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What's Next? New Health Data Innovations Using Artificial Intelligence, Social Determinants of Health and EHR Metadata

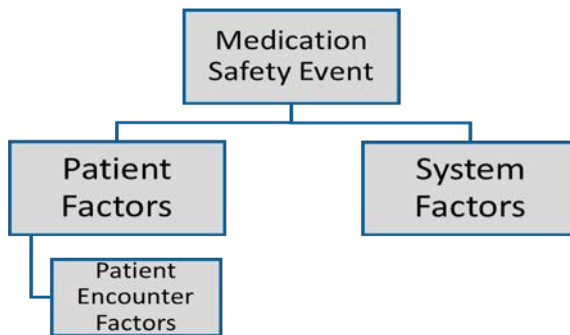
Sybil Klaus MD MPH
Alexandria Case

What's Next?

- **New Health Data Innovations & Research Study Examples:**
 - Types of Data
 - Electronic Health Record Metadata: Medication Safety Events
 - Types of Methods
 - Data Fusion: Rural Health Hospital Closures & Worker Safety
 - Data Reduction: Quality Measures
 - Data Modeling: Health Policy & Social Determinants of Health

Innovation Data Type: Electronic Health Record (EHR) Metadata

- **What Is Metadata?**
- **Are Researchers Using it Today?**
 - “EHR metadata” yielded 33 results
 - “Electronic health record metadata” returned 117 results
- **Example Research Study:**
 - Predict risk of medication safety event: machine learning & rare event logistic regression
 - Demographic, clinical factors, system factors, derived EHR metadata variables



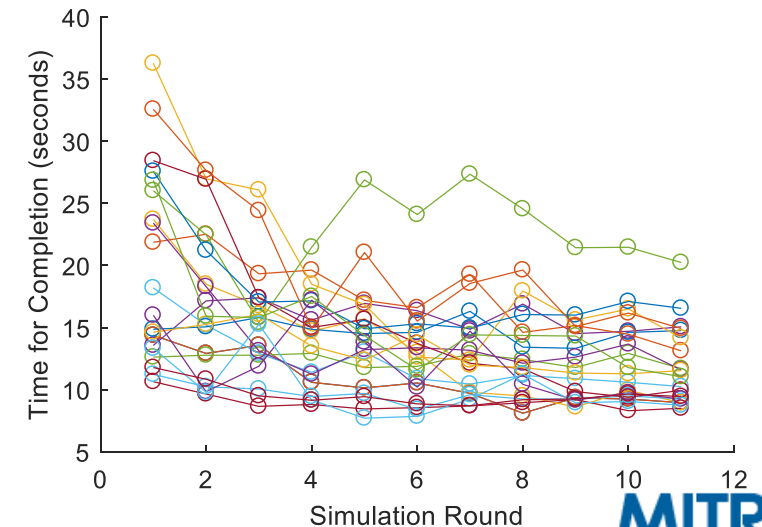
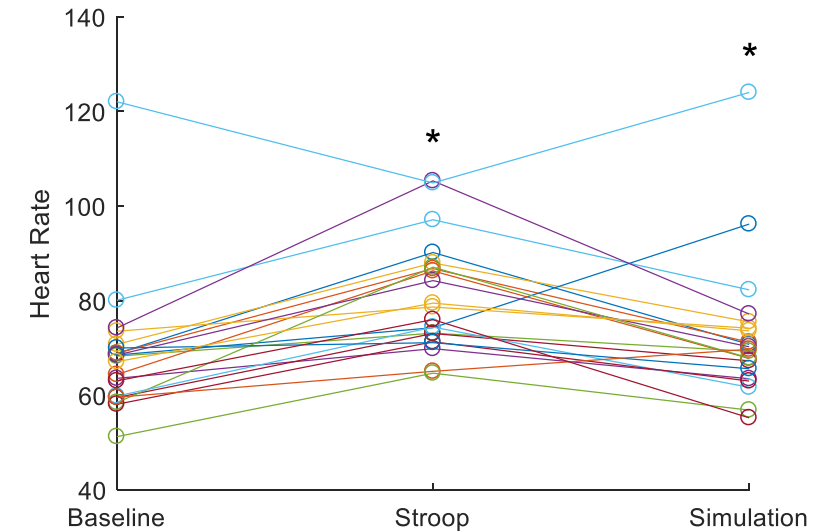
- **Preliminary Results:**
 - The odds of a medication safety event increase 80% with each inpatient day (OR: 1.808, 95% CI: 1.361-2.401, $p < 0.001$)

Model	Algorithm	AUC	Sensitivity	Specificity	Balanced Accuracy
Raw Variables	GBM	0.783	0.336	0.891	0.613
	Random Forest	0.769	0.940	0.973	0.956
Aggregated Variables	GBM	0.778	0.386	0.873	0.629
	Random Forest	0.761	0.256	0.905	0.580

- **Best Practice or Lessons Learned using EHR Metadata**
 - Pair Clinicians & Data Scientists
 - High Technical & Clinical Debt
 - Patient & Systems View

Innovation Methods: Data Fusion to Assess Worker Fatigue and Safety

- **What Is Data Fusion?**
- **Example Research Study:**
 - Fused data combining individual physiologic sensor data, workplace sensors, worker self-reported survey results, and performance measures using multi-modal machine learning.
- **Preliminary Results:**
 - Changes in physiologic data = increased cognitive load
 - Positive correlation between expertise and frustration
- **Best Practice or Lessons Learned:**
 - Complexity of the data
 - Different data unique structure, different bias, different context



Innovation Methods: Data Fusion for Policy Simulation

• Example Research Study

- Rural Hospital Closures: 41% are at risk for closure
- Geospatial and predictive modeling tool
 - View & explore data
 - Location or region
 - Services
 - View & explore measures
 - Closure risk scores
 - Financial Distress Index
 - Access models
 - Policy impact on health outcomes

The screenshot displays the Rural Health Atlas interface. At the top, navigation tabs include 'Rural Health Atlas', 'About RHA', 'Closure Risk', 'Correlation', 'County Info', 'Hospitals', and 'Closure Impact'. The main content area is divided into several sections:

- Select a hospital:** A dropdown menu shows 'Fairfield Memorial Hospital'. Below it, details for the hospital are listed: '102 US-321 Bypass, Winsboro, SC 29180-9251', phone '(803) 635-5548', a 'Website' link, and 'CMS ID: 421302'.
- Nearby Hospitals:** A table lists nearby facilities:

facility_name	street_address	city	trauma
Chester Regional Medical Center	1 Medical Park Dr	Chester	FALSE
Lexington Medical Center	2720 Sunset Blvd	West Columbia	TRUE
Palmetto Health Baptist Parkridge	400 Palmetto Health Pkwy	Columbia	FALSE
Palmetto Health Richland	5 Richland Medical Park Dr	Columbia	TRUE
- Nearby hospitals:** A table lists nearby hospitals with their distance in miles:

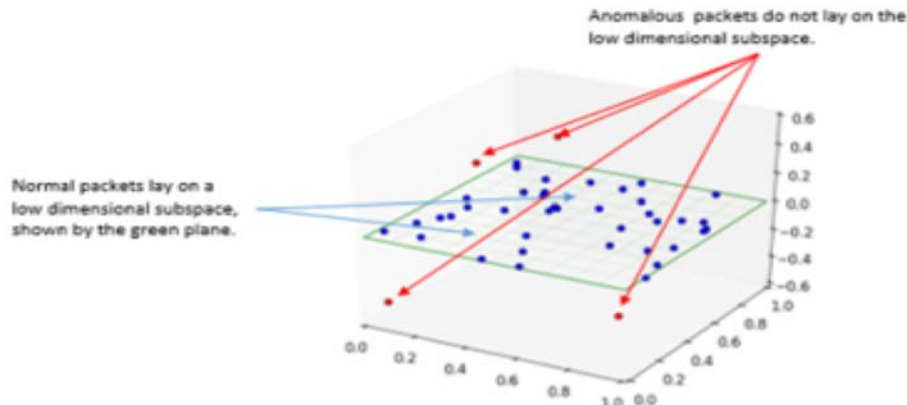
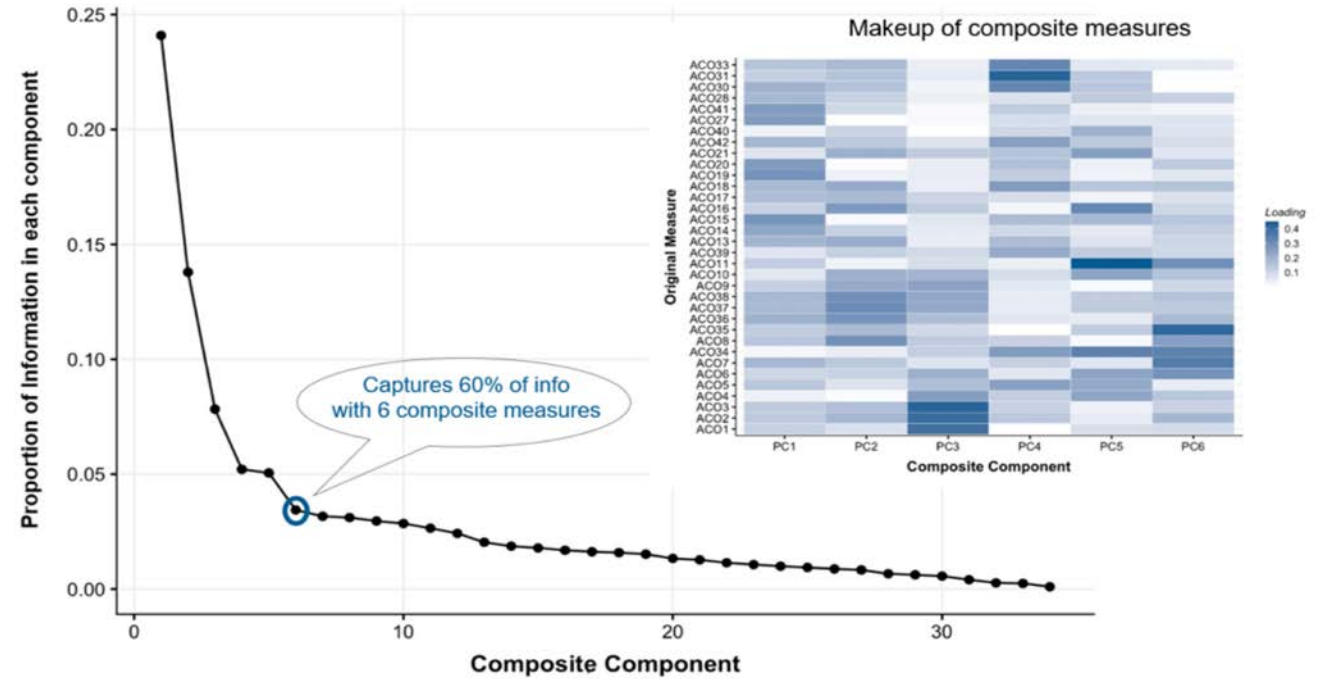
Facility Name	Dist. Mi.
Palmetto Health Baptist Parkridge	19.90
Chester Regional Medical Center	22.00
Palmetto Health Richland	24.00
Providence Health	25.20
Lexington Medical Center	25.30
- Patient Residency:** A map of South Carolina shows the service area for Fairfield Memorial Hospital in red, with surrounding counties in yellow and orange.
- County and DHEC Region:** A map shows the county (Charleston) and DHEC region (Lowcountry).
- Population Trend:** A line graph shows population change from 2010 to 2016, with a peak in 2014.
- Hospitals:** A table lists hospitals in the region:

Facility Name	Trauma Level	Total Beds
Blair Seaward Dr. Francis Hospital	Level 1	204
East Cooper Medical Center	Level 3	130
MUSC Health Medical Center	Level 1	713
Roper Hospital	Level 1	368
Ringer St. Francis Mount Pleasant Hospital	Level 1	85
- County Health Ranking:** A table shows health rankings for various counties:

FIPS	County	Length_Rank	Quality_Rank	Behavior	Clinical_Care	SES_Rank
45013	Beaufort	1	1	1	7	
45035	Dorchester	2	12	3	13	
45019	Charleston	3	5	4	1	
45091	York	4	2	8	32	
45045	Greenville	5	7	2	9	
45063	Lexington	6	3	12	4	
45015	Berkeley	7	8	17	8	

Innovation Methods: Data Reduction in Quality Measures

- **What Is Data Reduction?**
- **Example Research Study:**
 - Identify combinations of quality measures using Principal component analysis
 - Optimize quality measures using robust principal component analysis
 - Prioritize using advanced machine learning algorithms



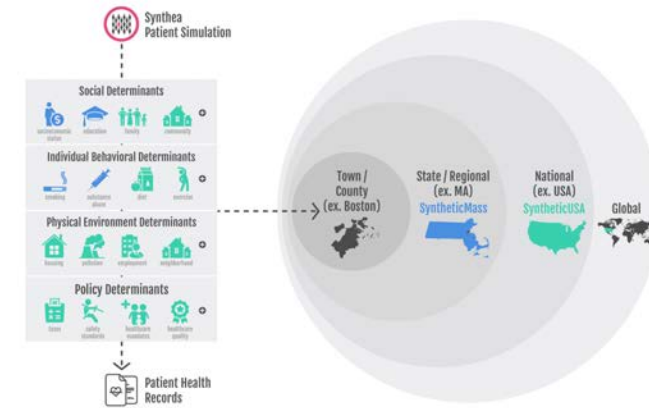
Innovation Methods: Data Modeling: Health Policy & Social Determinants

- **What Is Modeling & Simulation?**
- **Example Research Study:**
 - Model:
 - Social Determinants of Health
 - Healthcare facilities and utilization
 - Insurance coverage and costs
 - Cost to individual and family burden (annual and lifetime)
 - Simulate impact of health policy
 - Characterize health outcomes including Quality Adjusted Life Years (QALY), Disability Adjusted Life Years (DALY), and Quality Measures
- **Best Practice & Lessons Learned:**
 - M&S potential to test solutions without impacting real people and real costs
 - Dream big and aim for useful

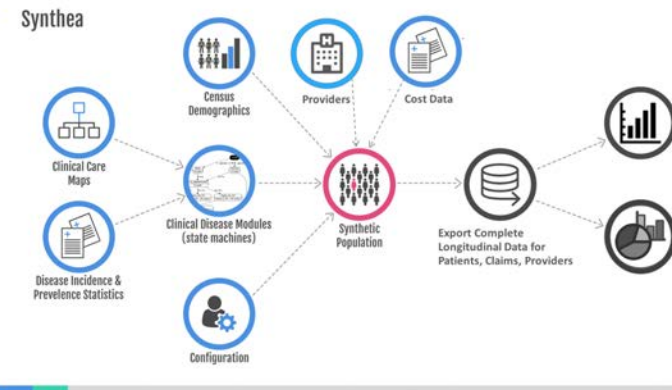
Determinants of Health

Current

- Age
- Gender
- Race/Ethnicity
- Language
- Education
- Occupation
- Income
- Alcohol
- Tobacco
- Drug Use



Synthea Architecture



60,000 ways the human body can fail
Long Tail of Diseases and Global Burden of Diseases (GBD)

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