A Call to Action for Cardiologists: Impactful Artificial Intelligence-Driven Clinical Decision Support and Value-Based Care

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Disclosures

None related to this presentation

The Mount Sinai Health System: Key Statistics

Mount Sinai Health System

At a glance

One Medical School

▲ **Icahn School of Medicine at Mount Sinai**
One Gustave L. Levy Place
New York, NY 10029

Seven Hospital Campuses

1. **Mount Sinai Beth Israel**
First Avenue at 16th Street
New York, NY 10003

2. **Mount Sinai Brooklyn**
3201 Kings Highway
Brooklyn, NY 11234

3. **The Mount Sinai Hospital**
One Gustave L. Levy Place
New York, NY 10029

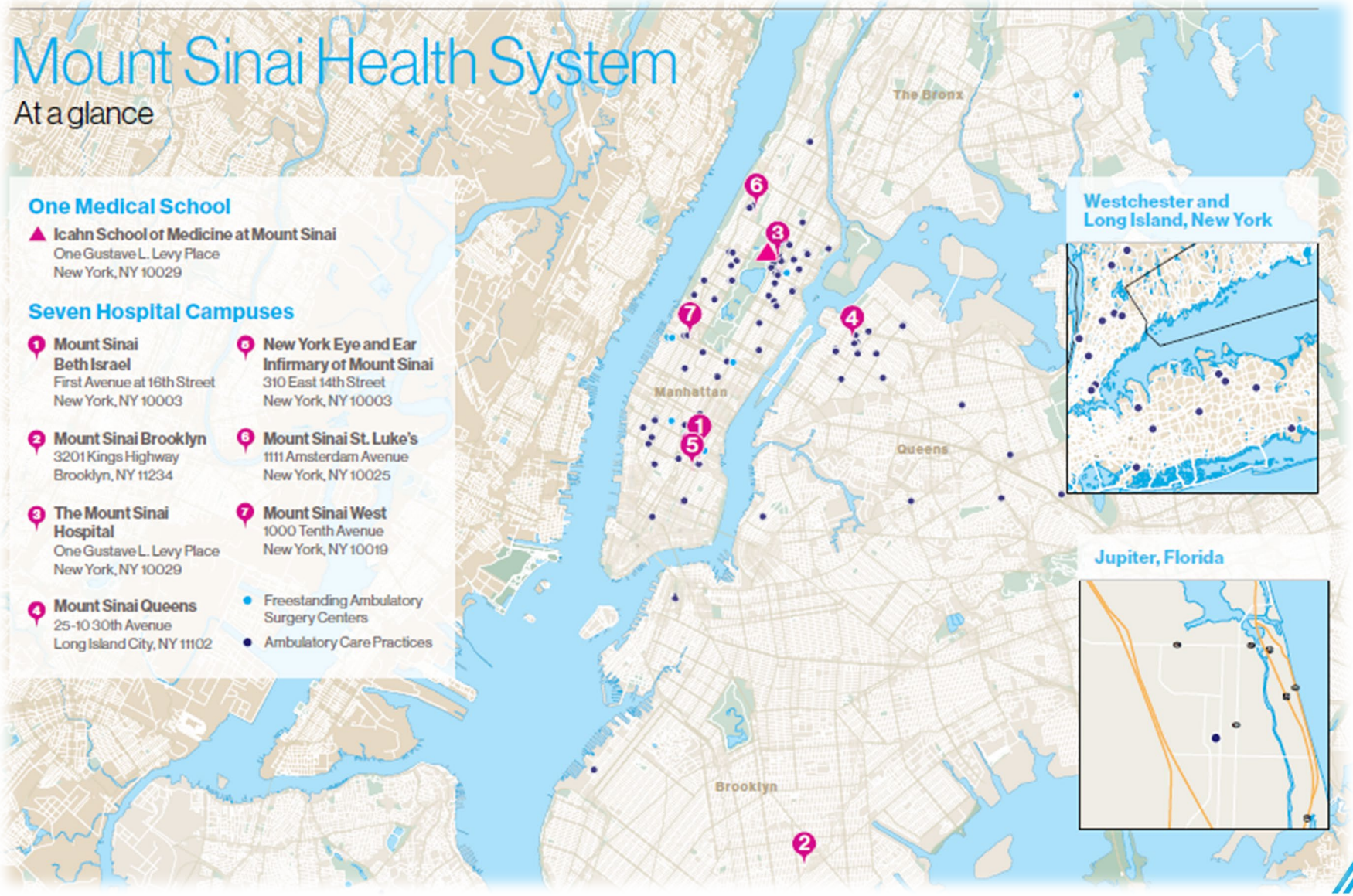
4. **Mount Sinai Queens**
25-10 30th Avenue
Long Island City, NY 11102

5. **New York Eye and Ear Infirmary of Mount Sinai**
310 East 14th Street
New York, NY 10003

6. **Mount Sinai St. Luke's**
1111 Amsterdam Avenue
New York, NY 10025

7. **Mount Sinai West**
1000 Tenth Avenue
New York, NY 10019

- Freestanding Ambulatory Surgery Centers
- Ambulatory Care Practices



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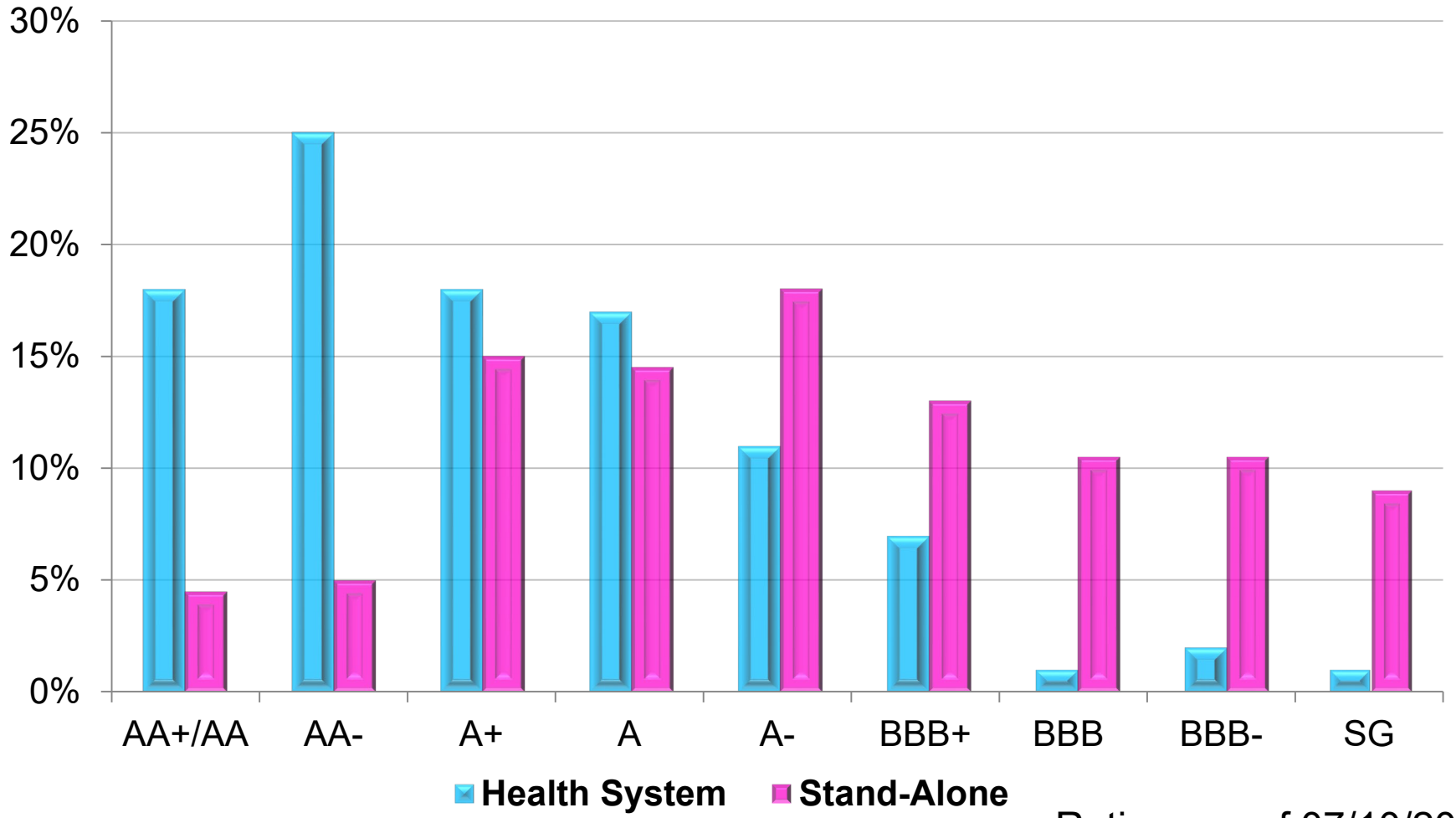
Bond Rating Distribution

Health Systems vs. Stand-Alone



Ratings as of 07/10/2013

Source: S&P U.S. NFP Health Care Sector Outlook, 2013

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Caveats

- Must focus on true drivers of outcomes and economics
- False:
  - Cost of an OR hour, PACU minute or ICU day
  - Cost of an MRI
  - Cost of an ICU day
- True:
  - Cost of nurses, anesthesiologists, surgeons, and support staff
  - Cost of purchasing, maintaining, and staffing a MRI

Economic Drivers of Health Care

- Personnel (FTE's): MD's RN's, extenders, support staff
- Expensive resources
  - Hospital care, especially critical care
  - Emergency Departments
  - Post-acute care: SNF, LTACH, Home Care
  - Supplies: Drugs and remainder of supply chain
  - Capital costs of aging infrastructure

Value Metrics

- Observed-to-expected mortality and complication rates better than benchmarks
- Beyond external measures: Infectious complications, length of stay, readmissions
- Controlling costs: ICU and hospital stay; blood, laboratory, radiology, consultations, post-acute care

Why Value?

$$\text{Value} = \frac{\text{Quality} \quad \text{Safety} \quad \text{Satisfaction}}{\text{Cost}}$$

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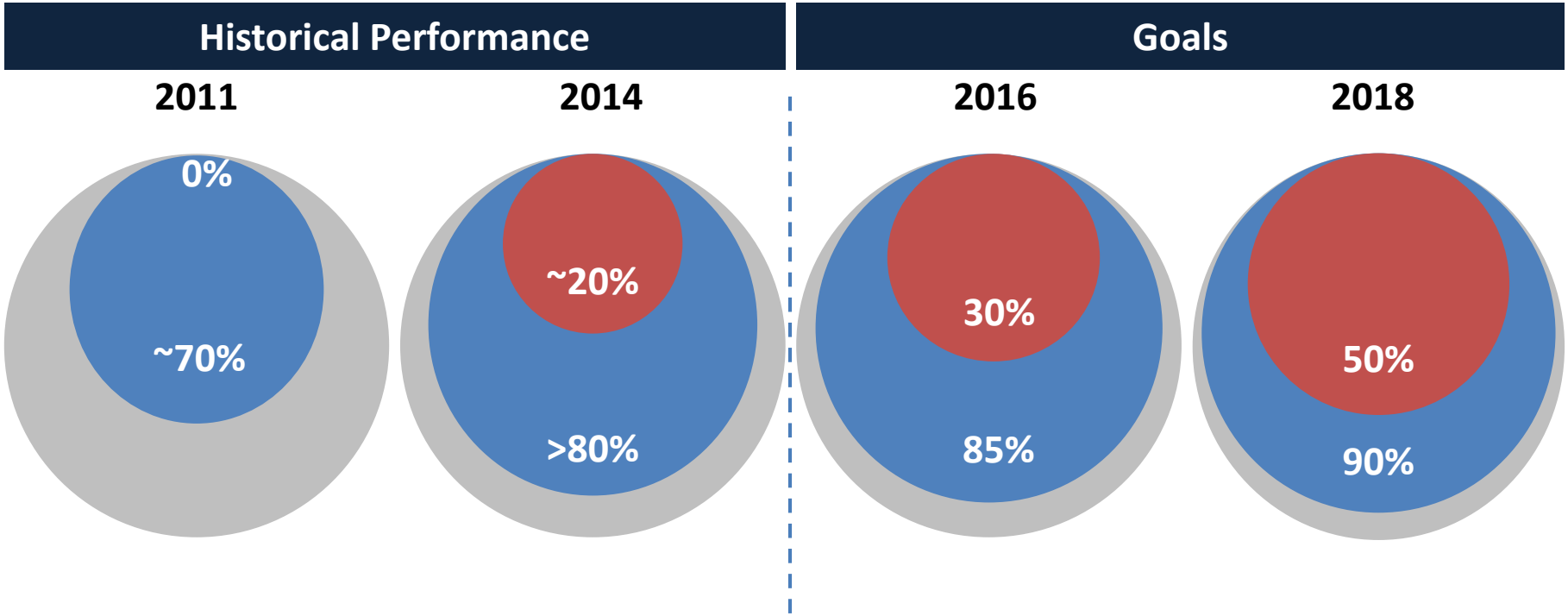
A National Transition to Value-Based Reimbursement

CMS Timeline Expects By 2018, 50% of Payments in Alternative Payment Models

- Payments linked to alternative payment models
- Fee-for-Service ("FFS") linked to quality
- All Medicare FFS



Source: Centers for Medicare and Medicaid Innovation ("CMMI") Center, Bundled Payment Summit, June 2015

Programs Risk

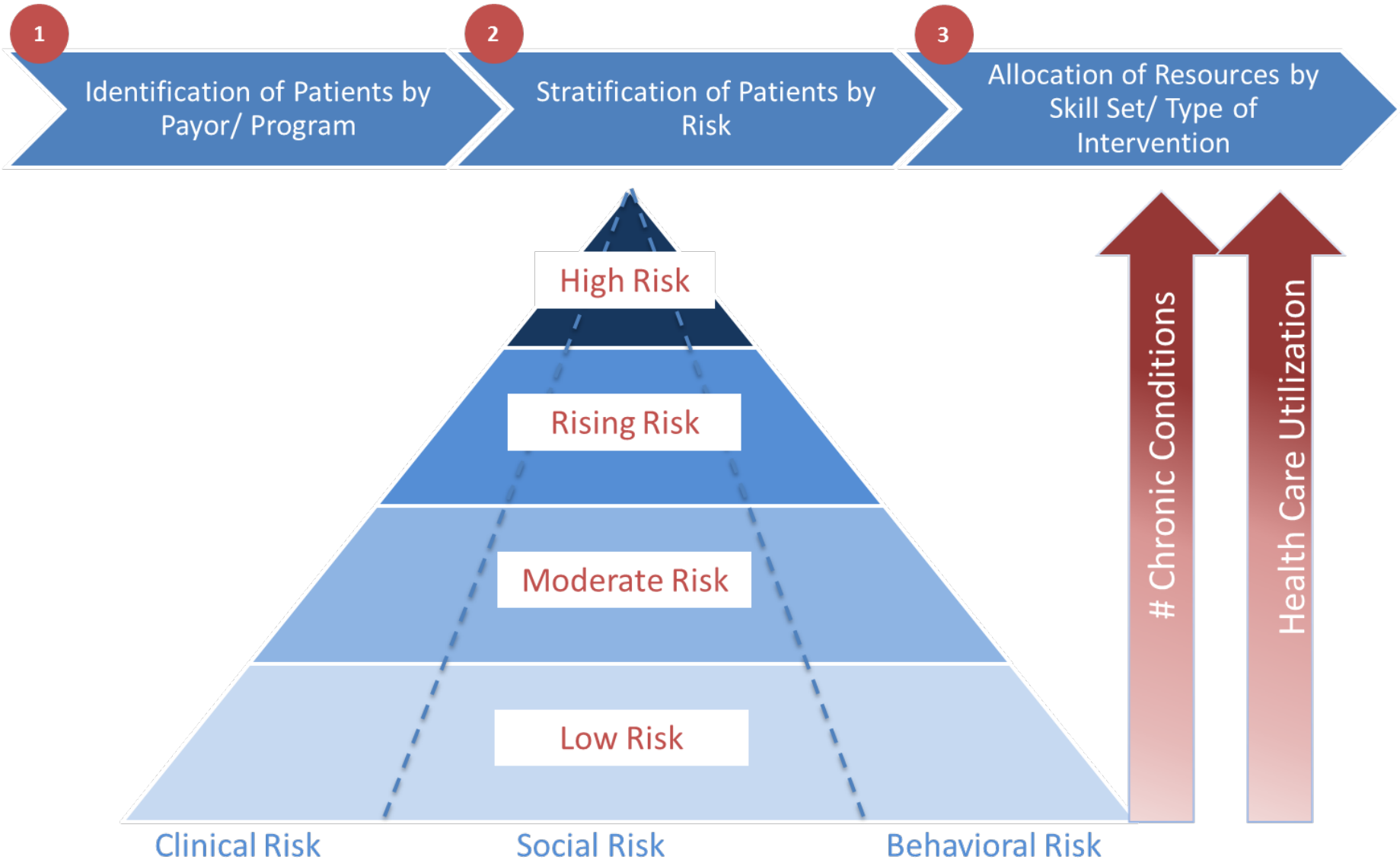
Percentage Revenue at Risk by Commercial Payer

- Aetna – 2%
- Cigna – 2%
- Emblem Health (currently undetermined)
- Empire QHIP – 4%
- HealthFirst – pmpm dollars scaled based on star rating
- United Healthcare – 3%

Percentage Revenue at Risk by CMS

- VBP – +/- 2%
- HRRP – 3%
- HAC – 1%

Comprehensive & Integrated Care Coordination



Palliative Care Enhancement

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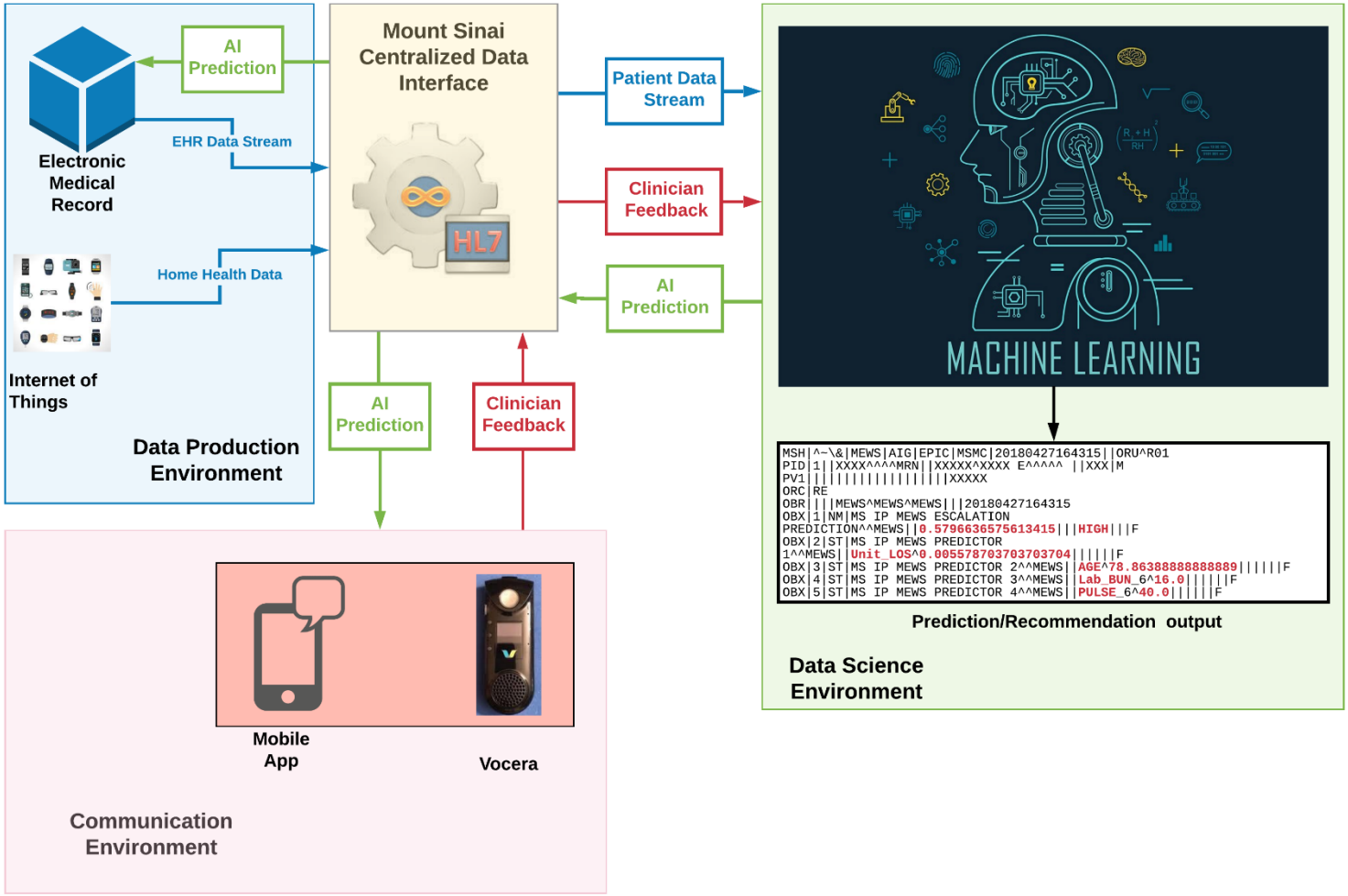
Building the AI models

Machine Learning Platform



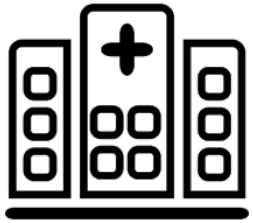
Deployed Predictive Models

Malnutrition

Falls

Delirium

Deterioration



Discharge Planning

Malnutrition: Identifying and Evaluating Malnourished Patients

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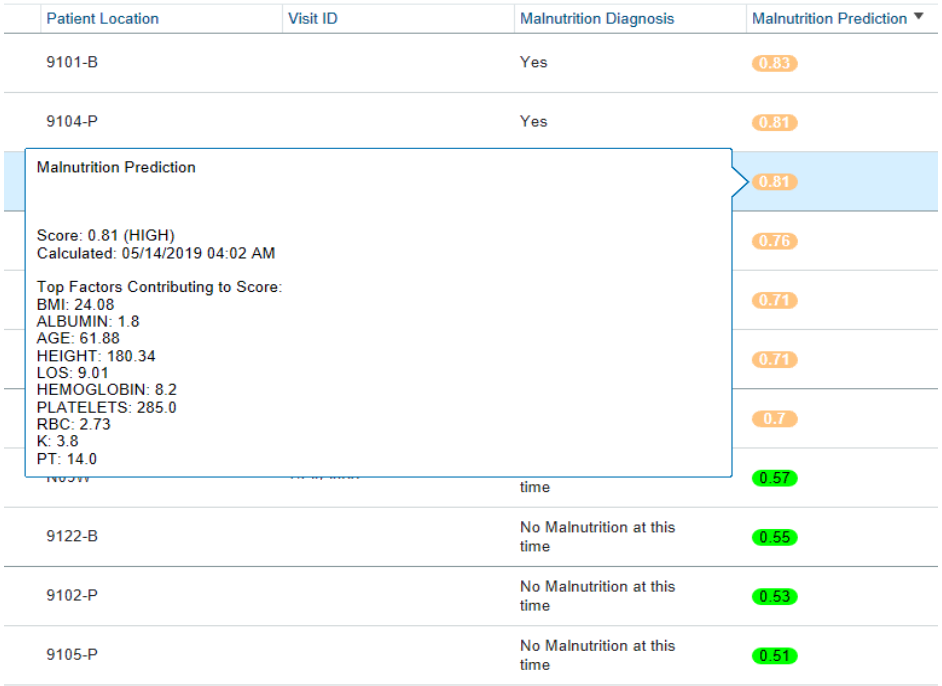
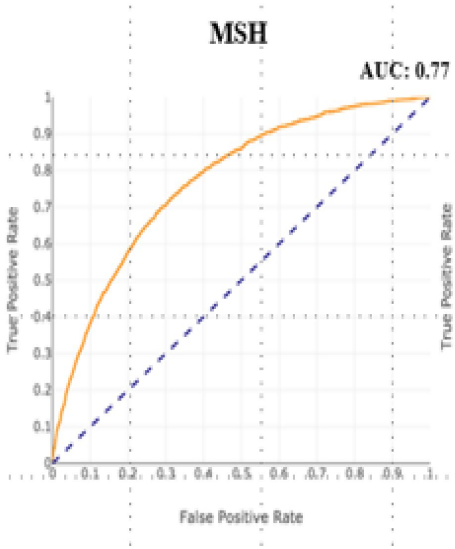
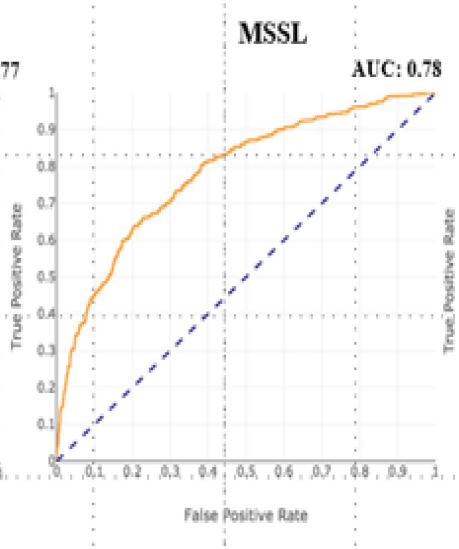
1. **Situation** – Dieticians were missing patients that were malnourished.
   - Patient safety and outcome
   - Operational impacts
   - Financial impacts
2. **Goal** – Better identify patients likely to be malnourished and prioritize seeing them.
3. **Action** – Train a machine learning/AI model to identify malnutrition and deploy in a real-time platform.
4. **Result** – All patients receive daily malnutrition scores. Dieticians evaluate patients with the highest scores.

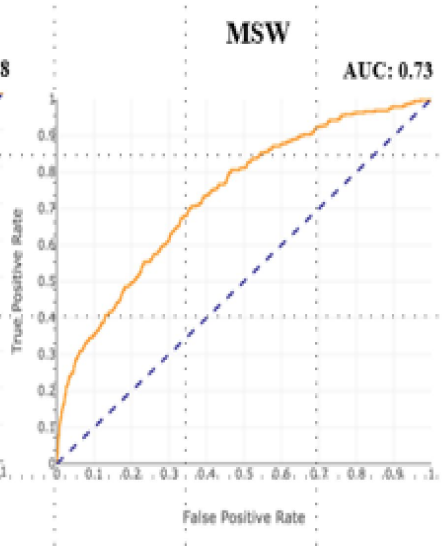


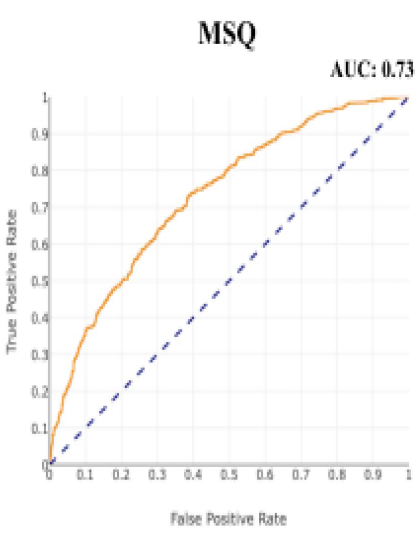
Malnutrition: Consistent Performance Across Hospitals

Facility	Population Size	Threshold	Sensitivity	Specificity	Accuracy	Precision	F1 - Score
MSH	6710	0.53	0.59	0.8	0.75	0.47	0.52
MSSL	1343	0.44	0.71	0.7	0.7	0.53	0.61
MSW	1513	0.4	0.71	0.64	0.65	0.39	0.51
MSQ	1417	0.5	0.67	0.67	0.67	0.5	0.57

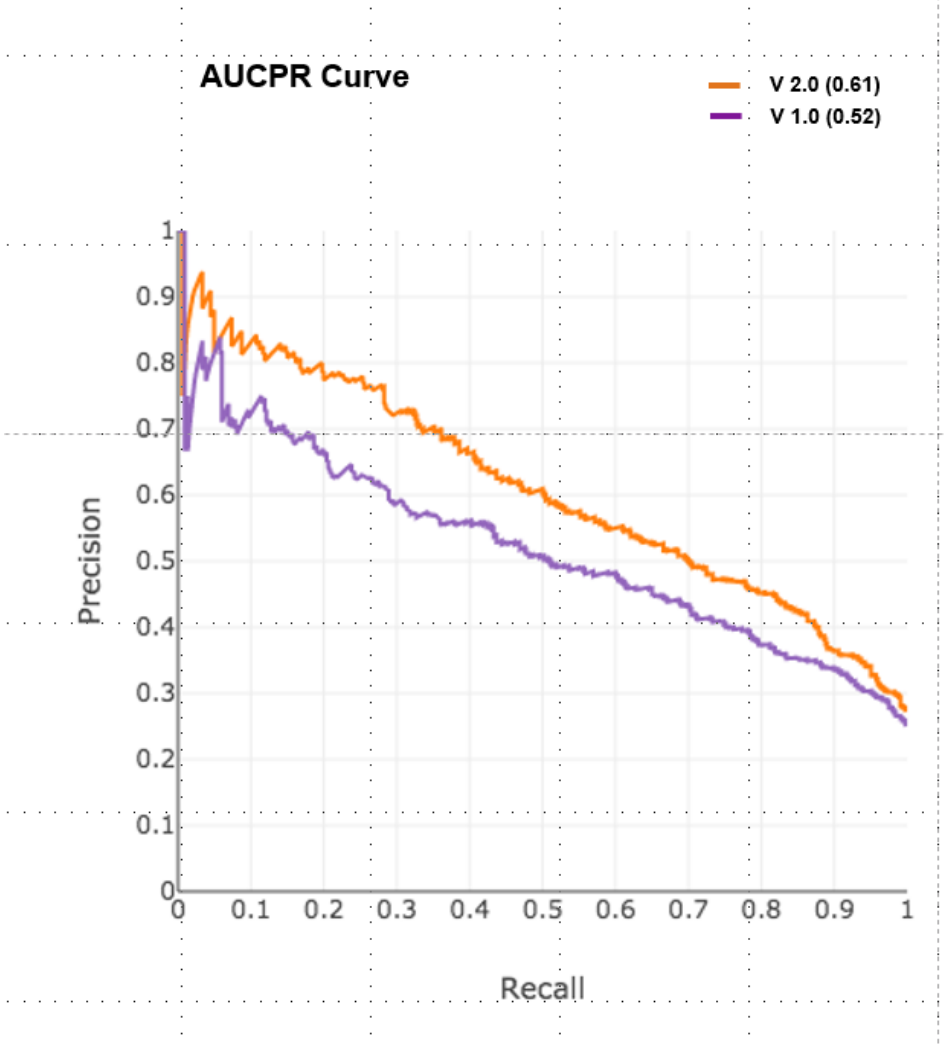


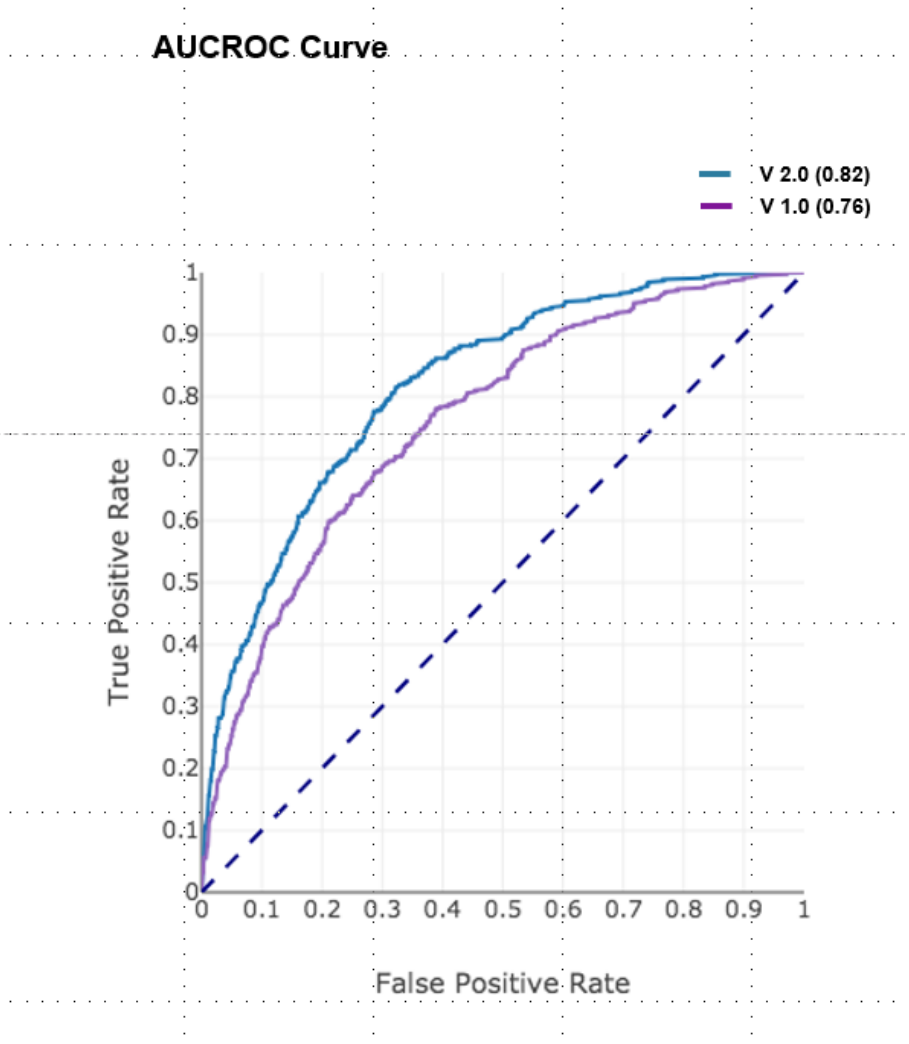




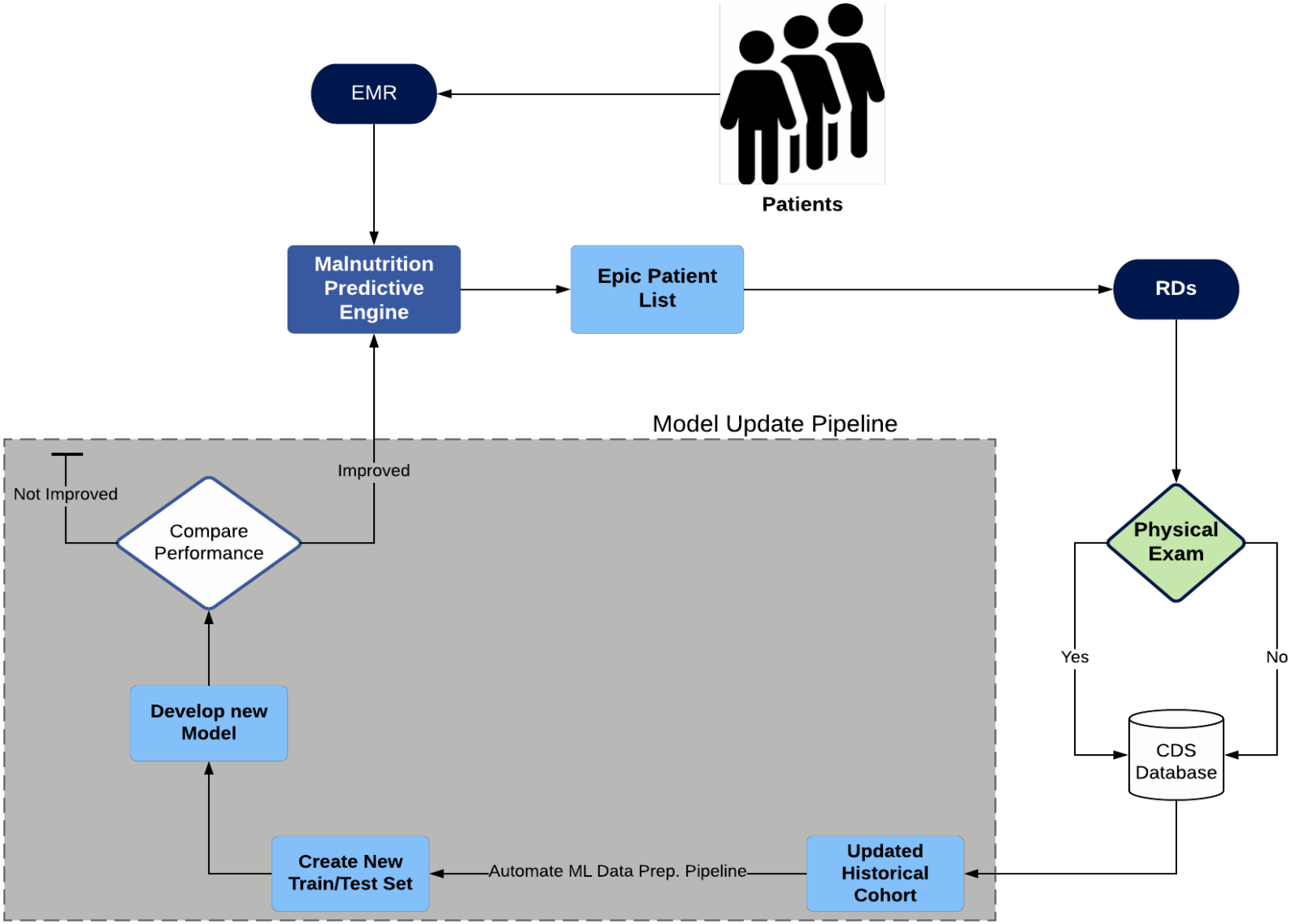


Malnutrition: AI Learning Makes the Model Better





Key Principle to Improve the AI Model: Staff Engagement in Continual Learning



ReSCUE-ME: Preventing Deterioration Before It Happens

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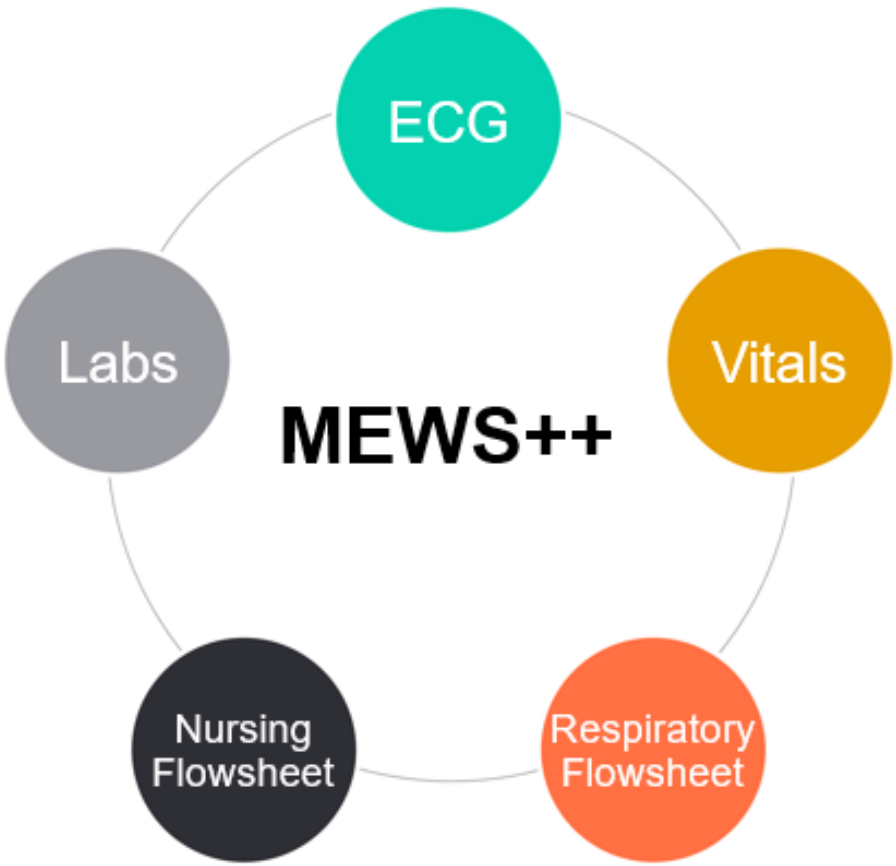
1. **Situation** – Patients sometimes deteriorate clinically, resulting in ICU transfer or even death.

2. **Goal** – Better identify patients likely to deteriorate and notify the primary care team and Rapid Response Team accordingly, **before** they deteriorate

3. **Action** – Train a machine learning/AI model (MEWS++) to identify clinical deterioration and deploy it on the real-time platform. Send text and voice pages to clinicians

4. **Result** – Randomized Controlled Trial (ReSCUE-ME, NCT NCT04026555) performed. Enrolled 2800 patients prior to pandemic



ReSCUE-ME: Smart Clinician Alerts

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Data science platform generates real-time predictions and notifies frontline RN's and MD's

VoIP notifications to frontline RN

Secure text notifications to Rapid Response MD

MEWS+

```
{
  MRN:
  Bed:
  Probability: 0.74
  PULSE: 95.0
  BUN: 32.0
  AGE: 95.23
  SBP: 151.0
  INR: 1.5
  DBP: 72.0
  HEMOGLOBIN: 10.7
  RESP: 19.0
  Na: 140.0
  CREATININE: 1.86
}
```

Stable, overall improved. Bouts of RVR in the setting of Afib. Will suggest medication optimization. No need for upgrade.

Sent

ReSCUE-ME Pilot

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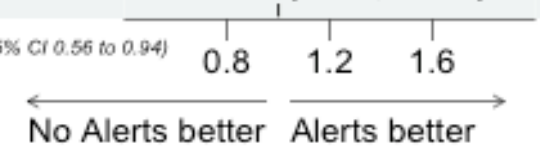
(a)

Pre-specified outcomes	Relative Risk (95% CI)	Adj. p-value
Primary outcome		
Ever escalated	1.22 (0.97 to 1.54)	0.099
Secondary outcomes		
Ever received cardiovascular support orders	1.35 (1.10 to 1.66)	0.007
Survived to Discharge or 30 days*	1.39 (1.06 to 1.79)	0.015

*Equivalent Relative Risk for in-hospital or 30-day mortality 0.72 (95% CI 0.56 to 0.94)



(b)

Ad-hoc outcomes	Hazard Ratio (95% CI)	Adj. p-value
Faster hospital discharge	1.10 (1.01 to 1.19)	0.023
Likelihood of ICU escalation within 12 hours	3.36 (1.38 to 8.21)	0.013
Likelihood of ICU escalation within 24 hours	2.82 (1.37 to 5.81)	0.013

Cardiology Calls to Action

- Cardiologists in partnership to reduce acquisition cost of catheters, rhythm management devices and related supplies
  - Limited number of vendors; Direct vendor negotiation
  - Focus on cardiac rhythm management
- Lead in creating quality- and value-driven improvements
  - Decrease “failure to rescue” with rapid response teams
  - Timely referrals to palliative care for goals of care discussions
  - Partnering in reducing expenses for supplies and labor
  - Helping facilitate 340B opportunity in ambulatory hospital care
    - PCSK9 and other high-cost medications

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Thank You

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