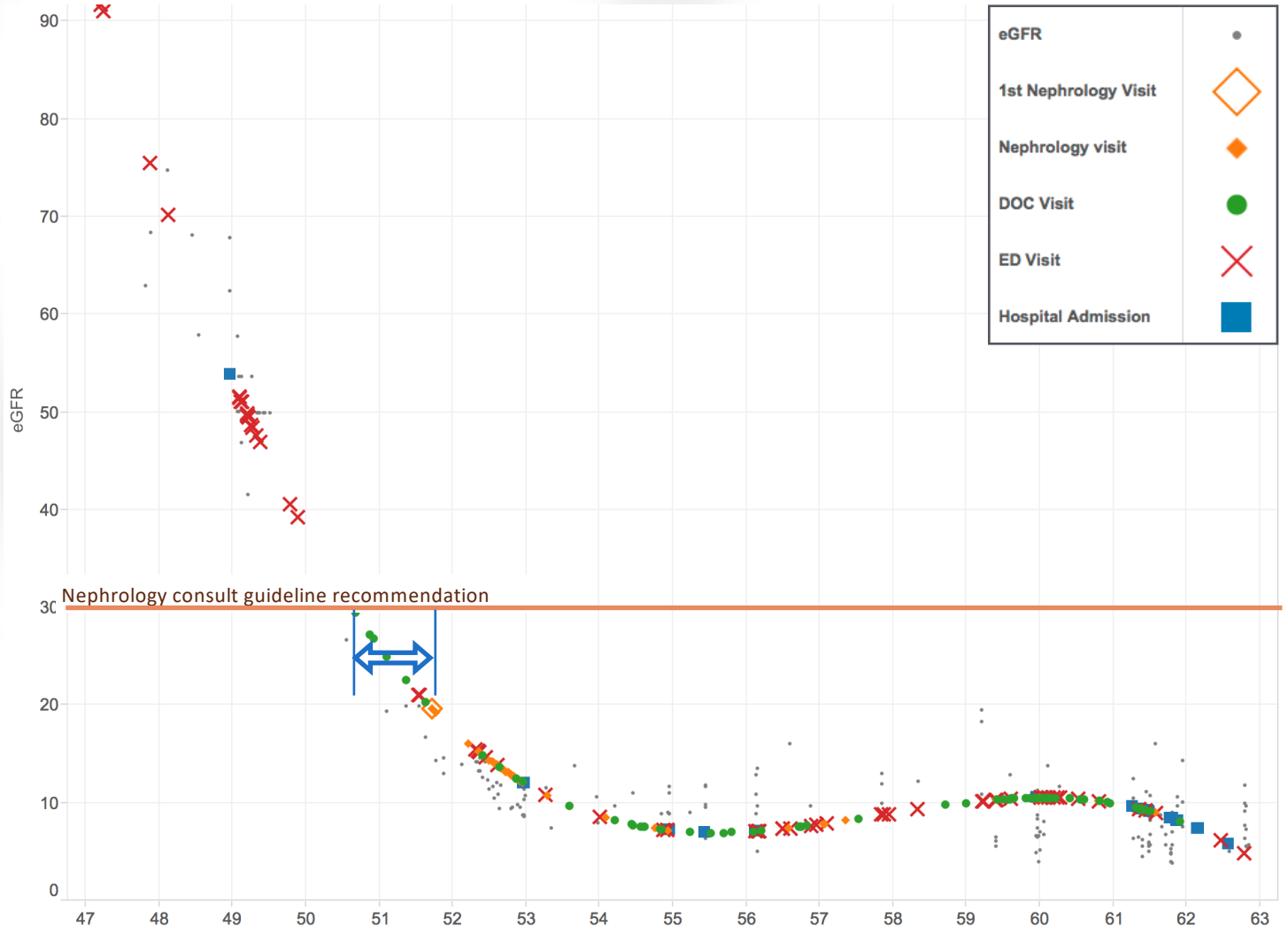

Population Rounding™ for CKD

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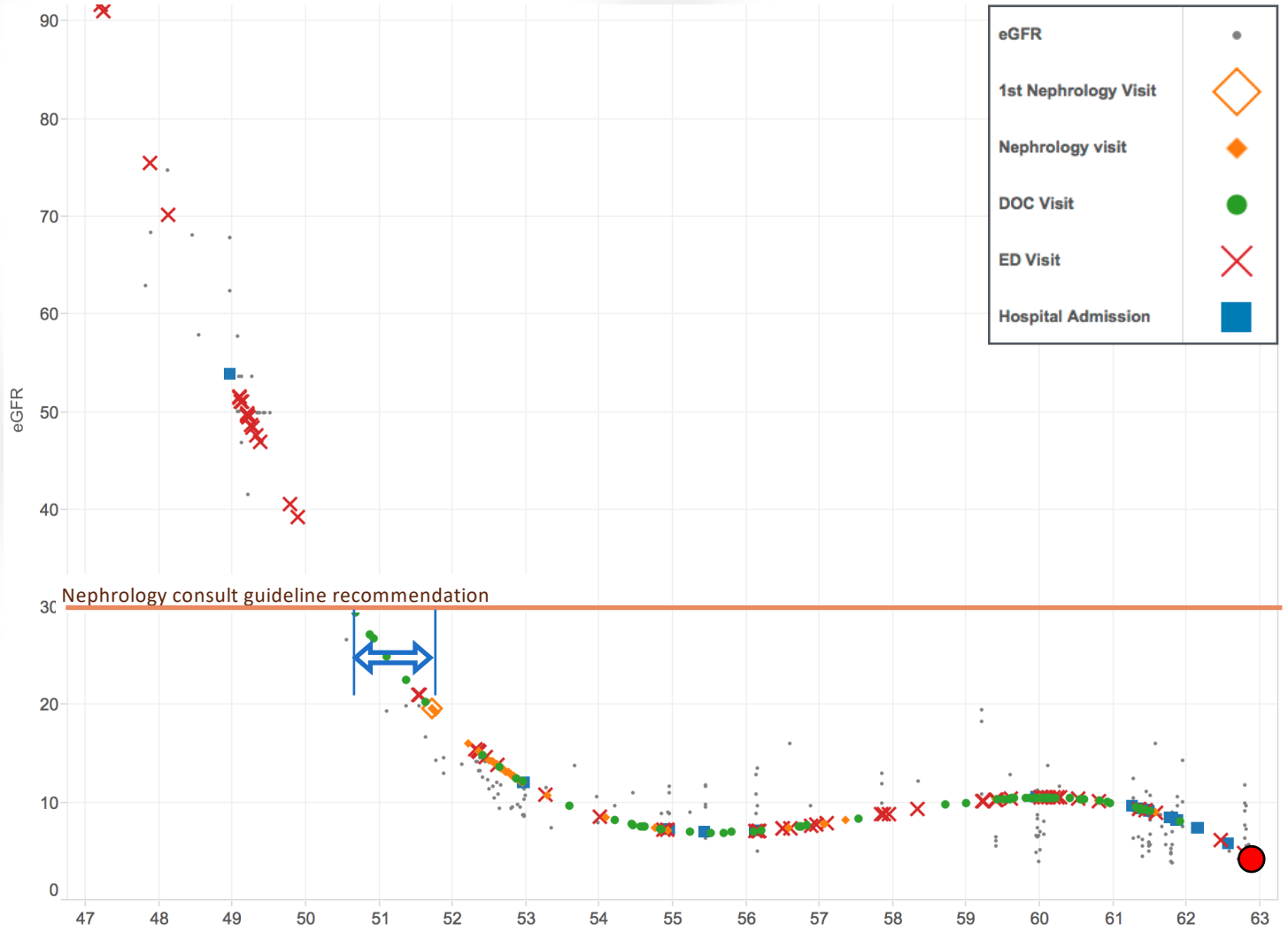

Population Rounding™ for CKD

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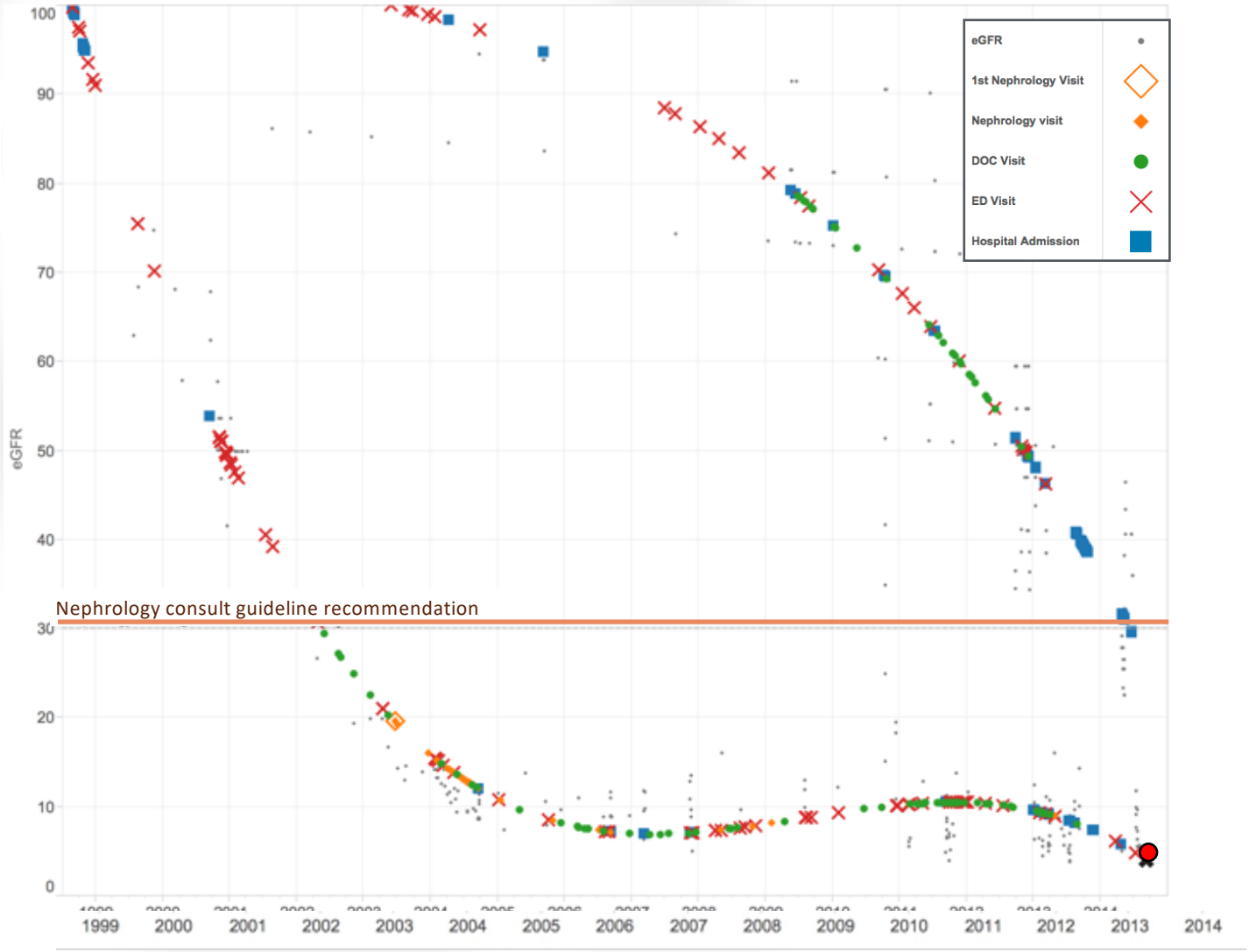

“Doc, why didn’t anyone tell me sooner?”

Integrating Validated Measures

2010-2014

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Original Contribution

April 20, 2011

A Predictive Model for Progression of Chronic Kidney Disease to Kidney Failure

Navdeep Tangri, MD, FRCPC; Lesley A. Stevens, MD, MS, FRCPC; John Griffith, PhD; et al

» Author Affiliations | Article Information

JAMA. 2011;305(15):1553-1559. doi:10.1001/jama.2011.451

5 Year Risk of ESRD Progression, JAMA, 2011

Decline in Estimated Glomerular Filtration Rate and Subsequent Risk of End-Stage Renal Disease and Mortality

Josef Coresh, MD, PhD; Tanvir Chowdhury Turin, MD, PhD; Kunihiro Matsushita, MD, PhD; Yingying Sang, MSc; Shoshana H. Ballew, PhD; Lawrence J. Appel, MD; Hisatomi Arima, MD; Steven J. Chadban, PhD; Massimo Cirillo, MD; Ognjenka Djurdjev, MSc; Jamie A. Green, MD; Gunnar H. Heine, MD; Lesley A. Inker, MD; Fujiko Irie, MD, PhD; Areef Ishani, MD, MS; Joachim H. Ix, MD, MAS; Csaba P. Kovesdy, MD; Angharad Marks, MBBCh; Takayoshi Ohkubo, MD, PhD; Varda Shalev, MD; Anoop Shankar, MD; Chi Pang Wen, MD, DrPH; Paul E. de Jong, MD, PhD; Kunitoshi Iseki, MD, PhD; Benedicte Stengel, MD, PhD; Ron T. Gansevoort, MD, PhD; Andrew S. Levey, MD; for the CKD Prognosis Consortium

2 Year eGFR Change JAMA, 2014

Adapt Workflows, Roles, and Organization

2010-2014

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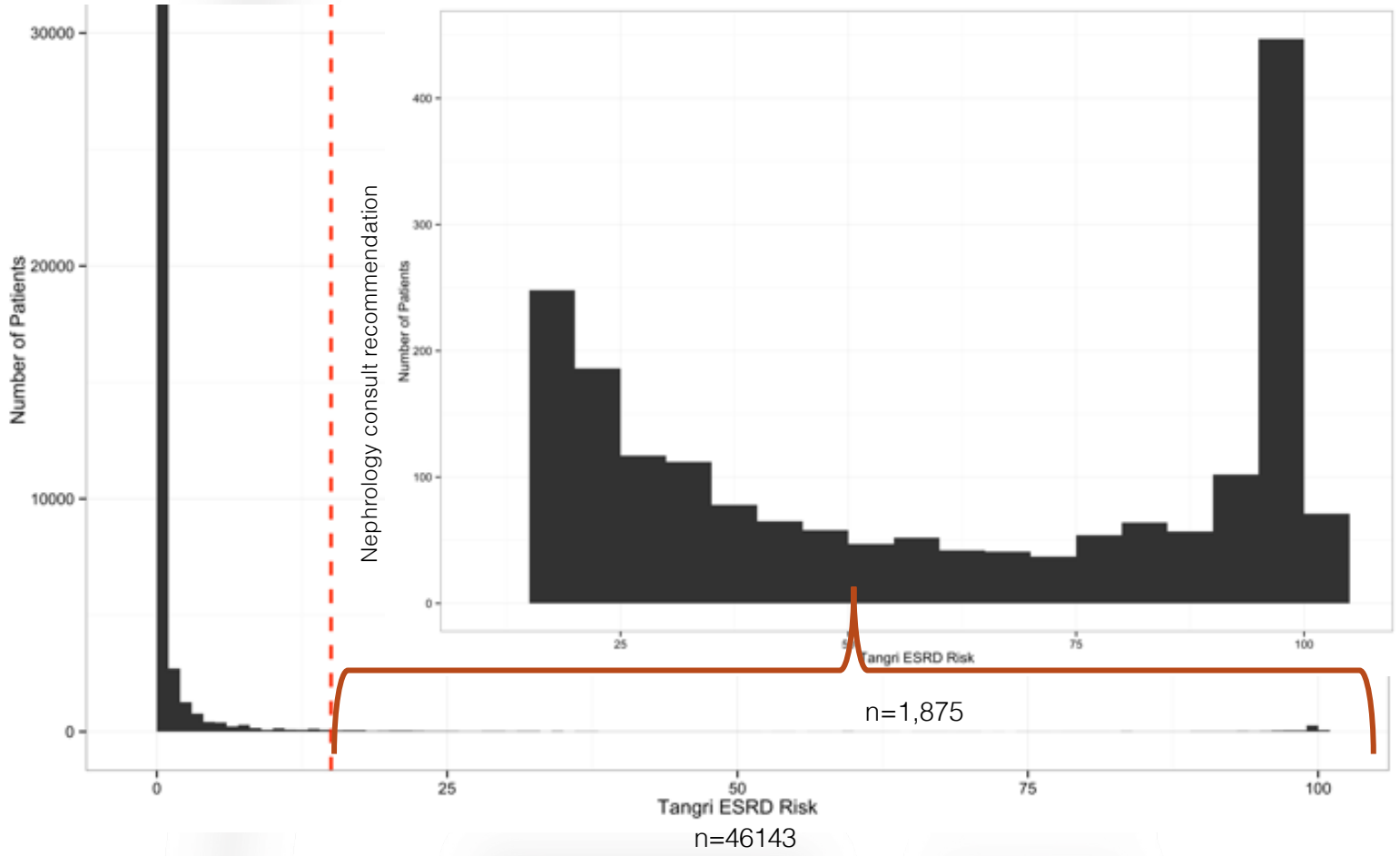
Don't Rely on Existing Workflows to Solve Problems



Already seen Nephrologist	1068
Deceased	246
Don't have CKD	83
ESRD	65
Eligible for Rounding	**413**

Population Rounding™ workflow

2010-2014

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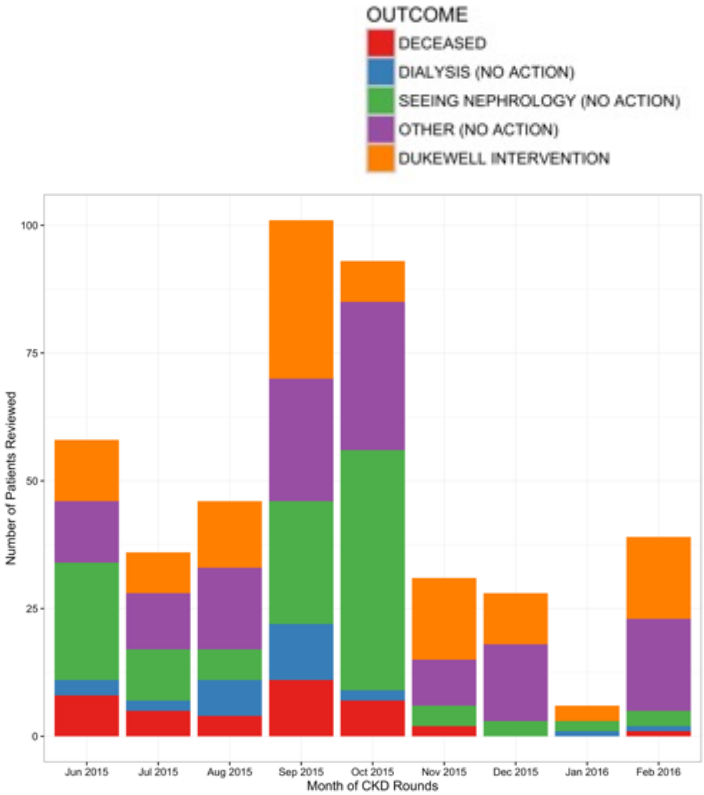
Don't Rely on Existing Workflows to Solve Problems



Adapt Workflows, Roles, and Organization

2010-2014

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Population Rounding™ model now extended and applied to:

- **Non-alcoholic fatty liver disease (NAFLD)**
- **Peripheral artery disease (PAD)**
- **Community-based palliative care**

"The difference in [algorithm] performance is negligible compared to the difference that a good physician champion makes, or a good intervention plan makes. Those are by far and away the most important things to the success of a project. The actual model itself is, as much as I might delude myself or whatever, it's actually not that important."

- *Technical Stakeholder*

2010-2014

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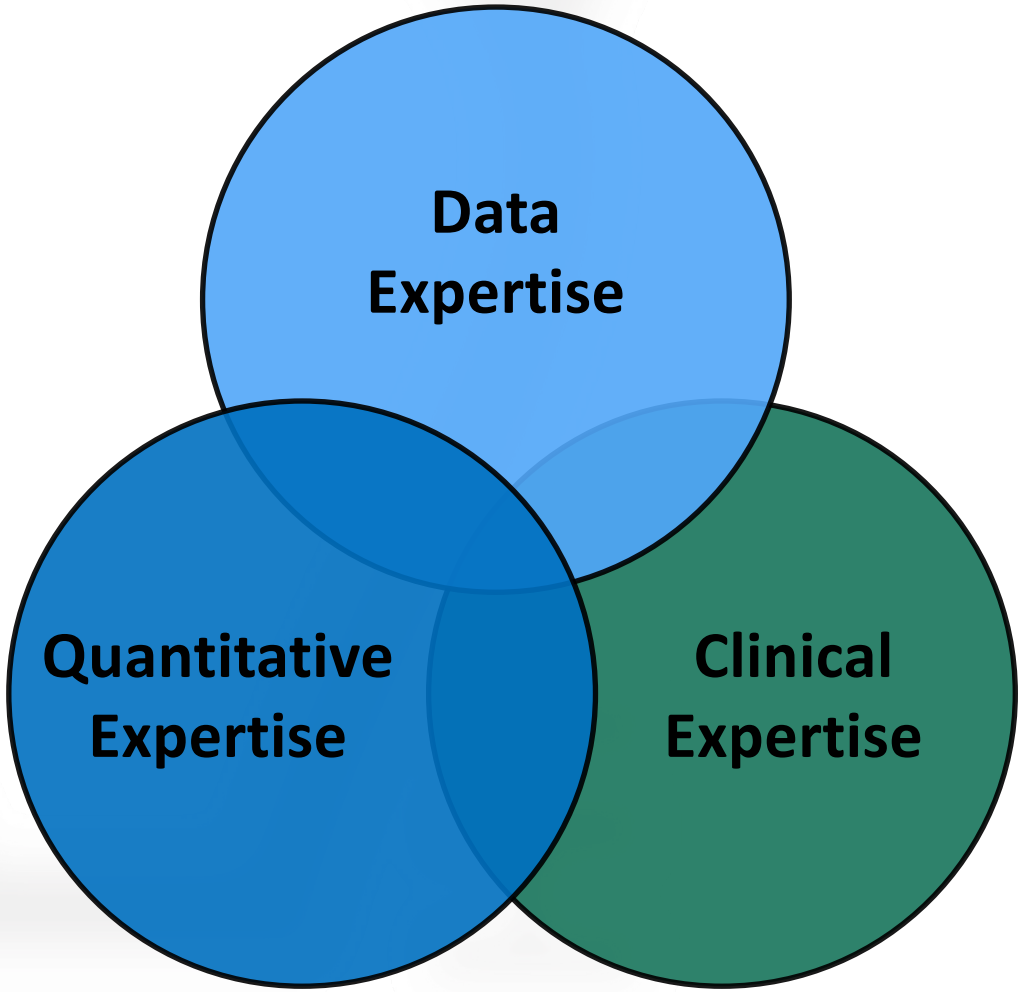

Interdisciplinary staff model

2010-2014

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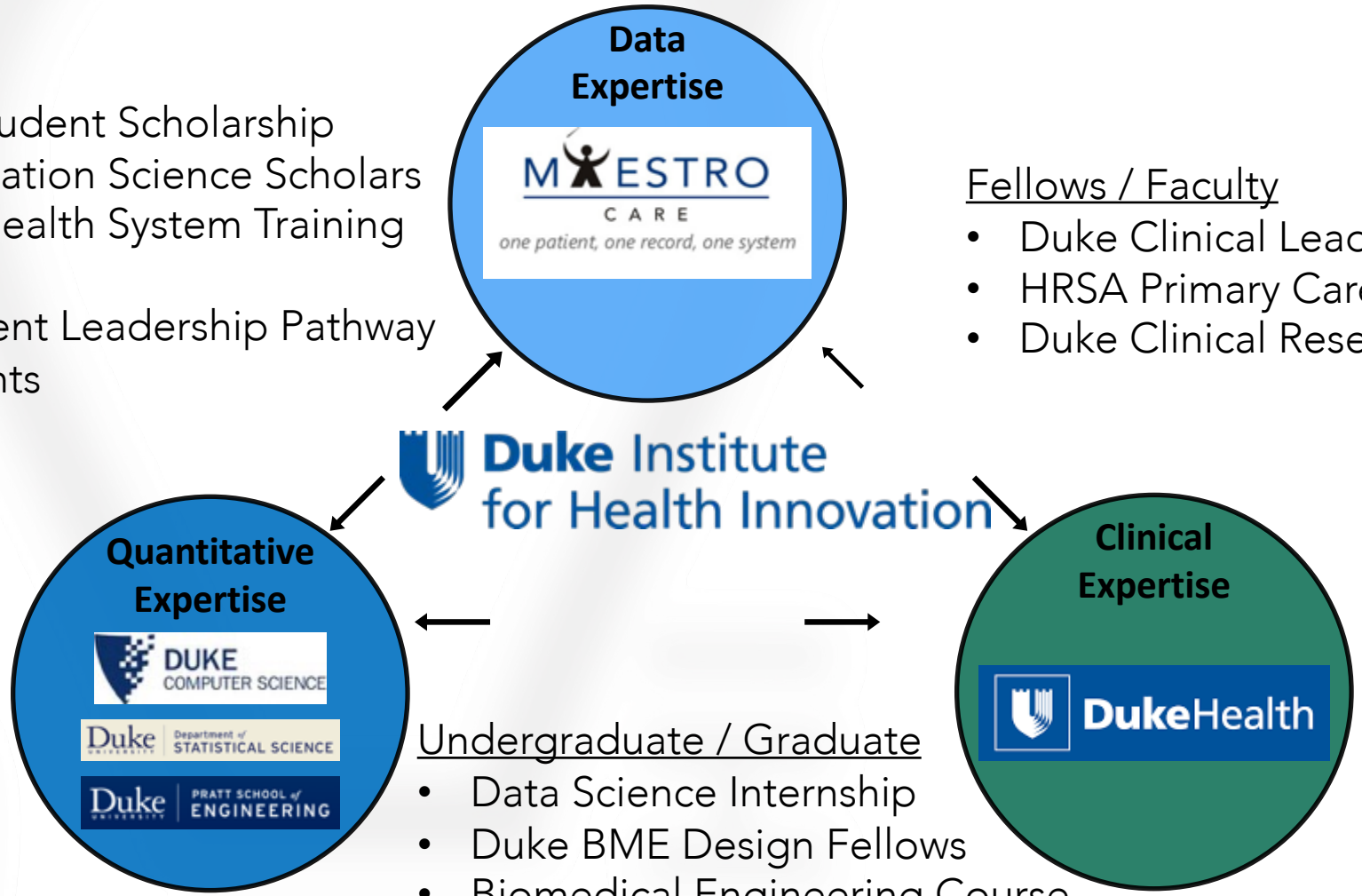
<u>UME / GME</u>

- Medical Student Scholarship
- Implementation Science Scholars
- Learning Health System Training Program
- Management Leadership Pathway for Residents



<u>Fellows / Faculty</u>

- Duke Clinical Leadership Program
- HRSA Primary Care Fellowship
- Duke Clinical Research Fellowship

<u>Undergraduate / Graduate</u>

- Data Science Internship
- Duke BME Design Fellows
- Biomedical Engineering Course
- Graduate Student Research

Embed Dedicated Capacity and Expertise on Projects

2010-2014

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- Recruit "π" shaped talent to bridge domains (expertise in 2 or more domains)
- Project managers and technology developers to build and implement solutions
- Demonstrate early results

Era :: Rolling in the deep

2015-2019

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Era :: Scalable foundations for AI in Healthcare

2015-2019

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Risk Prediction Solutions

Inpatient Risk…
- Sepsis Watch™
- Decompensation
- HealthGuard™
- Hyperglycemia

Out-patient…
- Mortality
- Autism
- Surgical AEs

Data & MLOps Infrastructure

- Real-Time Data Pipeline
- Automated Data Curation Platform
- Meta-Data & Quality System

Best Practices for AI / ML

- Model Facts
- Model & Impact Monitoring
- Socio-technical Change Mgmt.

Data & Model Governance

- Integration Governance
- Data Governance
- Model-specific Governance

Sepsis Watch™

2015-2019

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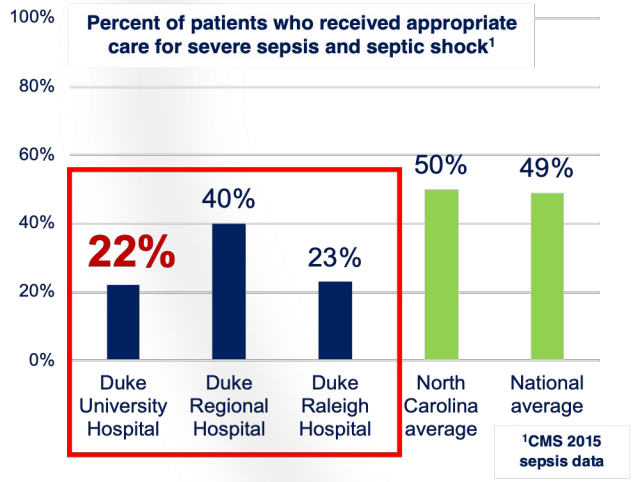
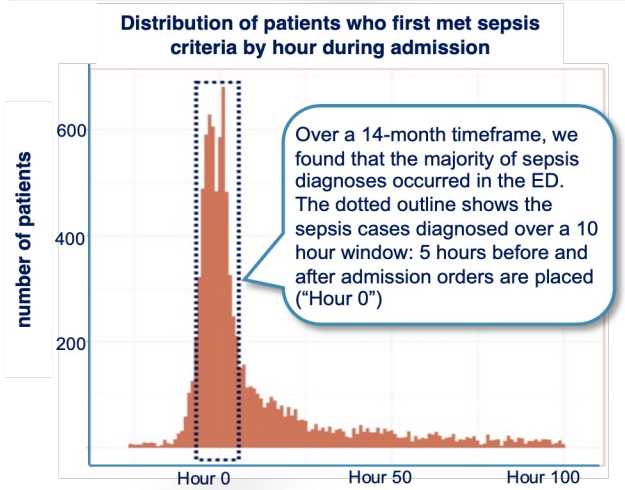
Summary :: What is Sepsis Watch?

The Problem: Struggle with sepsis

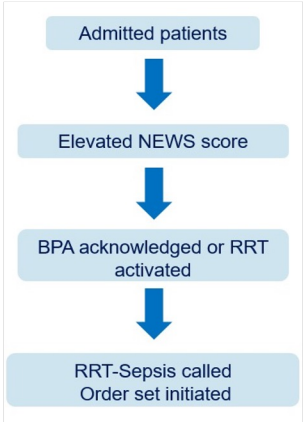
1 What is the problem? *Sepsis*



2 Where does the problem occur? *The ED*



3 Why are we failing to solve the problem today? *Slow, false alarms*



(fake) NEWS

- Only 6.8% of patients with NEWS (National Early Warning Score) BPA had discharge diagnosis of sepsis
- BPA fired 447 times/day on 42 unique patients/day on average (up to ~100x/patient).
- 63% of BPAs canceled.

The Solution: Sepsis Watch

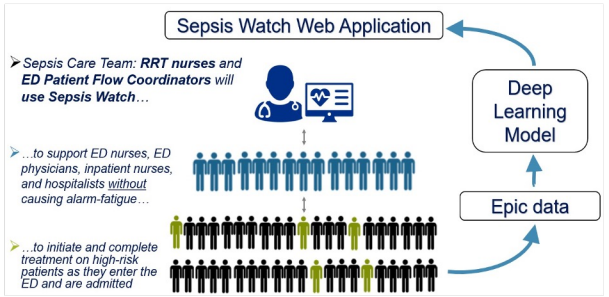
1 Define adult sepsis at Duke

2 or more SIRS criteria	- Temperature >38°C or <36°C (6 hours) - HR >90 (6 hours) - RR >20 (6 hours) - WBC count >12, <4, or % bandemia >10% (24 hours)
Suspect Infection	- Blood culture order (24 hours)
1 element of end organ failure	- Creatinine >2.0 (24 hours) - INR >1.5 (24 hours) - Total bilirubin >2.0 (24 hours) - SBP <90 or decrease in SBP by >40 (6 hours) - Platelets <100 (24 hours) - Lactate ≥2 (24 hours)

2 Create machine learning model to predict sepsis quickly and accurately

- **42,000+ inpatient encounters analyzed** at Duke Hospital over 14 months, **21.3%** with a sepsis event.
- **32+ million data points incorporated**: 25 million vital sign measurements, 2 million med admins, 5.2 million labs.
- **34** physiological variables (5 vitals, 29 labs).
  - At least one value for each vital in 99% of encounters.
  - Some labs rarely measured (2-4%), most measured 20-80% of the time.
- **35** baseline covariates (e.g. age, transfer status, comorbidities).
- **10** medication classes (antibiotics, opioids, heparins).

3 Design web application to show real-time model results and track treatment



Sepsis Watch is a custom-built tool to support identification of patients at risk of sepsis in the hospital. Access Sepsis Watch App at **https://sepsiswatch.dhe.duke.edu/**

Sepsis Watch™ RRT User Interface

2015-2019

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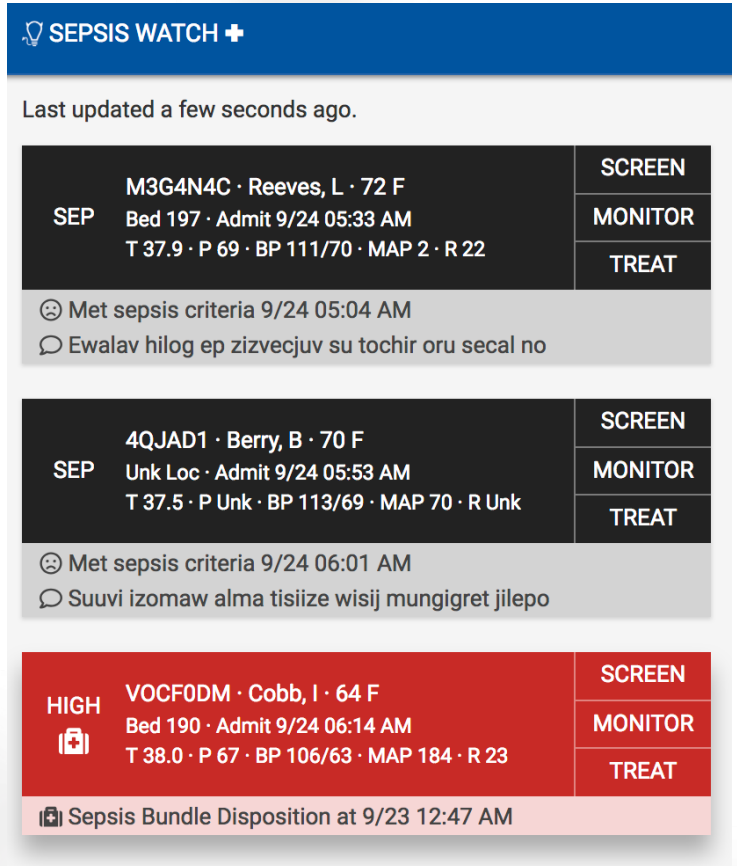

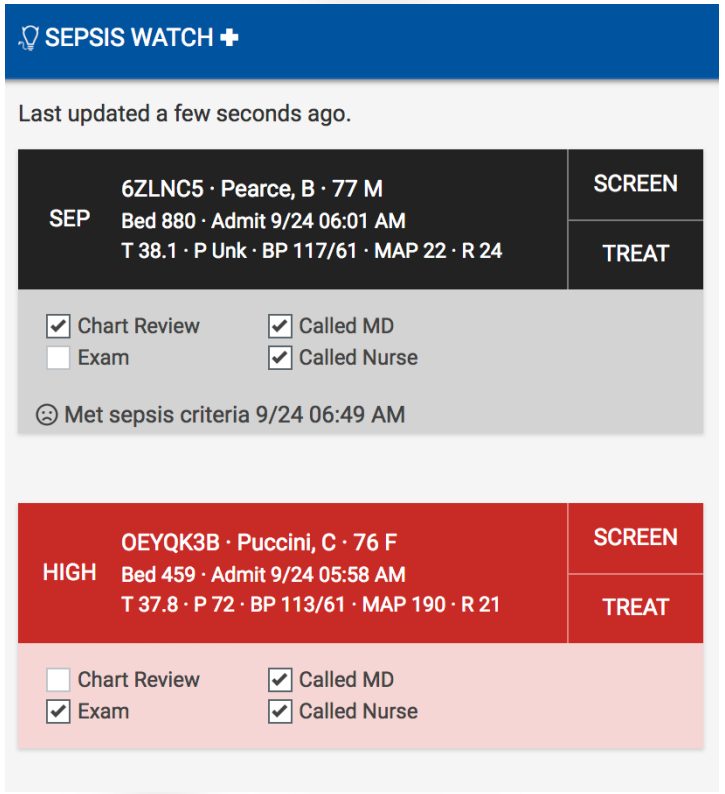

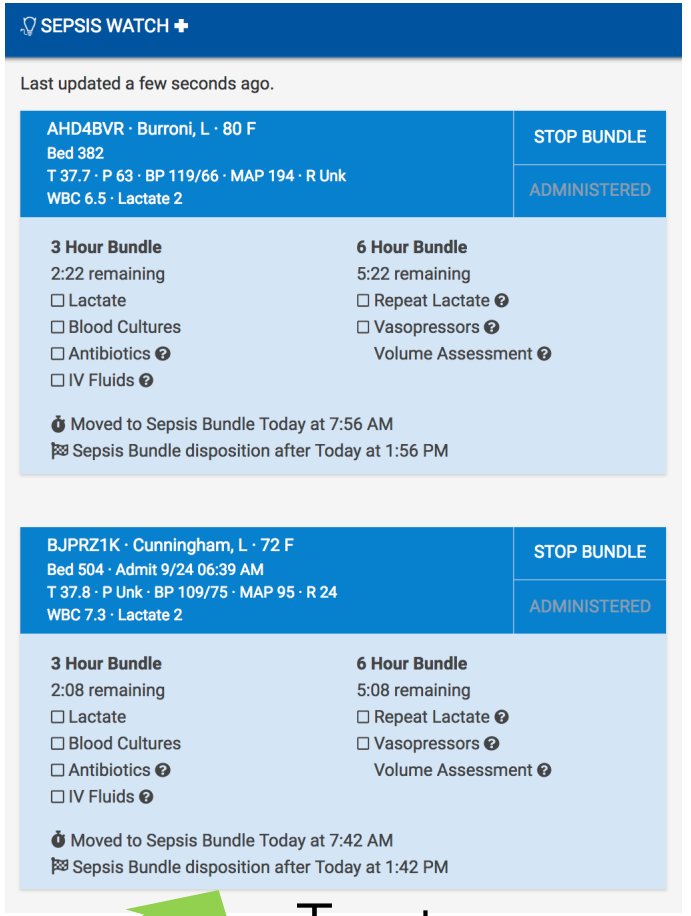

Triage → Monitor → Treat

Disclaimer: These are test patients and fake data, and so may show incorrect values.

Sepsis Watch™ Impact

2015-2019

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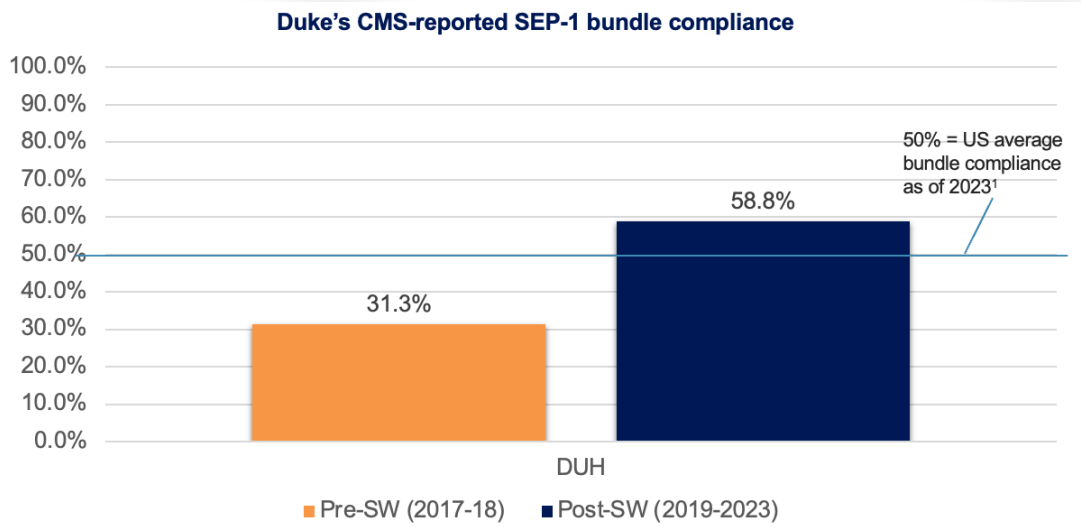
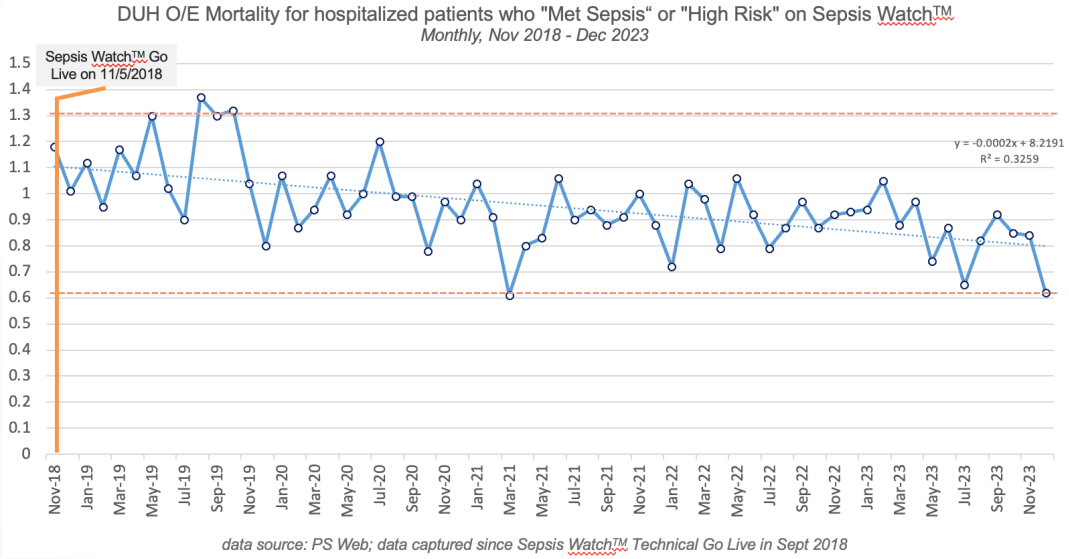
	SEP-1 Bundle Compliance – reported to CMS
DUH 2017 Q1 – 2018 Q3. → 2018 Q4 – 2023 Q4	▲ 89% (31.3% → 58.8%)

	O/E Mortality for Sepsis Watch patients
DUH Nov 2018 – Dec 2023	▼27% (1.10 → 0.80 trend line)





Secure Data Pipeline Infrastructure

2015-2019

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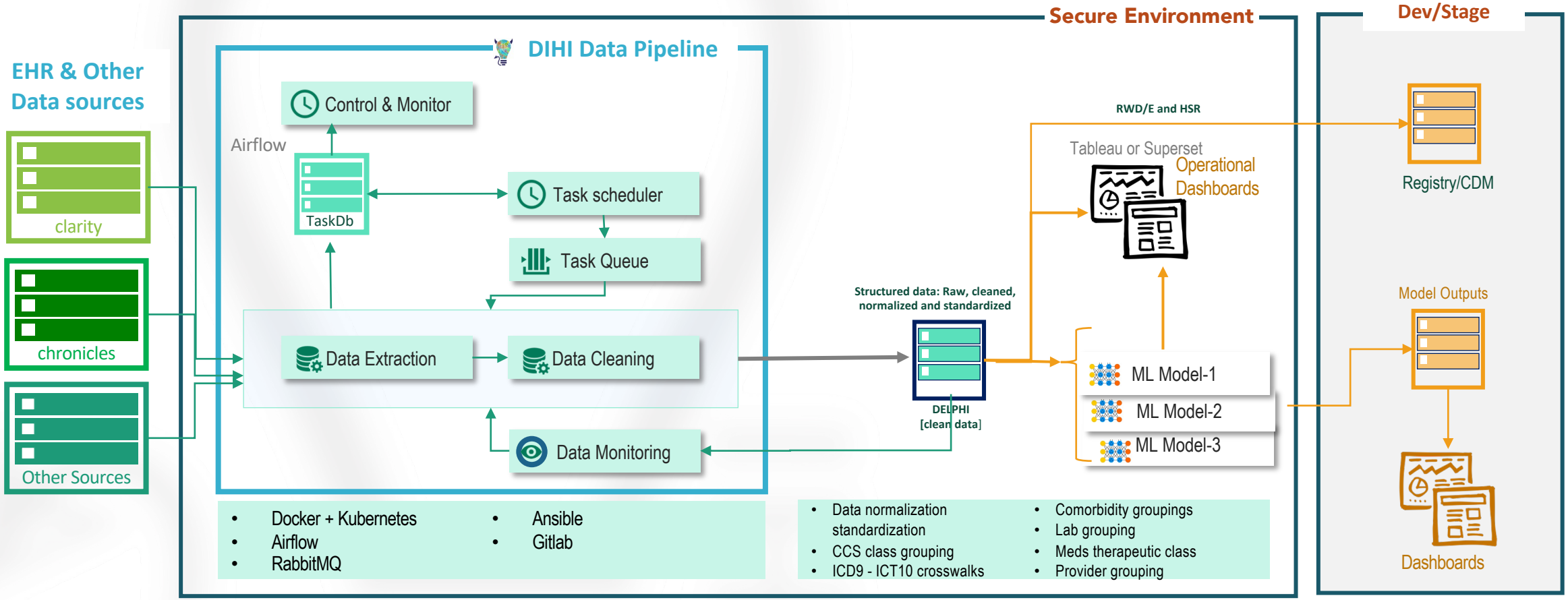

Data and MLOps Infrastructure | Cloud Agnostic

2015-2019

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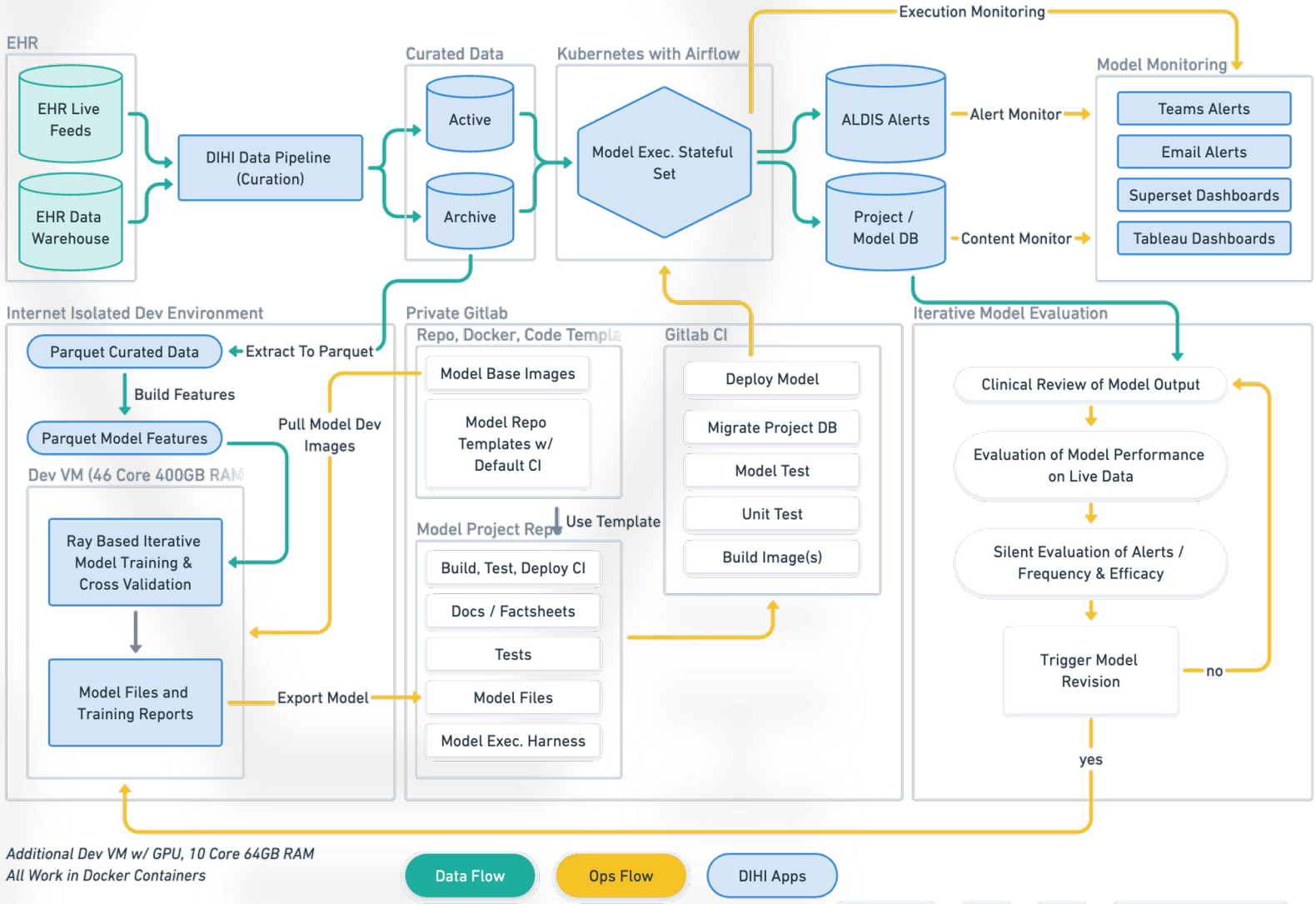

AI/ML Model Fact Labels

2015-2019

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Model Facts

Model name: Deep Sepsis **Locale:** Duke University Hospital

Approval Date: 09/22/2019 **Last Update:** 09/24/2019. **Version:** 1.0

Summary

This model uses EHR input data collected from a patient's current inpatient encounter to estimate the probability that the patient will meet sepsis criteria within the next 4 hours. It was developed in 2016-2019 by the Duke Institute for Health Innovation. The model was licensed to Cohere Med in July 2019.

Mechanism

- **Outcome** ..... sepsis within the next 4 hours, see (1) for sepsis criteria
- **Output** ..... 0% - 100% probability of sepsis occurring in the next 4 hours
- **Patient population** ..... all adult patients >18 y.o. presenting to DUH ED and admitted
- **Time of prediction** ..... every hour of a patient's encounter
- **Input data source** ..... electronic health record (EHR)
- **Input data type** ..... demographics, analytes, vitals, medication administrations
- **Training data location and time-period** ..... DUH, 10/2014 – 12/2015
- **Model type** ..... Recurrent Neural Network

Validation and performance

	Prevalence	AUC	PPV @ Sensitivity of 60%	Sensitivity @ PPV of 20%
Local Retrospective	18.9%	0.88	0.14	0.50
Local Temporal	6.4%	0.94	0.20	0.66
Local Prospective	TBD	TBD	TBD	TBD
External	TBD	TBD	TBD	TBD

Uses and directions

- **Operational use case(s):** Every hour, data is pulled from the EHR to calculate risk of sepsis for every patient at the DUH ED. A rapid response team nurse reviews every high-risk patient with a physician in the ED to confirm whether or not to initiate treatment for sepsis.
- **General use:** This model is intended to be used to by clinicians to identify patients for further assessment for sepsis. The model is not a diagnostic for sepsis and is not meant to guide or drive clinical care. This model is intended to complement other pieces of patient information related to sepsis as well as a physical evaluation to determine the need for sepsis treatment.
- **Examples of appropriate decisions to support:** Patient X has a high risk of sepsis according to the model. A rapid response team nurse discusses the patient with the ED physician caring for the patient and they agree the patient does not require treatment for sepsis.
- **Before using this model:** Test the model retrospectively and prospectively on local data to confirm generalizability of the model to the local setting.
- **Safety and efficacy evaluation:** Analysis of data from clinical trial (NCT03655626) underway. Preliminary data shows rapid response team, nurse-driven workflow was effective at improving sepsis treatment bundle compliance.

Comment | Open Access | Published: 23 March 2020

Presenting machine learning model information to clinical end users with model facts labels

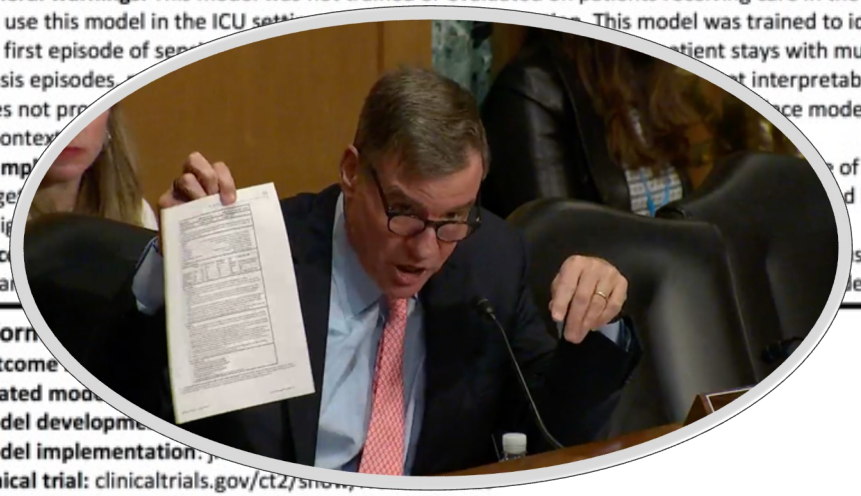
Mark P. Sendak, Michael Gao, Nathan Brajer & Suresh Balu

npj Digital Medicine **3**, Article number: 41 (2020) | Cite this article

5222 Accesses | **9** Citations | **73** Altmetric | Metrics

Warnings

- **General warnings:** This model was not trained or evaluated on patients receiving care in the ICU. Do not use this model in the ICU setti... This model was trained to identify the first episode of sep... ...tient stays with multiple sepsis episodes, ...t interpretable and does not pr... ...ce model output in contex...
- **Examp...** ... of the targe... ...d is not desig...
- **Disc...** ...se case or la... ...el.



Other inform...

- **Outcome** ...
- **Related mod...** ...
- **Model developme...** ...
- **Model implementation:** ...
- **Clinical trial:** clinicaltrials.gov/ct2/...
- **Clinical impact evaluation:** TBD
- **For inquiries and additional information:** please email mark.sendak@duke.edu

Data Quality Check Framework

2015-2019

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

EHR Data Quality Assessment Dimensions

CONFORMANCE

Value Conformance

Data elements meet prespecified value constraints

Relational Conformance

Data meet structural constraints and meet database integrity

Calculation Conformance

Derived values yield intended results within & between datasets

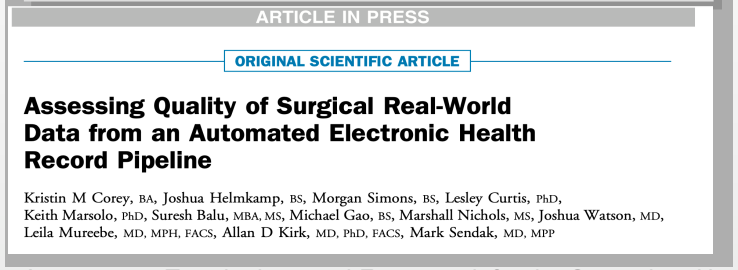
COMPLETENESS

Atemporal Completeness

Absence of data at a moment without reference to structure

Temporal Completeness

Presence of data over time without reference to other data


ARTICLE IN PRESS

ORIGINAL SCIENTIFIC ARTICLE

Assessing Quality of Surgical Real-World Data from an Automated Electronic Health Record Pipeline

Kristin M Corey, BA, Joshua Helmkamp, BS, Morgan Simons, BS, Lesley Curtis, PhD, Keith Marsolo, PhD, Suresh Balu, MBA, MS, Michael Gao, BS, Marshall Nichols, MS, Joshua Watson, MD, Leila Mureebe, MD, MPH, FACS, Allan D Kirk, MD, PhD, FACS, Mark Sendak, MD, MPP

PLAUSIBILITY

Temporal Plausibility

Time-varying variables change values as expected (event rate)

Atemporal Plausibility

Observed values, distributions, densities agree with standard

Uniqueness Plausibility

Duplication check for objects

Kahn MG, Callahan TJ, Barnard J, et al. A Harmonized Data Quality Assessment Terminology and Framework for the Secondary Use of Electronic Health Record Data. *EGEMS (Wash DC)*. 2016;4(1):1244. Published 2016 Sep 11. doi:10.13063/2327-9214.1244

DIHI monitoring AI: doveryai no proveryai*

2015-2019

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Effective monitoring of AI/ML solutions also requires multidisciplinary combination of technical and human capabilities, including expertise in engineering, data analysis, AI/ML, and clinical domain knowledge employed during the solution development phase.

Model Monitoring

- Data quality monitoring
  - Input data accurate, complete, and up-to-date
  - Entity/grouper monitoring
  - Continuous monitoring
- Performance comparison
  - auroc, auprc wrt. training
  - Analysis cadence: M/Q/Y
- Output drift monitoring
  - Data distribution
  - Category distribution

Solution Monitoring

- Outcome monitoring
  - Project specific measures
  - Bi-annual for most solutions
- Workflow changes
  - Observation / documentation
- Usage monitoring
  - UI tools/dashboard usage
  - Secondary data analysis
- User feedback
  - Survey for model & solution usability and refinements

Operations Monitoring

- Alerting & notification
  - Flexible rules-based engine for alerting
  - Used in clinical workflow
  - Email/page/spok/sms etc.
- Technical monitoring
  - Model run times, failures etc.
  - Service level monitoring
- Regulatory & Policy
  - Compliance monitoring for regulation & Duke policies
  - Ethical and legal standards

*Trust but VERIFY, a Russian proverb

Solution and input data monitoring at Duke examples

2015-2019

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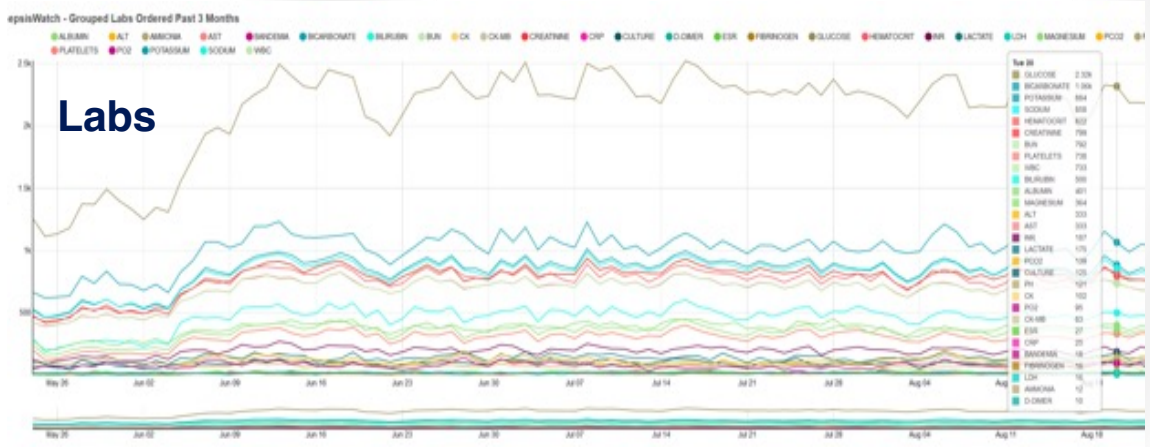
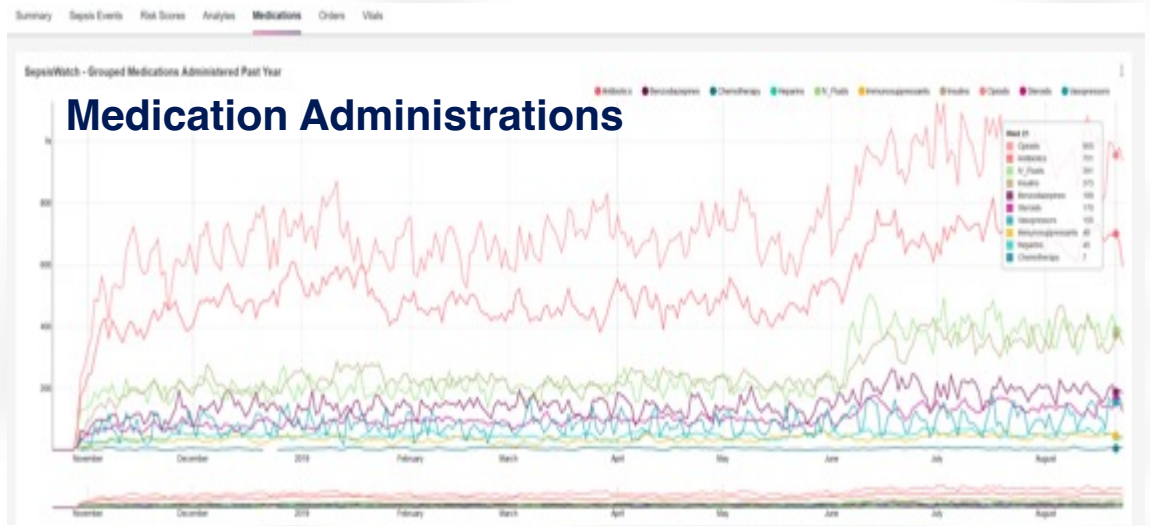
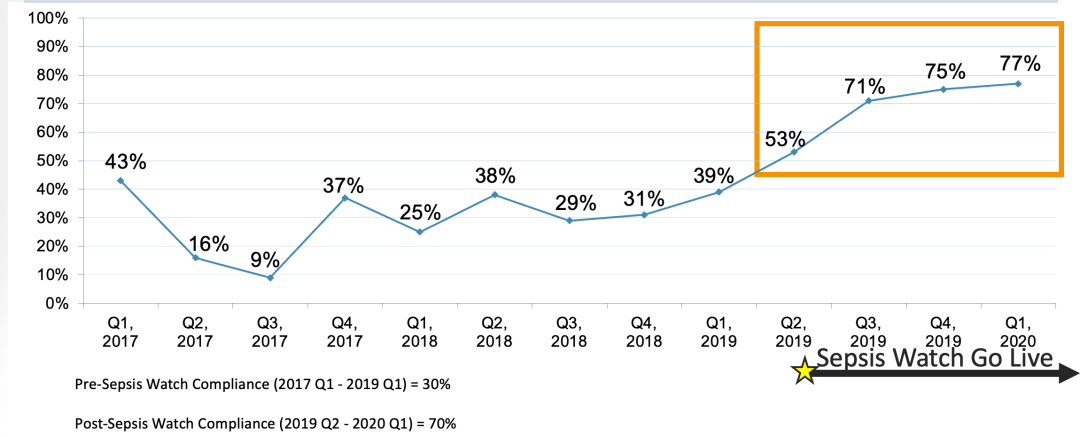
Continuous monitoring to ensure safety & quality of data





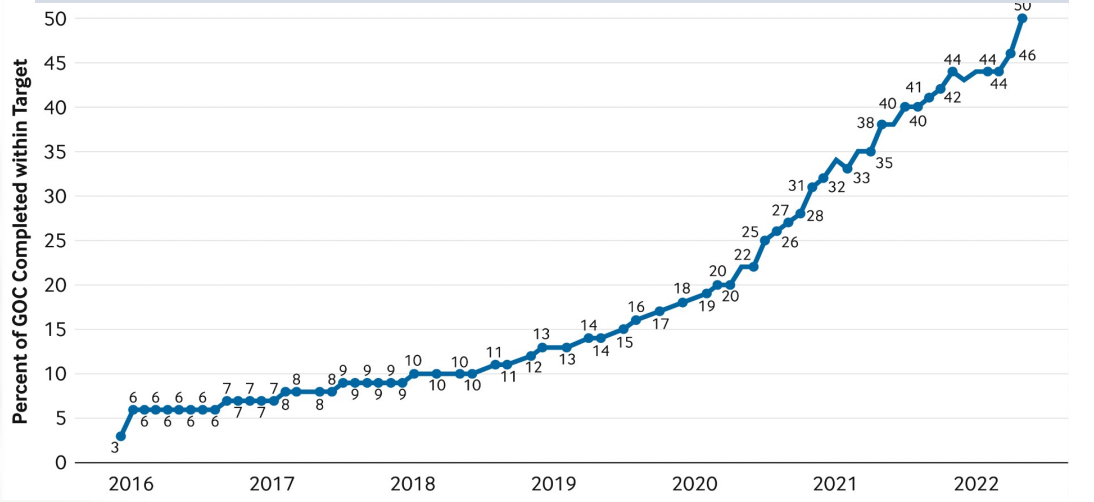
SEP-1 bundle compliance | Sepsis Watch™ model



Pre-Sepsis Watch Compliance (2017 Q1 - 2019 Q1) = 30%

Post-Sepsis Watch Compliance (2019 Q2 - 2020 Q1) = 70%

Goal-concordant care outcome | HealthGuard™ model



Sepsis Watch™ Solution Change Management

2015-2019

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Governance Committee

- Associate Medical Director, Duke Hospital Medicine Program
- Medical Director of the Analytics Center of Excellence
- Chief Nursing & Patient Care Services Officer
- Assoc. Chief Nursing Officer (x3)
- Nurse Manager (RRT)
- Nurse Manager (ED)
- Medical Director, Emergency Department
- VP, Emergency Services and Patient Flow
- DIHI Director
- ED MD
- ED nurse
- RRT nurse

Era :: COVID Breathe (In The Air)

2020-2022

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Staffing & retention
Facility utilization; tele
Health Equity

Language Understanding & AI Infrastructure

DALL E, NLP, CoPilot
GPT-3: most dangerous
Governance & Regs

Rapid Scaling | Governance | Health AI Partnership

2020-2022

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

health ai partnership

Data & Model Governance

- Duke ABCDS
- Federal Regs

Automating AI/ML

- AutoML
- Feature Store

Core Analytics & Mobile Apps

- Duke SymMon
- COVID Real-time Analytics

Health AI Partnership

- Integration Governance
- Responsible AI Adoption

Do more, faster.

COVID-19 Monitoring

2020-2022

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

Hospital: DUH

Bed Location
(Select how to view bar chart)
Department

Select Bar Stack
Bed's COVID-19 & O2 Device Status

COVID-19 & O2 Device Status
- Empty
- COVID19+ ECMO & Vent
- COVID19+, Vent
- COVID19+, no ECMO or Vent
- No COVID19, Vent
- No COVID19, no ECMO or Vent

DUH Occupancy on 4/21/2020 5:22:49 PM

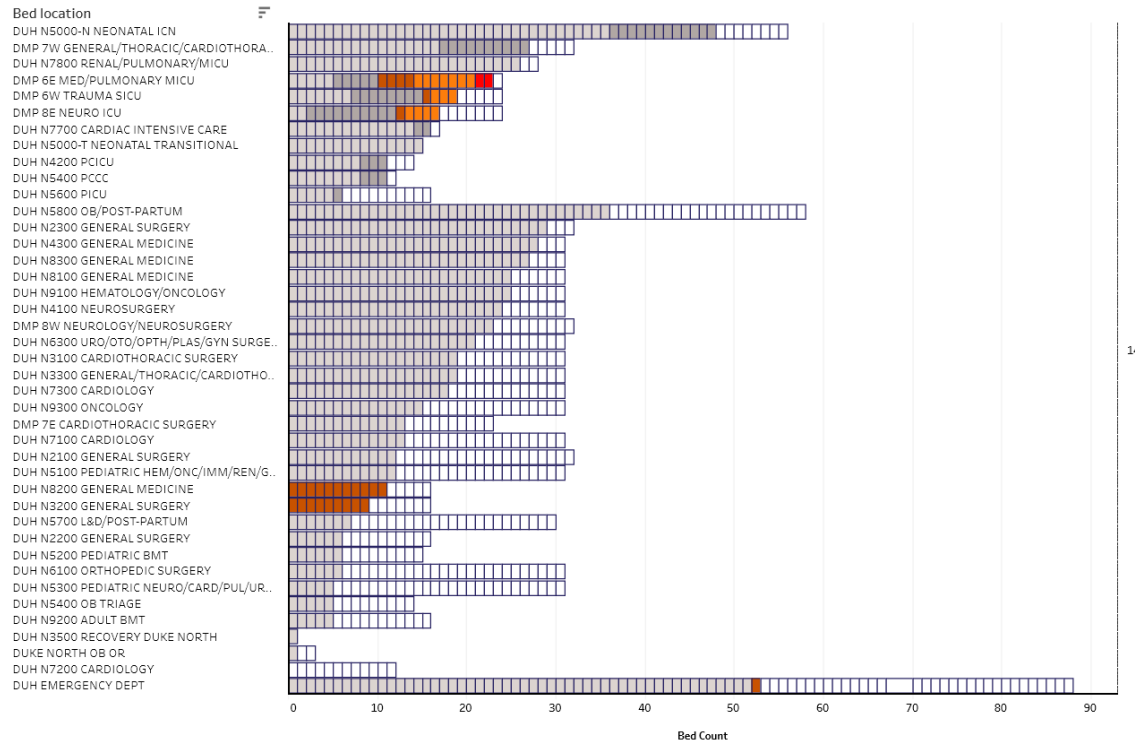
Use filter to change hospital viewed. Identifies count of filled beds, regardless of inpatient status.

Type	COVID-19	COVID-19 Vent	COVID-19 ECMO	Non-COVID Vent	Non-COVID ECMO	Bed filled	Beds Available
Grand Total	43	16	2	54	0	693	405
ICU	22	16	2	54	0	219	43
INTERMEDIATE	20	0	0	0	0	421	329
ED	1	0	0	0	0	53	33

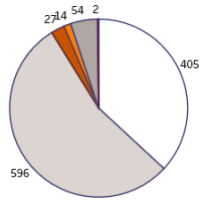
Department (Click 'Apply' to process)
- (All)
- DMP 6E MED/PULMONARY MICU
- DMP 6W TRAUMA SICU
- DMP 7E CARDIOTHORACIC SURGE...
- DMP 7W GENERAL/THORACIC/CA...
- DMP 8E NEURO ICU
- DMP 8W NEUROLOGY/NEUROSUR...
- DUH EMERGENCY DEPT
- DUH N2100 GENERAL SURGERY
- DUH N2200 GENERAL SURGERY
- DUH N2300 GENERAL SURGERY
- DUH N3100 CARDIOTHORACIC SU...
- DUH N3200 GENERAL SURGERY
- DUH N3300 GENERAL/THORACIC/...
- DUH N3500 RECOVERY DUKE NOR...
- DUH N4100 NEUROSURGERY
- DUH N4200 PCICU
- DUH N4300 GENERAL MEDICINE
- DUH N5000-N NEONATAL ICN
- DUH N5000-T NEONATAL TRANSIT...
- DUH N5100 PEDIATRIC HEM/ONC/...
- DUH N5200 PEDIATRIC BMT
- DUH N5300 PEDIATRIC NEURO/CA...
- DUH N5400 OB TRIAGE
- DUH N5400 PCCC
- DUH N5600 PICU
- DUH N5700 L&D/POST-PARTUM
- DUH N5800 OB/POST-PARTUM
- DUH N6100 ORTHOPEDIC SURGERY
- DUH N6300 URO/OTO/OPTH/PLAS...
- DUH N7100 CARDIOLOGY
- DUH N7200 CARDIOLOGY
- DUH N7300 CARDIOLOGY
- DUH N7700 CARDIAC INTENSIVE ...
- DUH N7800 RENAL/PULMONARY/...
- DUH N8100 GENERAL MEDICINE
- DUH N8200 GENERAL MEDICINE

Cancel | Apply

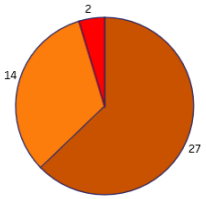
Compare Bed's COVID-19 & O2 Device Status according to Department



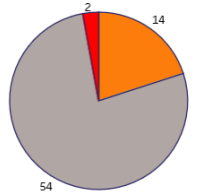
Total Beds



COVID19 +



Vent or ECMO



Inference Engines | Mortality models (inpatient, 3- & 6-month)

2020-2022

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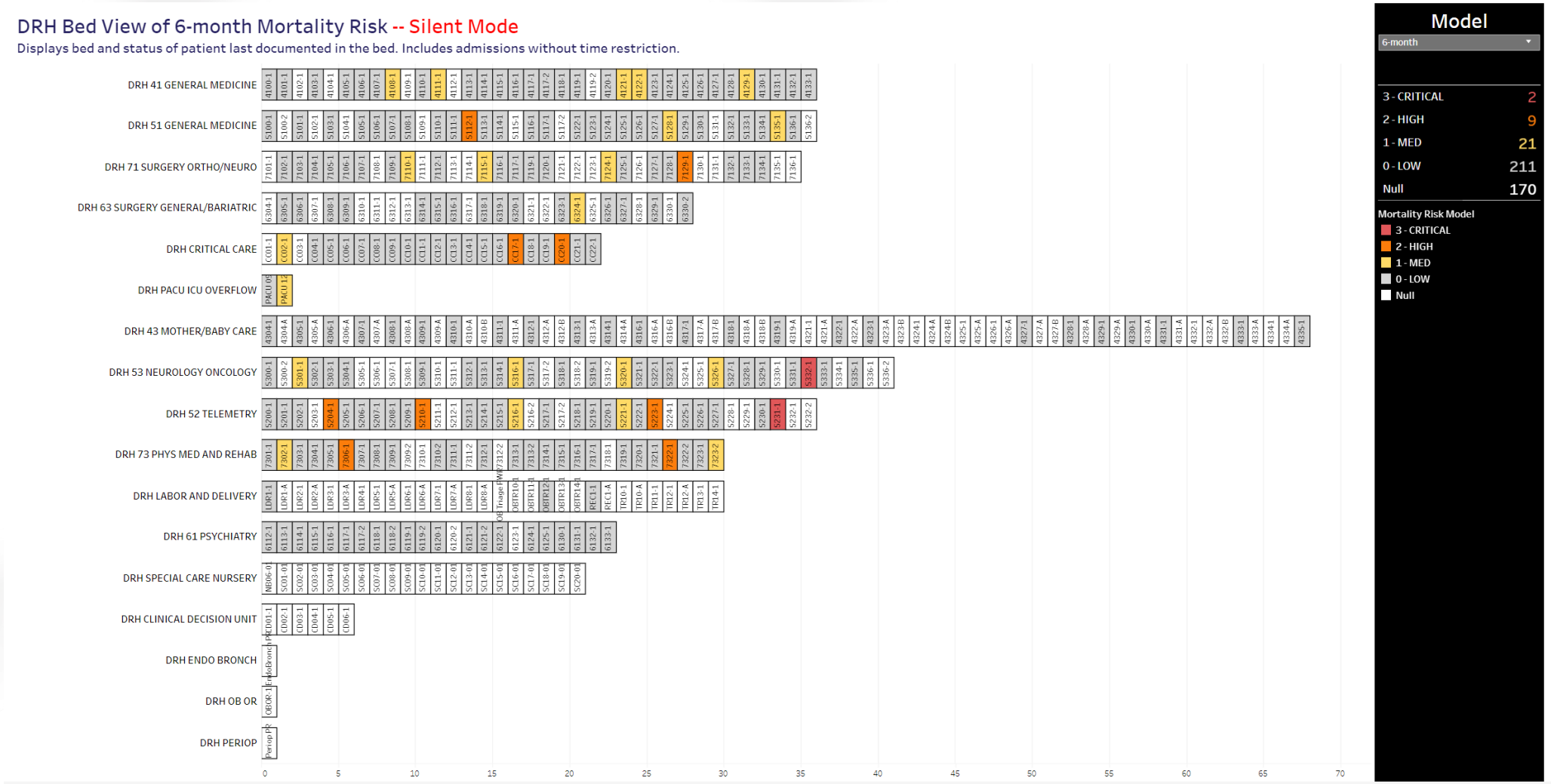

Health AI Partnership (HAIP) – global network

2020-2022

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objective: Empower healthcare professionals to use AI effectively, safely, and equitably through community-informed up-to-date standards

advance health equity

prioritize solutions to advance health equity and eliminate the AI digital divide

improve patient care

ensure AI adoption is driven by patient care needs, not technical novelty

improve the workplace

surface socio-technical challenges in AI use and foster a positive work environment

build community

create safe spaces to share learnings and consult peers

Health AI Partnership (HAIP) core

2020-2022

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health ai partnership

Healthcare Delivery Organizations

DukeHealth
MAYO CLINIC
Franciscan Missionaries of Our Lady HEALTH SYSTEM
Hackensack Meridian Health
Jefferson Thomas Jefferson University
KAISER PERMANENTE
MICHIGAN MEDICINE UNIVERSITY OF MICHIGAN
MOREHOUSE SCHOOL OF MEDICINE
NewYork-Presbyterian
UWHealth
PCCI
UCSF University of California San Francisco
scan HEALTH PLAN

Ecosystem Partners

AMA
Berkeley UNIVERSITY OF CALIFORNIA
DLA PIPER
OCHIN

Federal Agencies

ONC Office of the National Coordinator for Health Information Technology
*Participating as a federal observer
VA U.S. Department of Veterans Affairs Veterans Health Administration Office of Discovery, Education and Affiliate Networks
CMS CENTERS FOR MEDICARE & MEDICAID SERVICES

Sponsor

GORDON AND BETTY MOORE FOUNDATION

HAIP – 8 Key Decision Points for AI adoption

2020-2022

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Procurement

1. Identify and prioritize a problem
2. Evaluate AI as a viable component of the solution

Development & Adaptation

3. Develop measures of outcomes and success of the AI product
4. Design a new optimal workflow to facilitate integration
5. Evaluate pre-integration safety and effectiveness of the AI product

Clinical Integration

6. Execute change management, workflow integration, and scaling strategy

Lifecycle Management

7. Monitor and maintain the AI product
8. Update or decommission the AI product

AI Governance @ Duke Health

2020-2022

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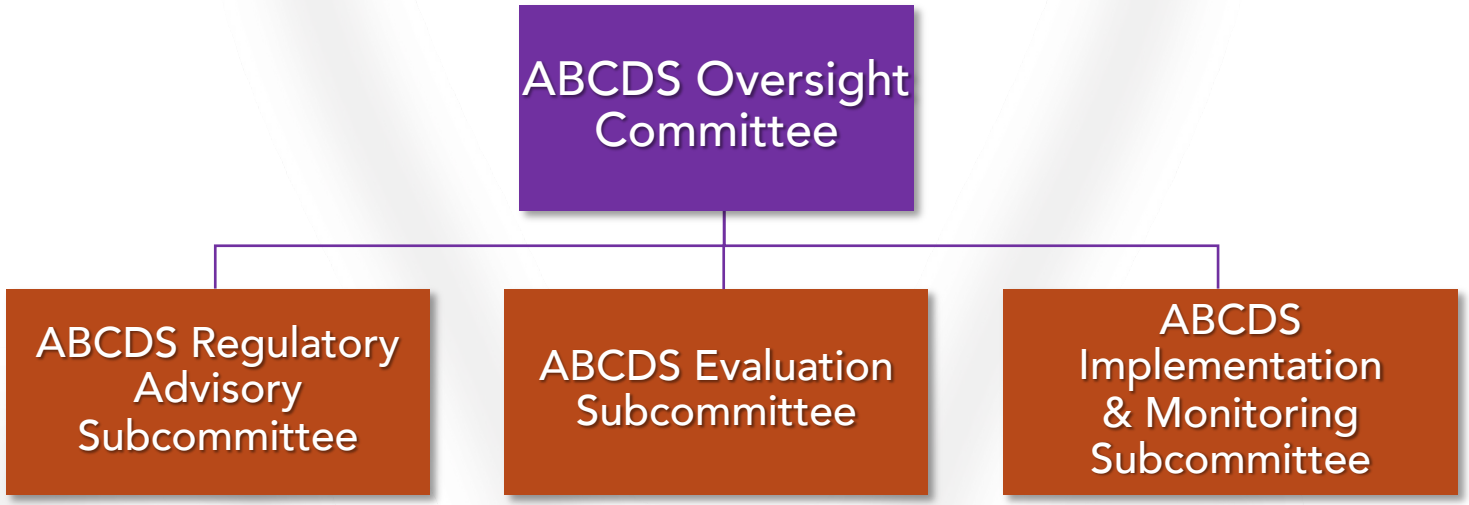
algorithm-based clinical decision system (abcds) Oversight Committee was formed in January 2021



1. **Transparency & Accountability**
2. **Clinical Value & Safety**
3. **Fairness & Equity**
4. **Usability, Reliability & Adoption**
5. **Regulatory Compliance**

Governance Framework for AI Lifecycle Management

2020-2022

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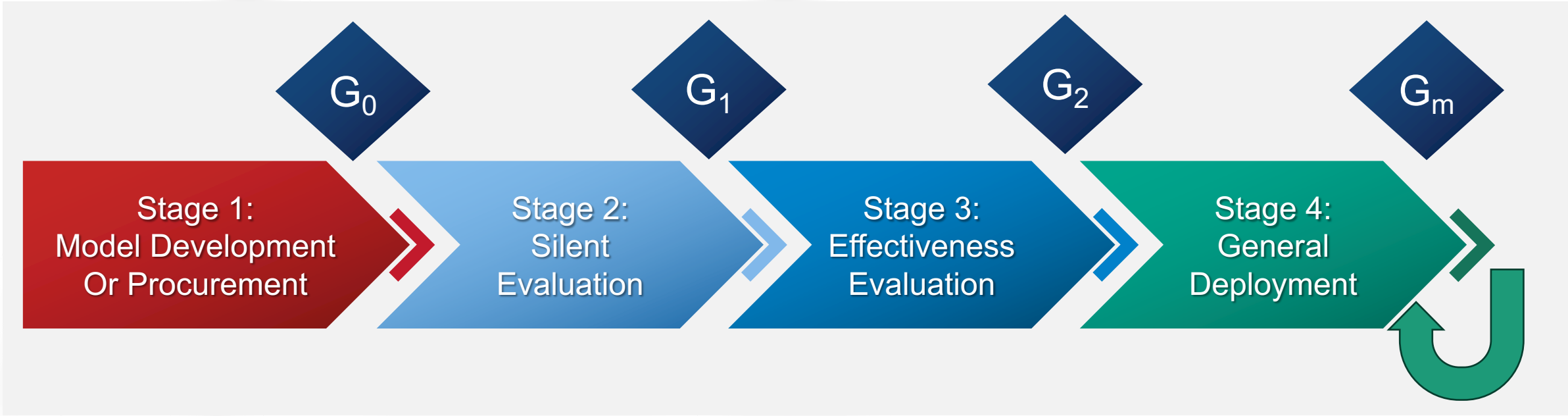
Focus is on ensuring safety, efficacy, equity of the AI solution

AI model and its integration into workflow

Anticipate, prevent, and mitigate algorithmic harms



Bedoya AD, et al., A framework for the oversight and local deployment of safe and high-quality prediction models. *J Am Med Inform Assoc*. 2022 Aug 16;29(9):1631-1636.

Regulation compliance

2020-2022

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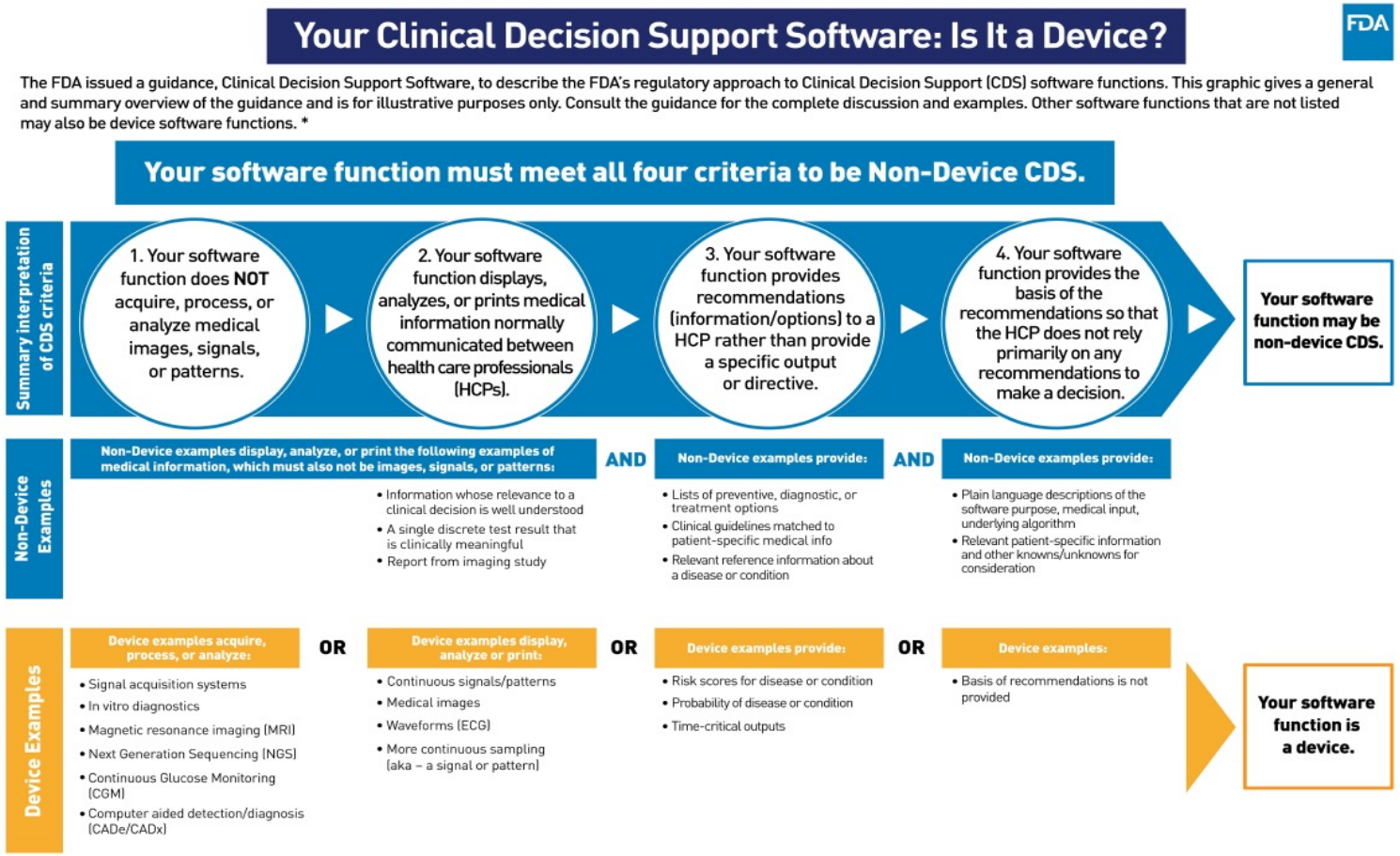

Reference: FDA Graphical Guide available at https://www.fda.gov/media/161775/download

https://www.fda.gov/medical-devices/digital-health-center-excellence/digital-health-policy-navigator

Contains Nonbinding Recommendations

Clinical Decision Support Software

Guidance for Industry and Food and Drug Administration Staff

Document issued on September 28, 2022.

DIHI Automated Model Refinery

2020-2022

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Automatically build models for defined clinical outcomes

RAY APACHE ARROW

State-of-the-art Performance

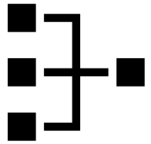
Searches over hundreds of thousands of model configurations to find best performance

Consistently replicate published state-of-the-art performance on mortality, ICU transfer, etc.

Easy to use

No-code interface means minimal programming is needed to use the system!

Clear documentation



Massively Parallel

Train hundreds of models simultaneously and intelligently prune low-performing models

Can take full advantage of compute resources

Uses same distributed computing framework as companies like OpenAI

Automated Evaluation

Models are automatically run through custom evaluation methods

Standard metrics reported and used for model selection

Model development and training can be measured in hours and days, rather than months!

DIHI Feature Store

2020-2022

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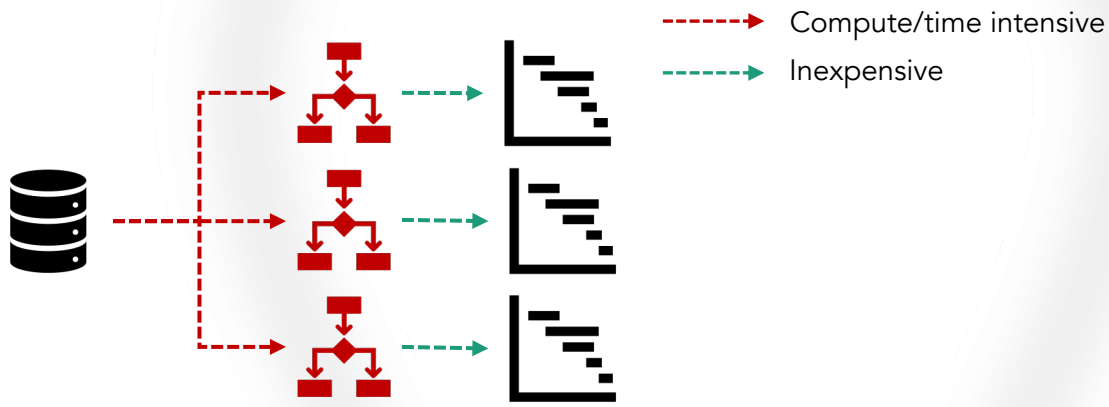
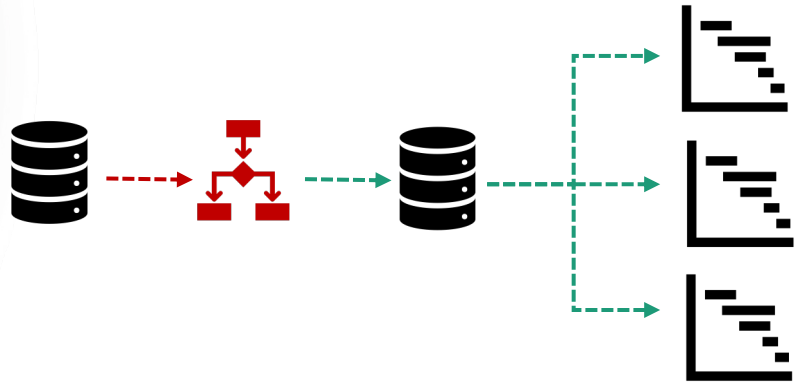




Old paradigm
1. Raw data is pulled individually for projects
2. Model inputs are created independently for each model
3. Results in redundancy in compute/code/time
4. Increases error rate due to code duplication

Feature Store paradigm
1. Raw data is pulled one time and used to generate features and placed into feature depot
2. Model inputs are available to all models as soon as they are generated
3. Code to generate models only requires one-time validation!
4. Heavily reduces compute cost

Feature stores provide on-demand features which are validated and highly-available
- Reduces model iteration time
- Increase feature complexity which can improve model performance

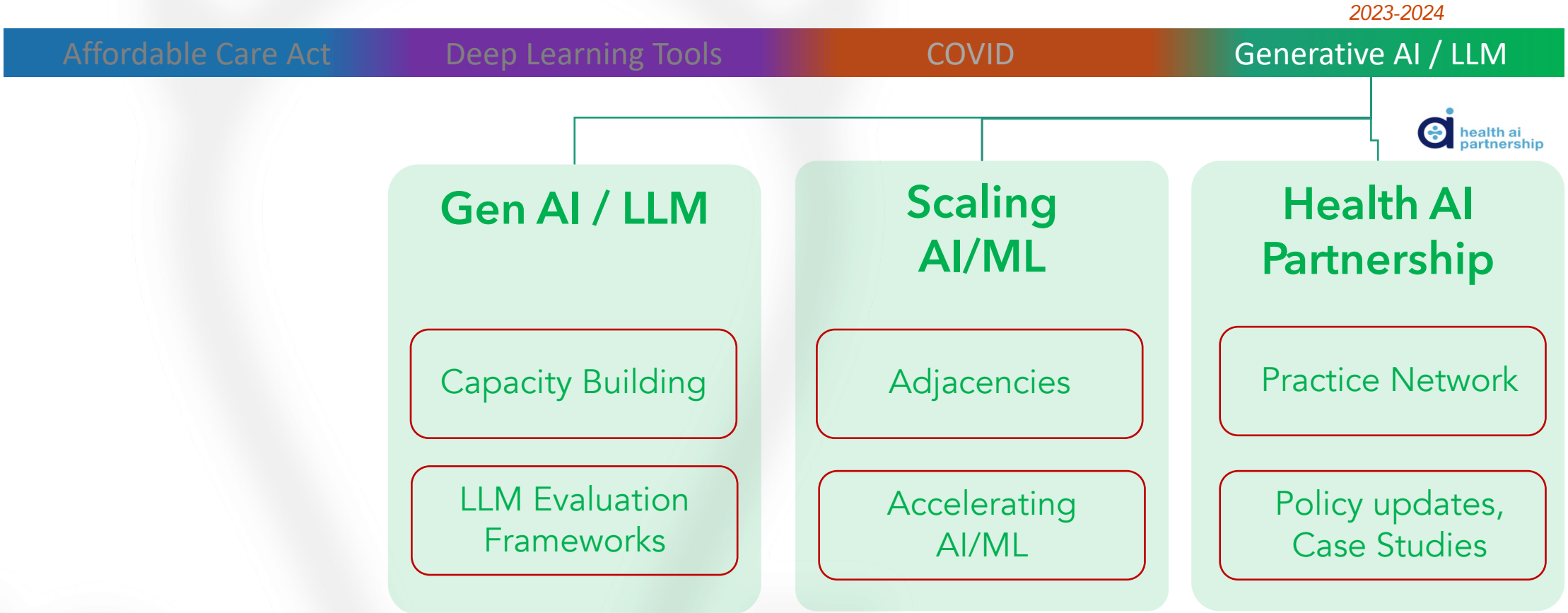
Era :: Gen AI – We didn't start the fire!

Margin challenges
Talent shortage for care
Demand for digital care

GenAI domination

GPT-4 / Gemini / Llama
White House EO, EU-AI Act, ONC HTI-1, FDA OCR-1557 …

Era :: Gen AI – We didn't start the fire!



Generative AI

2023-2024

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Portfolio of LLM-based Solutions in 2024

2023-2024

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

2024-2025 Innovations

AI-Powered Knowledge Management System and Training Module

Using artificial intelligence to reduce the burden of prior authorizations

Clinical Education Dashboards using large language models to improve education at Duke

Using AI for Surgery Pre-Authorization

AI-Powered Cardiothoracic ICU Handover Summarization Tool

Matching Transplant Donors to Recipients with Generative AI / LLM

Automating Oncology Patient Access and Elevating the Patient Experience

Automating Patient Connection for Health-Related Social Needs

Scaling AI/ML Solutions @ Duke Health and beyond

2023-2024

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

- Sepsis Watch
- Risk of Mortality
  - Inpatient, 30-day, 6-month and 1 year
  - Goal-concordant care / ACP
- Adult decompensation
  - Unplanned transfer to ICU/RRT
- ED Triage (admission prediction)
  - Regular bed vs ICU
- ED Diversion prediction
- IrAE: Immune therapy related adverse events
- Lung transplant outcomes prediction
- Equity in kidney transplant process
- Maternal Early Warning System
  - Maternal Sepsis
  - Hemorrhage in L&D
- PAD
- PE in Emergency Department
- Cardiac decompensation and Shock
  - Hypotension, hypoperfusion, vasopressor admin, Respiratory decline/intervention
- Pediatric Sepsis
  - Phenotype and predictive model
- Pediatric decompensation
- Pythion: Surgical Complication Prediction
  - MI, Stroke, VTE, Mortality, Readmission
- TBI CT model
- Dermatology [PCP use]
- CKD for population health
- AKI post CT surgery
- HIV PrEP

Sepsis ….. fast forward to 2024

2023-2024

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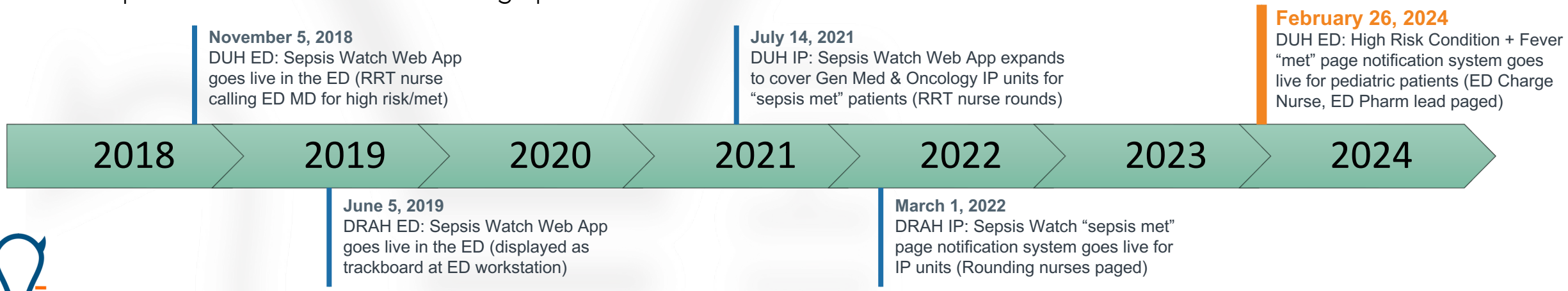
- Sepsis Watch dashboard and page notifications support live workflows at DUH and DRAH since 2018, with observed positive impact so far on bundle compliance, O/E mortality and O/E length of stay
- The "Sepsis Watch Program" now has two components:
  - (since 2018) Real-time prediction of and identification of the CMS real-time definition of sepsis
  - (new in 2024) day-after-discharge bundle compliance full report on all patients who met CMS real-time definition of sepsis
- The Sepsis Watch real-time solution has two delivery methods:
  - Web App: Sepsis Watch Web application (since 2018): Custom-developed Web UI to support identification of sepsis and bundle tracking once sepsis is identified
  - Secure paging: Sepsis Watch real-time "high risk" and "met sepsis" notifications can be pushed via secure page to front line clinician users for just-in-time review and intervention
- Sepsis Watch Pediatrics is catching up….



Health AI Conveners: fragmentation

2023-2024

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

Organization	Description
Health AI Partnership (HAIP)	A multi-stakeholder collaborative who seeks to empower healthcare organizations to use AI safely, effectively, and equitably. Vision is to be the trust partner and up-to-date source of actionable guidance for healthcare professionals using AI.
Coalition for Health AI	A community of academic health systems, organizations, and expert practitioners of artificial intelligence (AI) and data science.
Valid AI	A collaborative community to advance generative AI in a responsible manner to improve health care and research
HIMSS (Healthcare Information and Management Systems Society)	A member-based society that covers a large part of health technology ecosystem. This society offers educational resources such as course materials, guides, webinars, and certifications on a range of health information and technology subjects.
HLTH	Community for innovators in the healthcare ecosystem. Has a heavy industry focus. Hosts conferences and creates digital content like webinars, podcasts, and blogs.
Alliance for AI in Healthcare	An international multi-stakeholder membership-based advocacy group organized to influence regulatory principles for development and implementation of AI in healthcare.
AI Healthcare Coalition	An industry advocacy group to influence on health care AI policy and law.
Healthcare Products Collaborative	Promotes discussion and innovation in the healthcare products community, bringing together regulators, professionals, academics, and thought leaders to tackle industry challenges.
Connected Health Initiative	A multi stakeholder coalition that advocates for policies and laws related to AI in healthcare. They educate regulators and lawmakers and publish white papers that define industry best practices.
The AI Collaborative (Nuance + The Academy)	A peer learning and consulting services to clinical and operational executives who oversee their organization's investment in AI tools for healthcare.
KLAS Research	A consulting services that evaluates digital products by aggregating and synthesizing feedback about vendor products.
Machine Learning for Healthcare	Academic publishing and dissemination of scientific work
Association for Health Learning & Inference	Academic publishing and dissemination of scientific work

Organization	Description
American Medical Informatics Association (AMIA)	A society for health informatics professionals that offers education, training, accreditation, and certifications.
Society for Imaging Informatics in Medicine (SIIM)	Healthcare professional organization for those interested in use of informatics in medical imaging.
National Academies of Medicine AI Code of Conduct	Aimed at providing a guiding framework to ensure that AI algorithms and their application in health, health care, and biomedical science perform accurately, safely, reliably, and ethically in the service of better health for all.
Digital Health Collaborative	The Digital Health Collaborative is a group of leading healthcare and consumer organizations that share a commitment to "raising the bar" for evidence and value in digital health technology.
The AI Alliance	A community of technology creators, developers and adopters collaborating to advance safe, responsible AI rooted in open innovation.
Trustworthy & Responsible AI Network (TRAIN)	Through collaboration, TRAIN members will help improve the quality and trustworthiness of AI by: - Sharing best practices related to the use of AI in healthcare settings - Enabling registration of AI used for clinical care or clinical operations - Providing tools to enable measurement of outcomes associated with the implementation of AI - Facilitating the development of a federated national AI outcomes registry for organizations to share among themselves.
Collaborative Community on Ophthalmologic Imaging	A collaborative of academic institutions, government agencies, private businesses, and professional organizations dedicated to establishing standards of practice for innovative ophthalmic imaging.
Center for AI Policy (CAIP)	The Center for AI Policy (CAIP) is a nonpartisan research organization dedicated to mitigating the catastrophic risks of AI through policy development and advocacy.
Center for Public Sector A.I.	The Center' firmly believes that, if managed carefully and prudently by the right leaders, technology like generative AI can significantly improve government agencies' ability to serve the public.

Differentiation of HAIP AI Practice Network

2023-2024

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

Voice of healthcare organizations

Support high- and low-resource environments

Team of clinical, technical, operational, strategic, and regulatory stakeholders

Provider of technical assistance for AI implementation

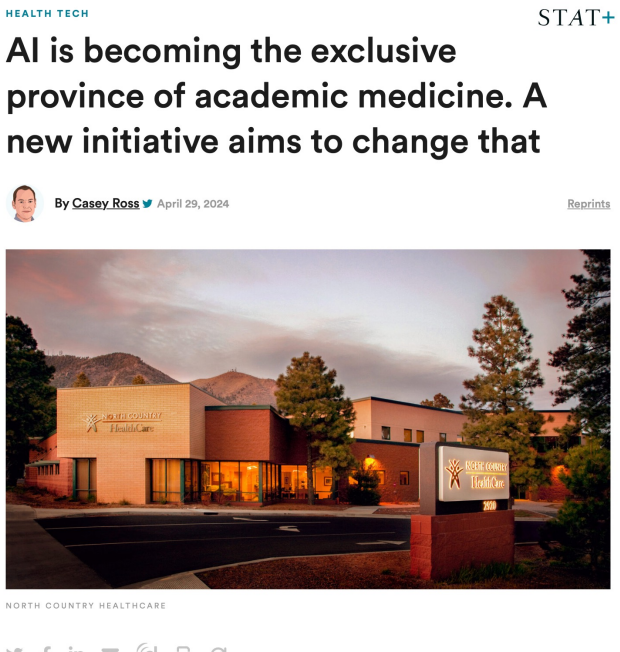
HAIP AI Practice Network

health ai partnership

2023-2024

Affordable Care Act | Deep Learning Tools | COVID | Generative AI / LLM

- **Enhance Procurement and Product Adaptation**: Augment procurement process for AI products and local adaptation of the AI product to ensure safe, effective, and equitable integration into care delivery. Implement best practices across HAIP key decision points.
- **Formalize AI Governance**: Utilize HAIP educational material to formalize localized AI governance. Iterate on organizational governance policies for AI tools with HAIP.
- **Programmatic Support**: One-on-one touchpoints with HAIP Coordinating Center to review progress navigating key decision points, and to address questions and challenges.
- **Expert Consultations**: Pre-arranged office hours and panel discussions with HAIP leadership council and Corps members, including broad range of data engineering expertise, AI methods expertise, and policy / regulatory expertise to address site-specific challenges.
- **Peer Learning Community**: Community meetings that bring together AI practitioners across practice network sites to share experiences navigating the AI product lifecycle management
- **Educational Materials**: Access guides, best practices, templates, and case studies curated by HAIP Corps sites. Utilize Health Equity Across the AI Lifecycle (HEAAL) framework to assess equity impacts of AI tools.



HEALTH TECH

STAT+

AI is becoming the exclusive province of academic medicine. A new initiative aims to change that

By Casey Ross April 29, 2024 Reprints

NORTH COUNTRY HEALTHCARE

In Kingman, Ariz., a windswept city of 35,000 at the eastern edge of the Mojave desert, data scientists are about as rare as a drenching rain. The local health clinic doesn't have a stable internet connection, much less the software to support the latest, greatest artificial intelligence.

Thank you!

suresh.balu @ duke.edu