# Data driven policy for pandemic response: Data, knowledge, and action well outside of the ivory tower

**Jessie Tenenbaum, PhD**
Duke University School of Medicine

**Chief Data Officer,**
**NC Dept of Health and Human Services**

@jessiet1023

**November 3, 2022**

# Disclaimer

“Photo” credit DALL-E

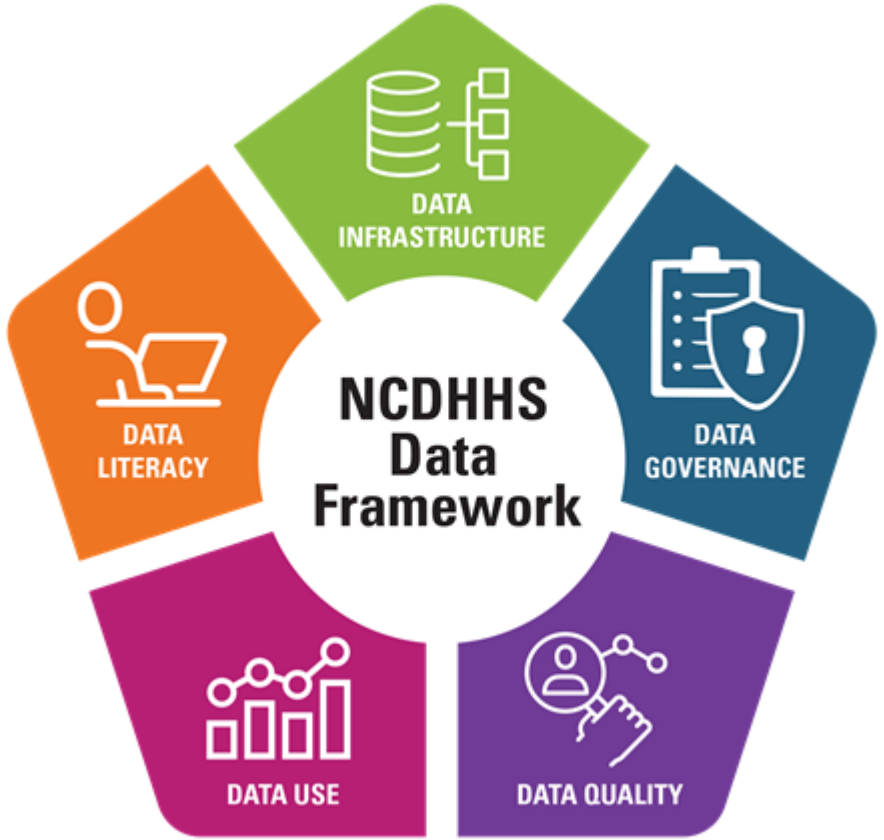
https://labs.openai.com/

NC DEPARTMENT OF
# HEALTH AND HUMAN SERVICES

**https://www.ncdhhs.gov/**

# NCDHHS Data Office

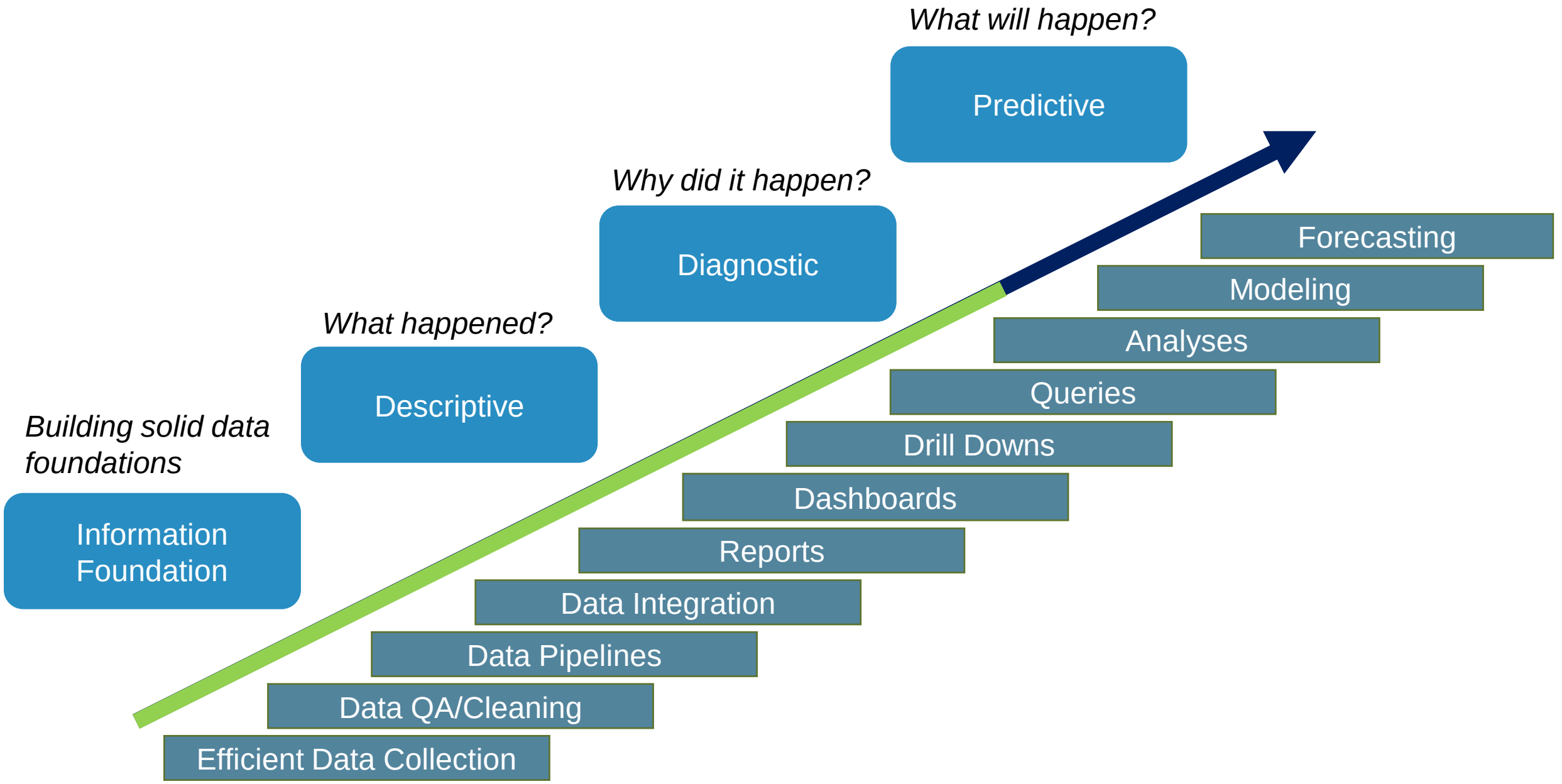
- Established 2019
- Led by Chief Data Officer
- Drive Department-wide cultural transformation
- Data as 1st class citizen, strategic business asset
- Data strategy and roadmap based on 5 data pillars



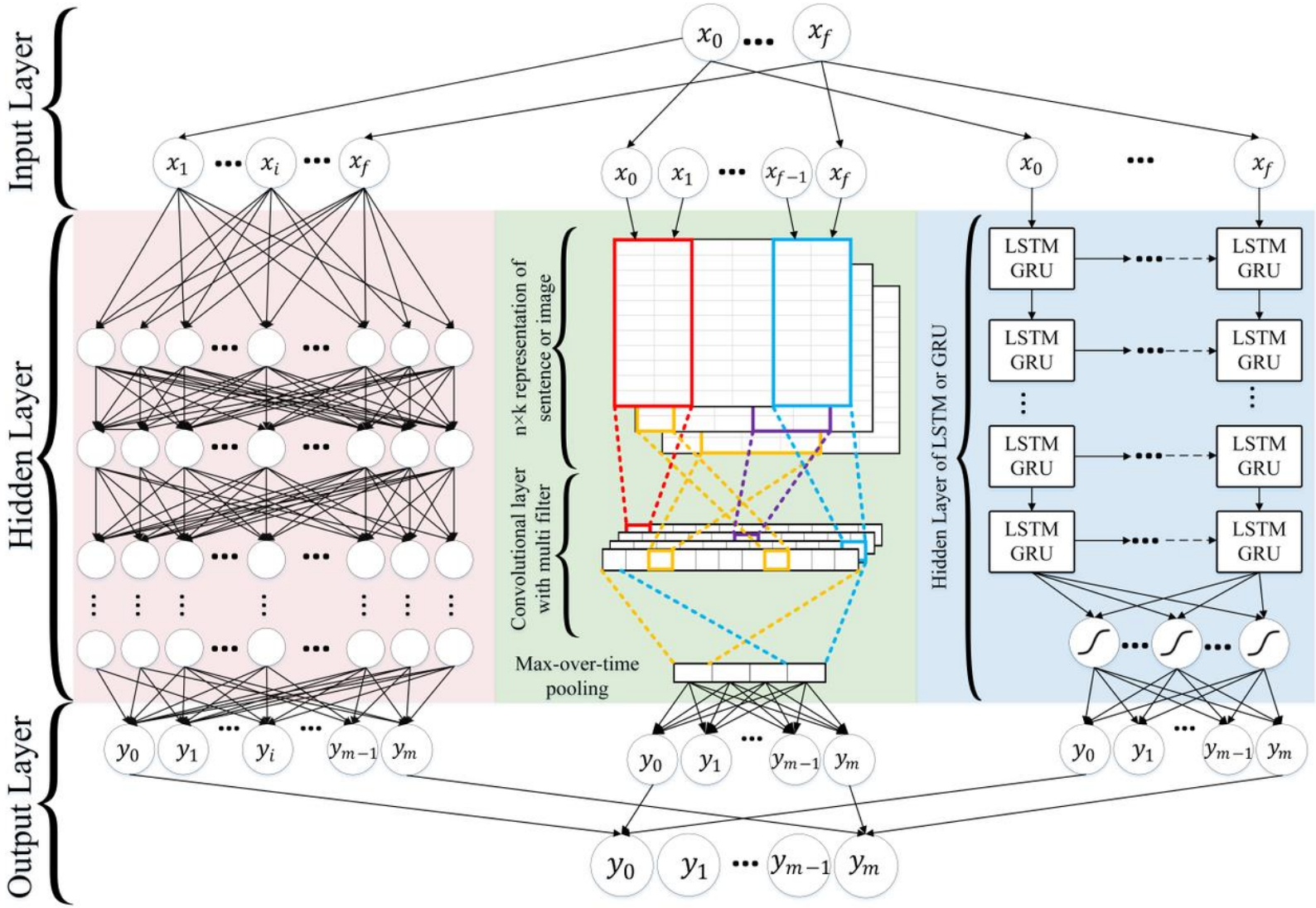
# Data Strategy Framework

- **Data Infrastructure:** Technology used to store, exchange, and access data
- **Data Governance:** People, processes, and technology for data security, management, and access
- **Data Quality:** Tools and processes to ensure data are valid, accurate, and trustworthy
- **Data Literacy:** Workforce training across all levels of baseline knowledge
- **Data Use:** Reports, visualization, and analysis

# Moving from descriptive to predictive



# What academics are focused on



# What most of the world needs

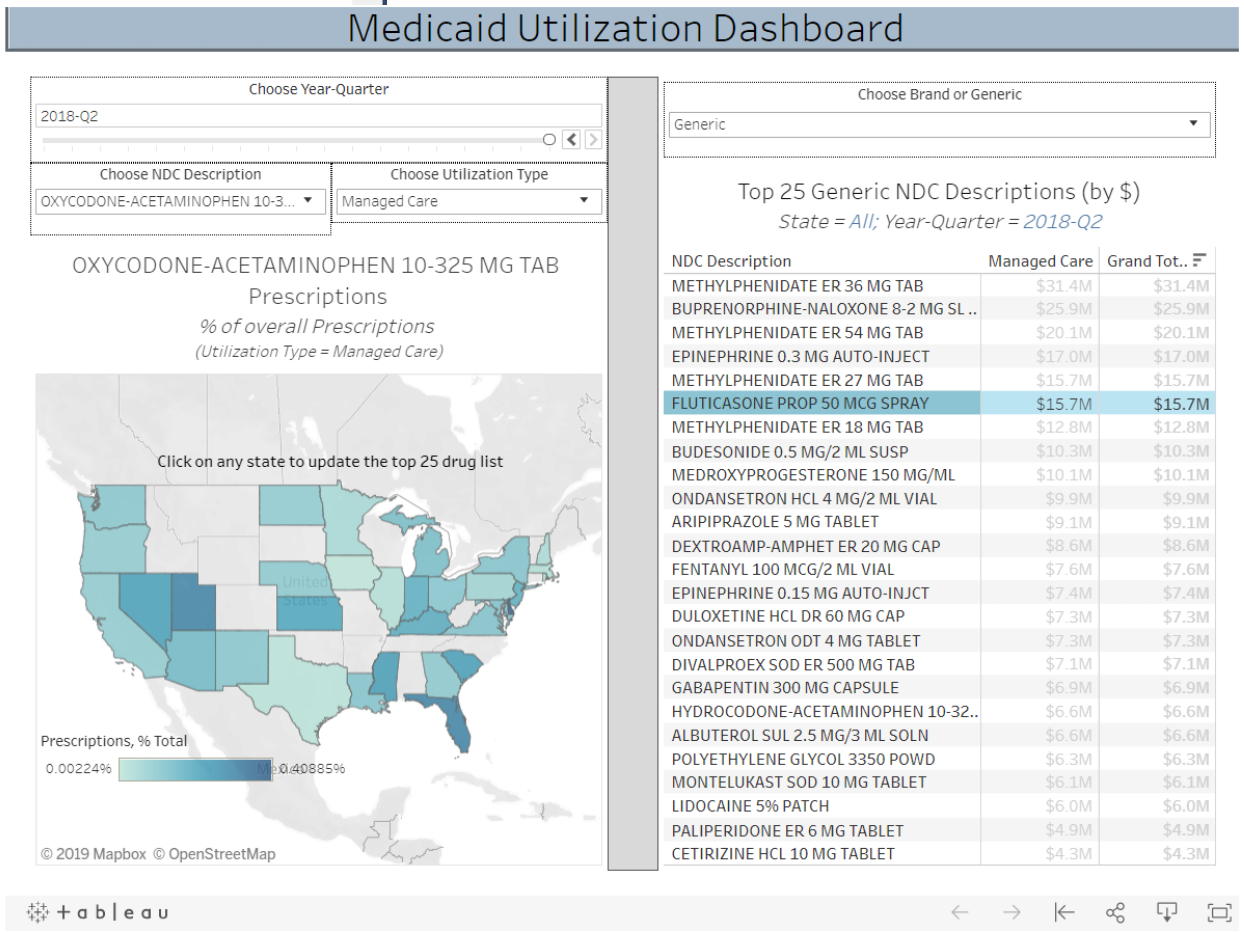
```sql
-- SQL Server Group By Example
USE [SQL Tutorial]
GO
SELECT Education,
    COUNT([EmpID]) AS [Total IDs]
    FROM [Customer]
    GROUP BY Education
```

100 %

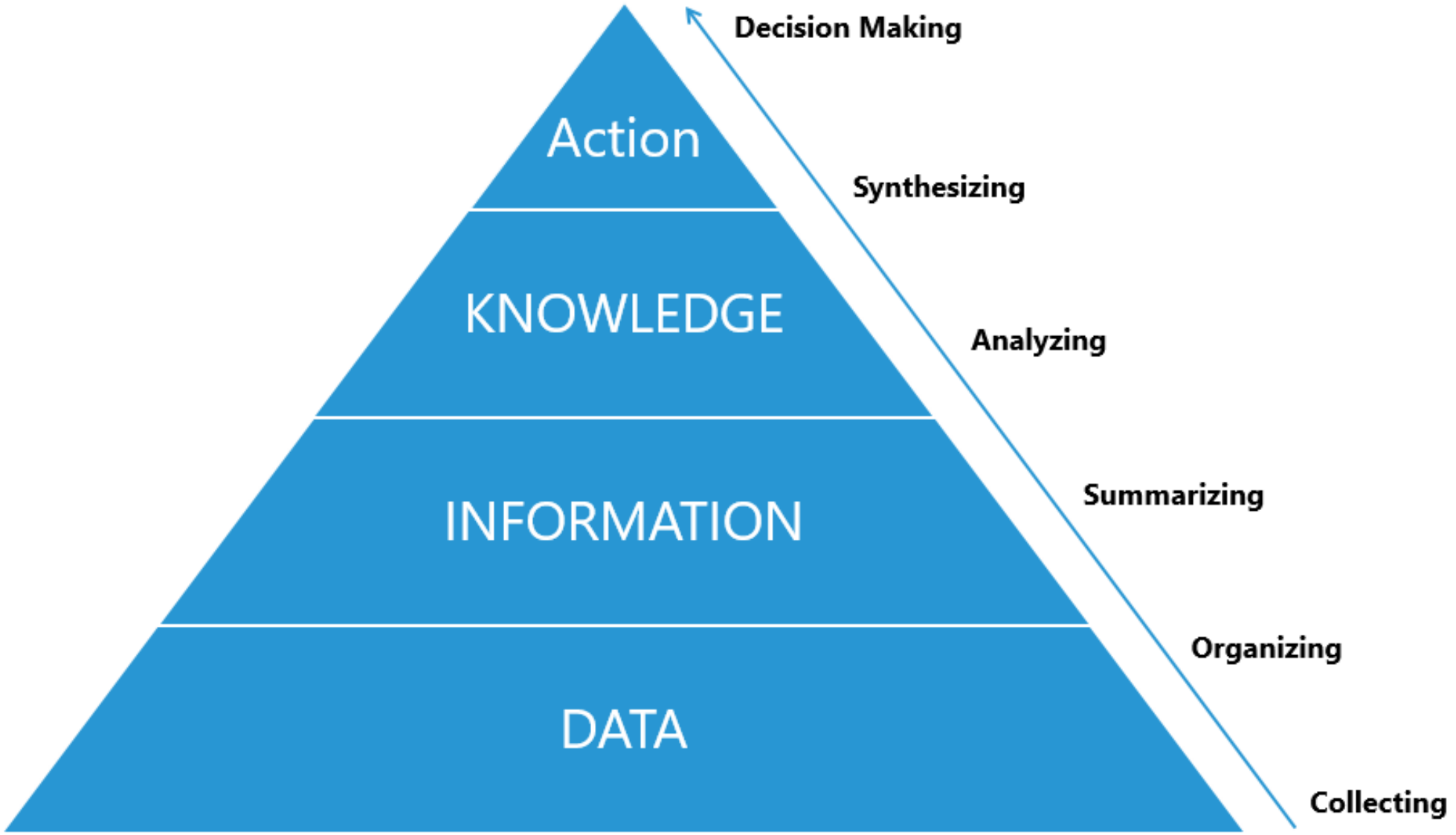
Results | Messages

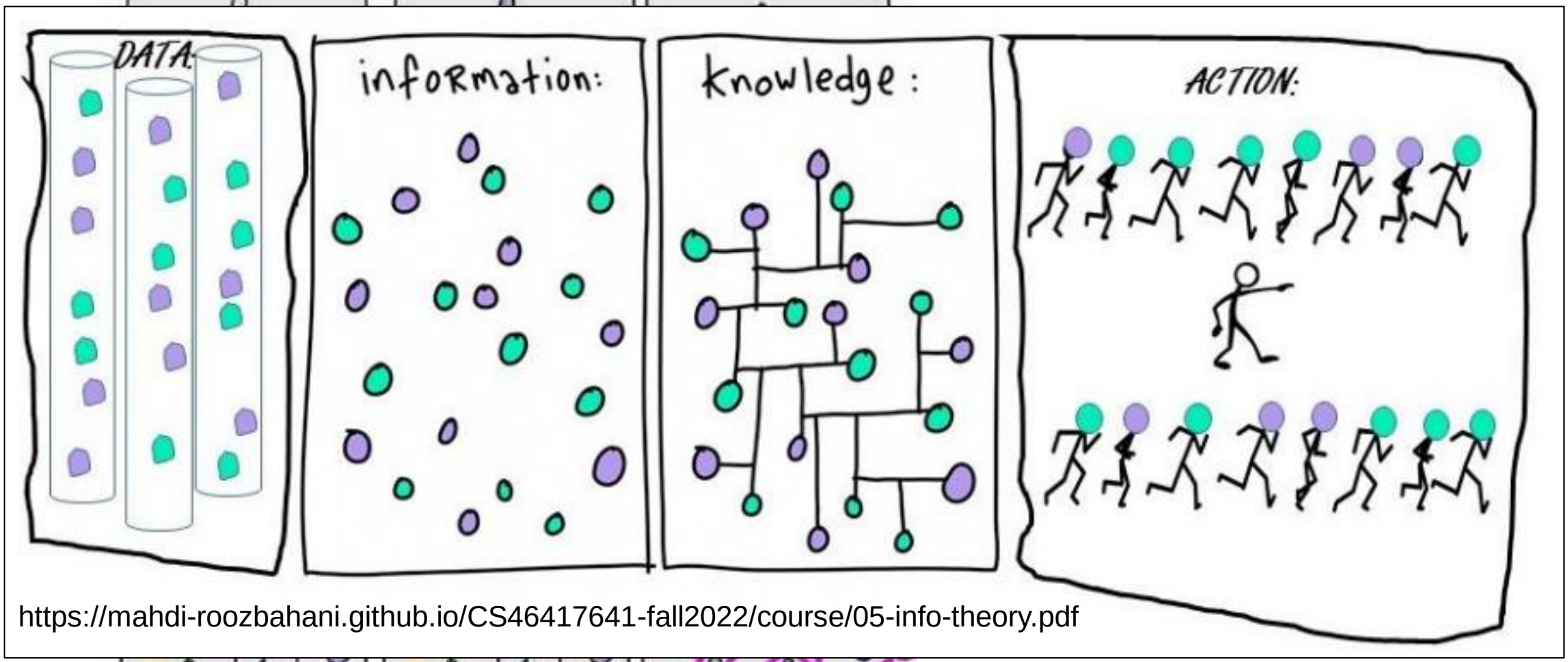
| | Education | Total IDs |
|---|---|---|
| 1 | Bachelors | 4 |
| 2 | Education | 2 |
| 3 | Graduate Degree | 2 |
| 4 | High School | 1 |
| 5 | Masters Degree | 2 |
| 6 | Partial College | 1 |
| 7 | Partial High School | 3 |

Query exec... | PRASAD (12.0 SP1) | PRASAD\sures



# The central dogma of informatics: DIKA





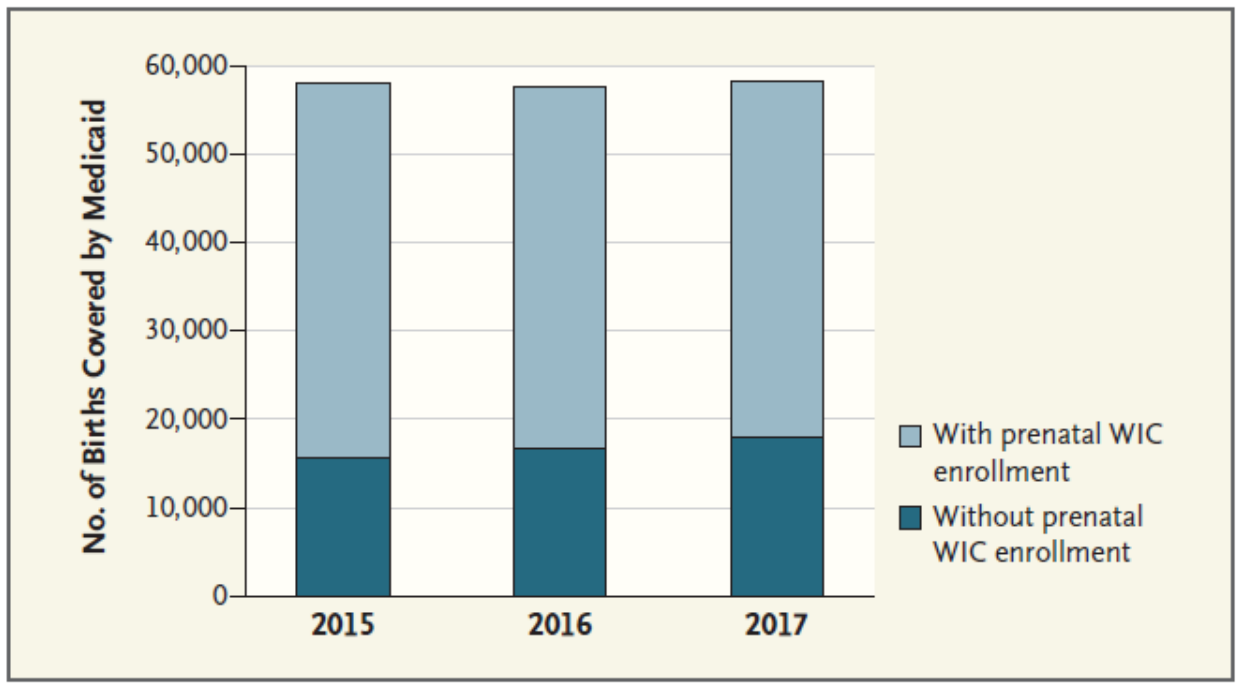

**Original source unknown**

The NEW ENGLAND JOURNAL of MEDICINE

Perspective FREE PREVIEW

# Focusing on Population Health at Scale — Joining Policy and Technology to Improve Health

Aaron McKethan, Ph.D., Seth A. Berkowitz, M.D., M.P.H., and Mandy Cohen, M.D., M.P.H.



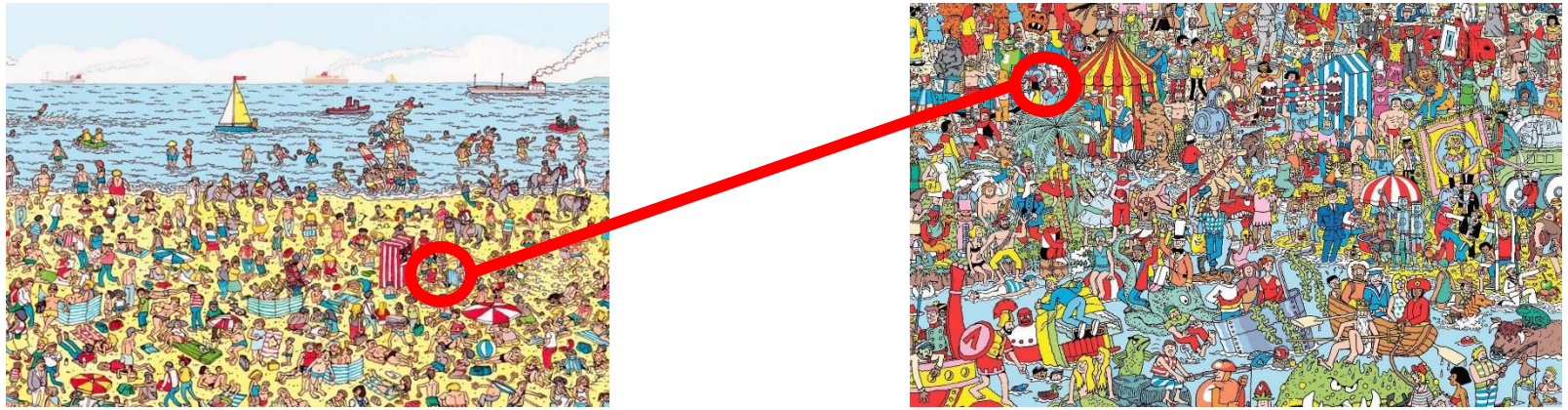

**Medicaid-Covered Births with and without Concurrent Prenatal WIC Enrollment, North Carolina.**

# In order to gain actionable knowledge, need 2 things:

1. **The ability to integrate data between divisional silos (“Data Integration”)**

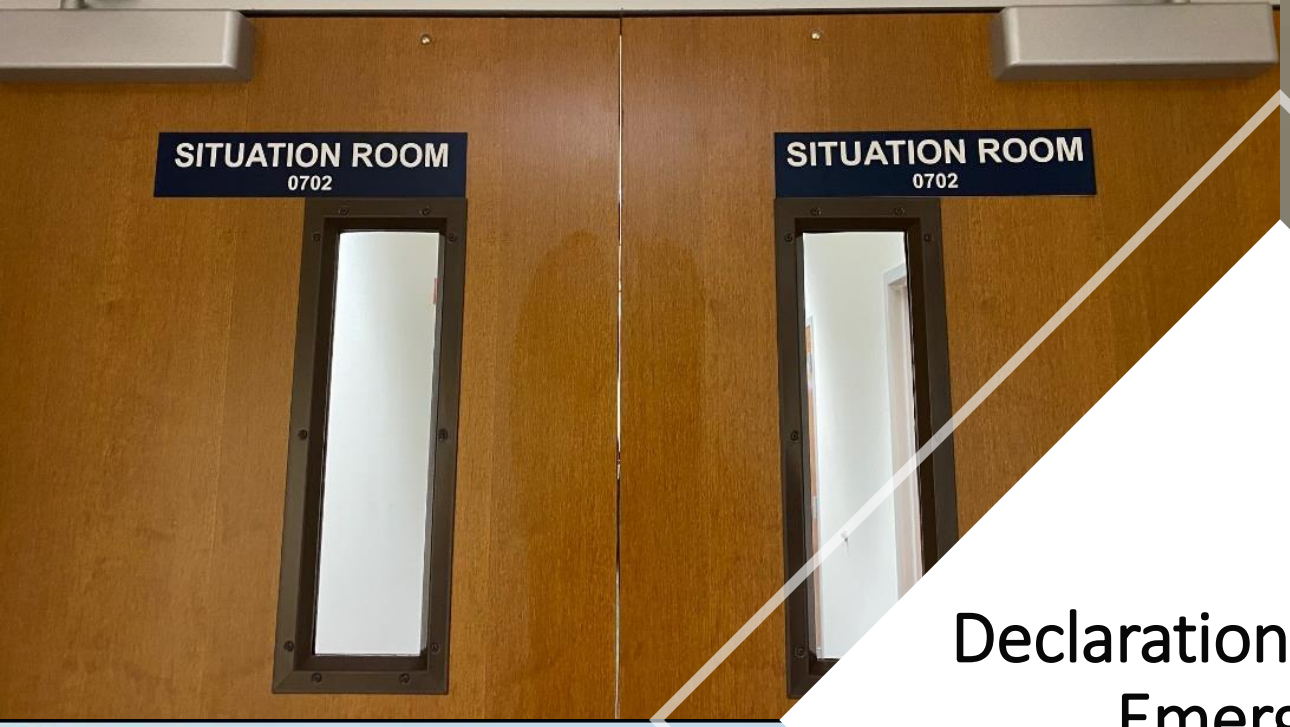
2. **The ability to identify and link the same individual from different datasets (“Entity Resolution”)**

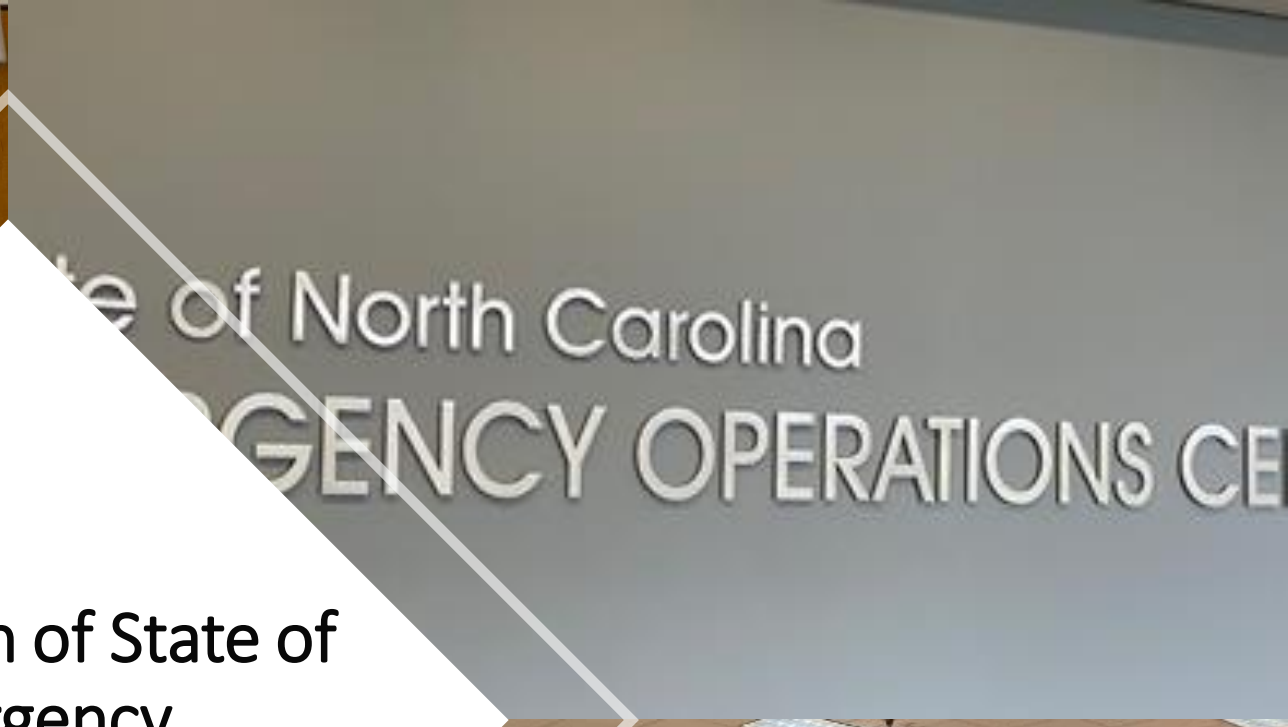
ID: 123456
Name: Waldo



ID: 123456
Name: Waldo

# We interrupt our regularly scheduled Data Office business to bring you…



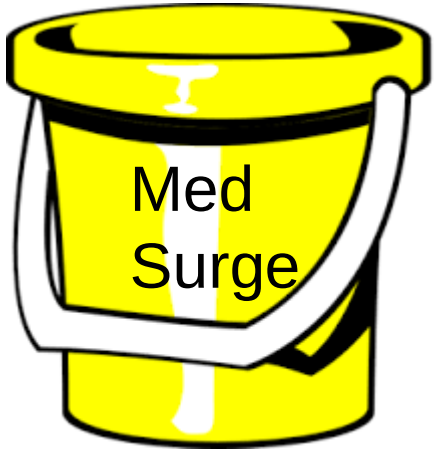

# Declaration of State of Emergency

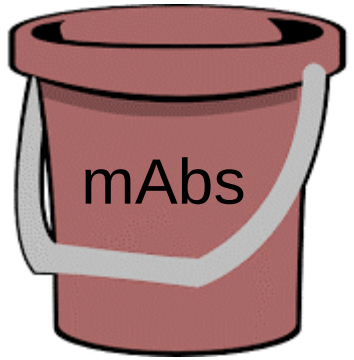
*March 10, 2020*

# Early Actionable Questions to Enable Data Driven Policy

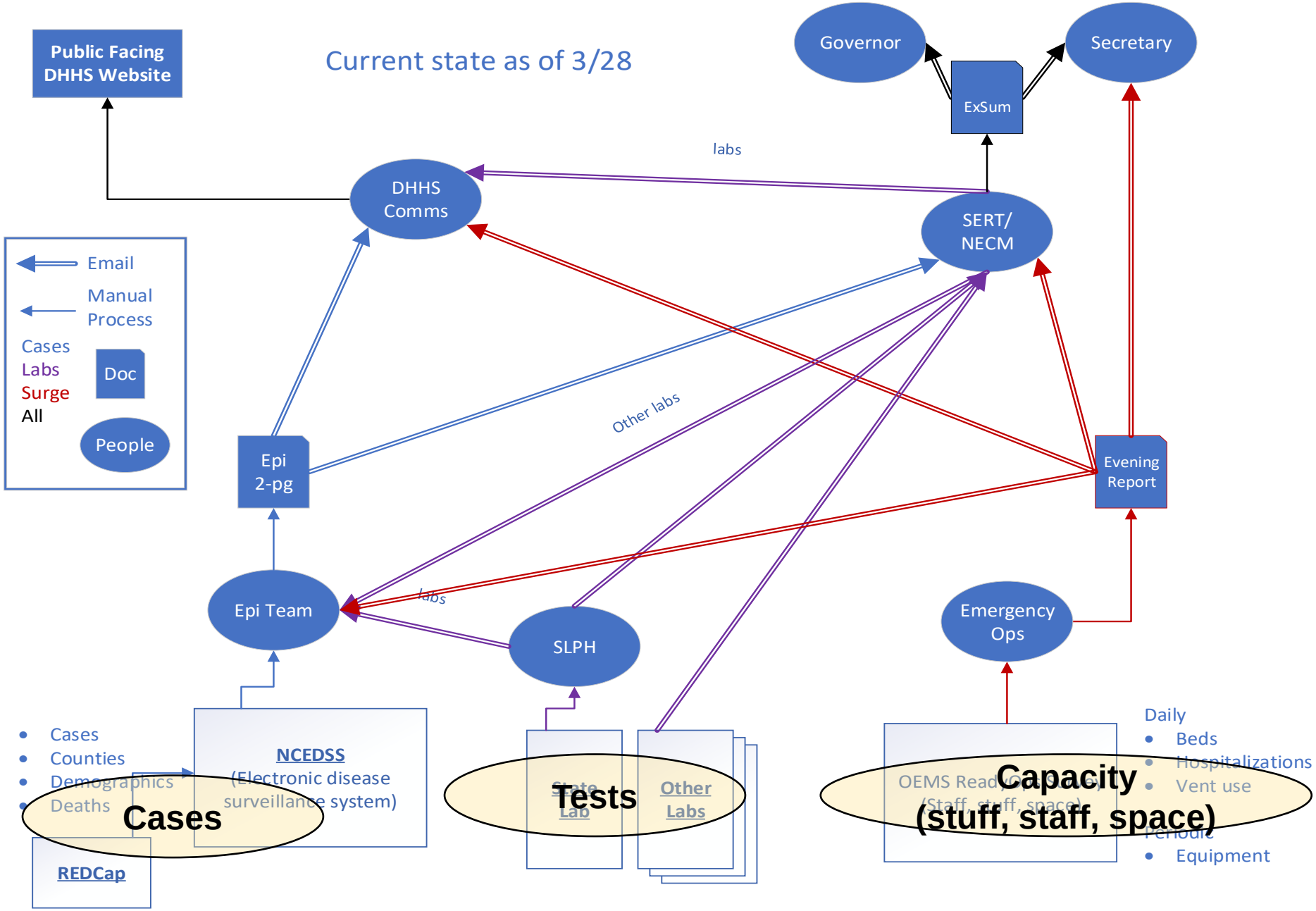
- How many cases will we see? When will our “epi curve” peak?
- How much (extra) PPE is needed, and where can we get it from?
- Will we run out of hospital beds? ICU beds? Ventilators?
- Should we shut down bars and restaurants? Schools? Businesses?
- How can we support families who are unable to work (either because workplace is shut down, or childcare is unavailable)?

# Buckets of NC DHHS COVID-19 Data

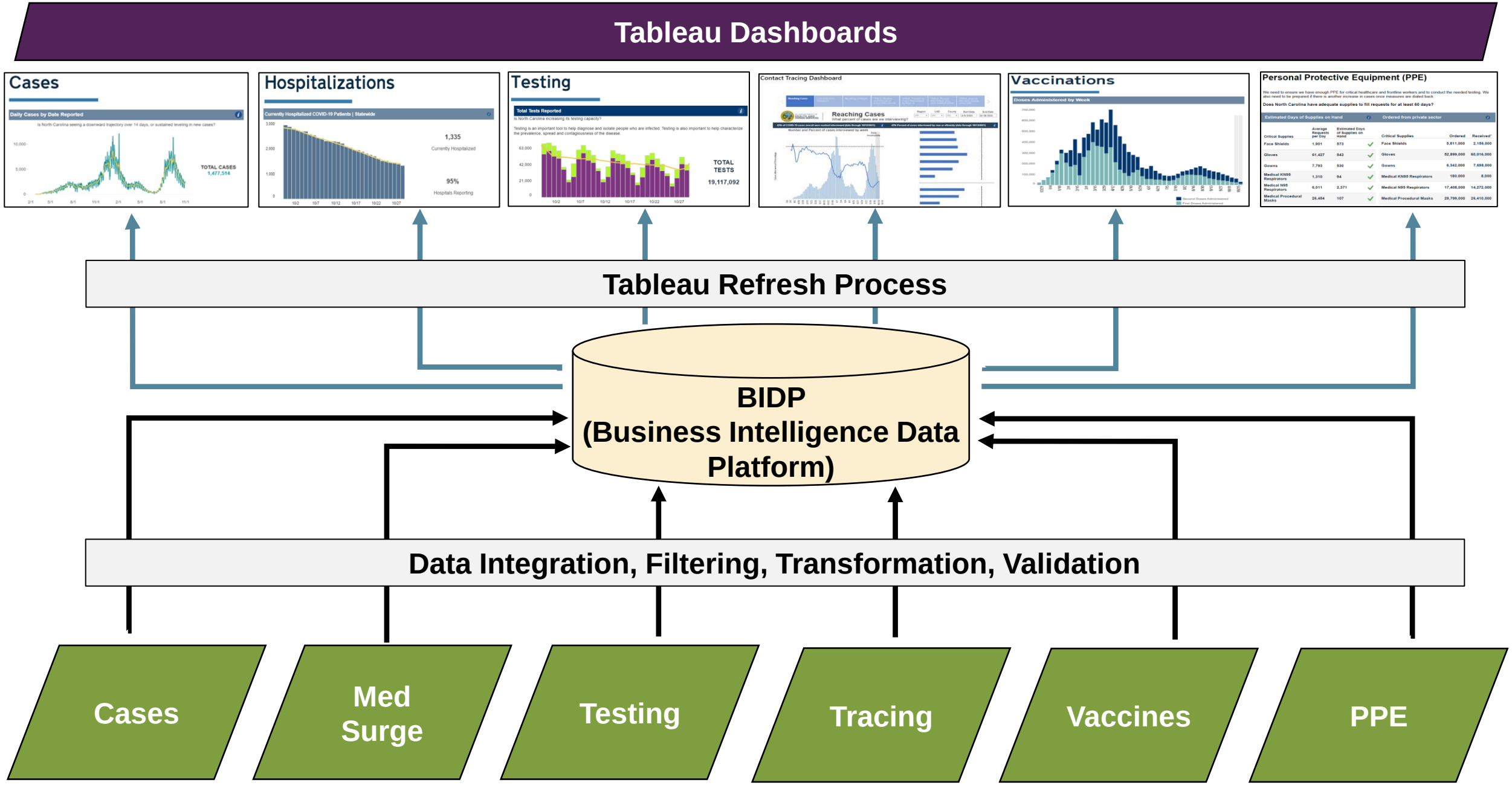


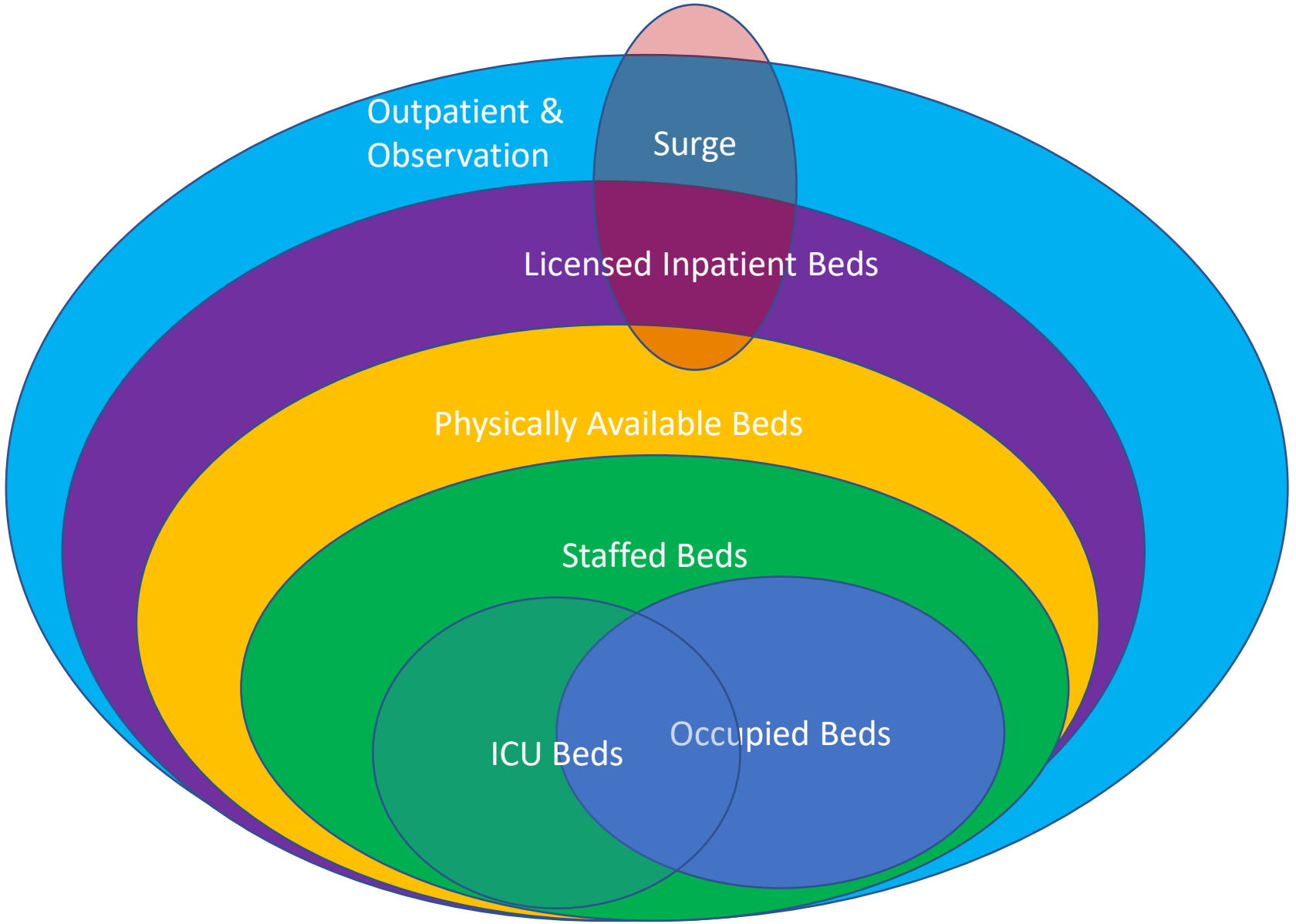


# Baseline Data Flow (as of March 2020)

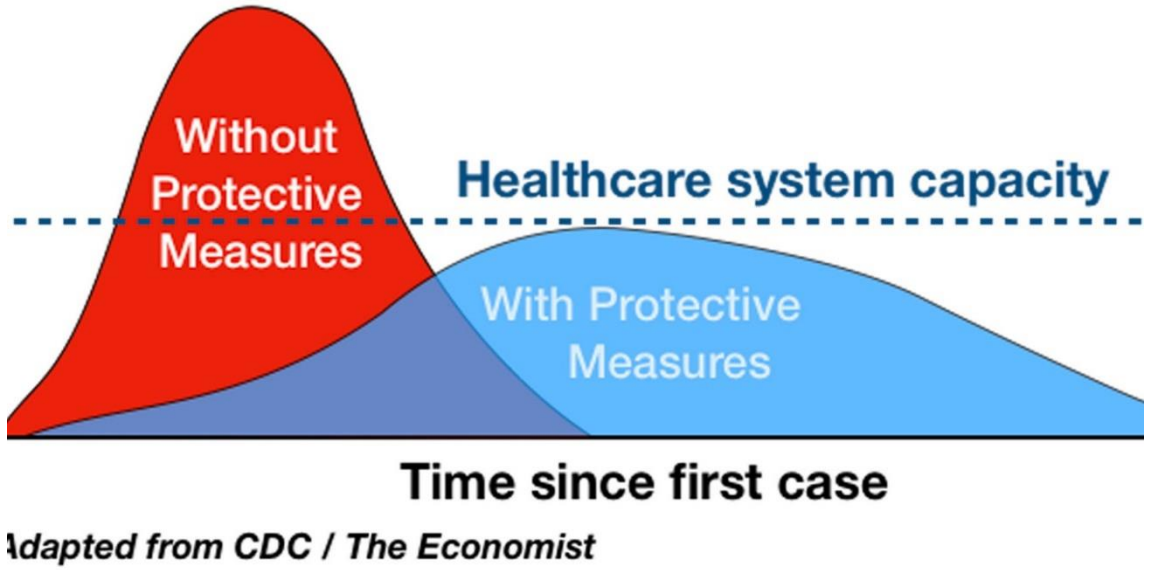


# Today's Data Flow

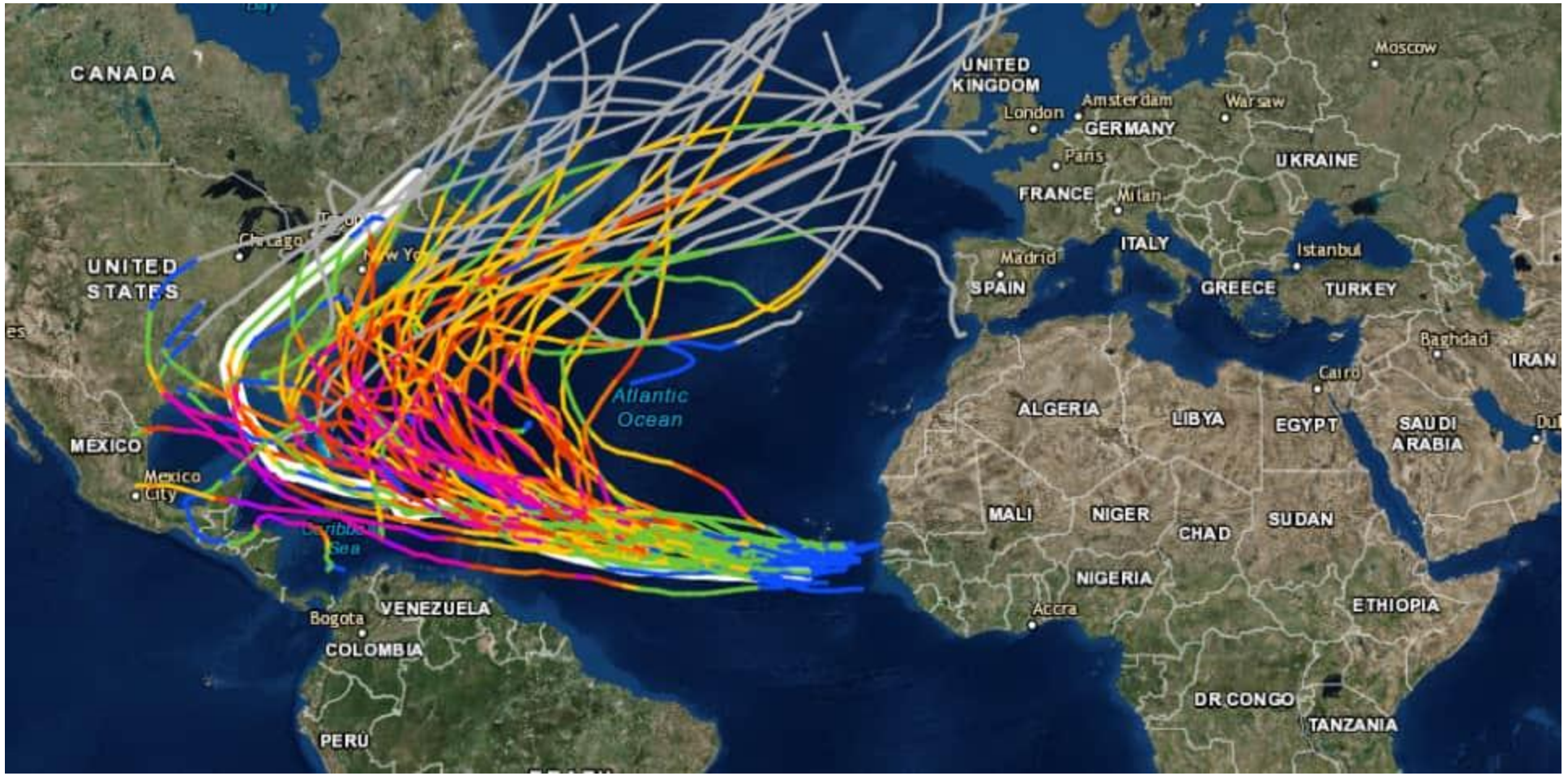



Outpatient &
Observation
Surge
Licensed Inpatient Beds
Physically Available Beds
Staffed Beds
ICU Beds
Occupied Beds

# Data Modeling: Team science at work




Courtesy of Aaron McKethan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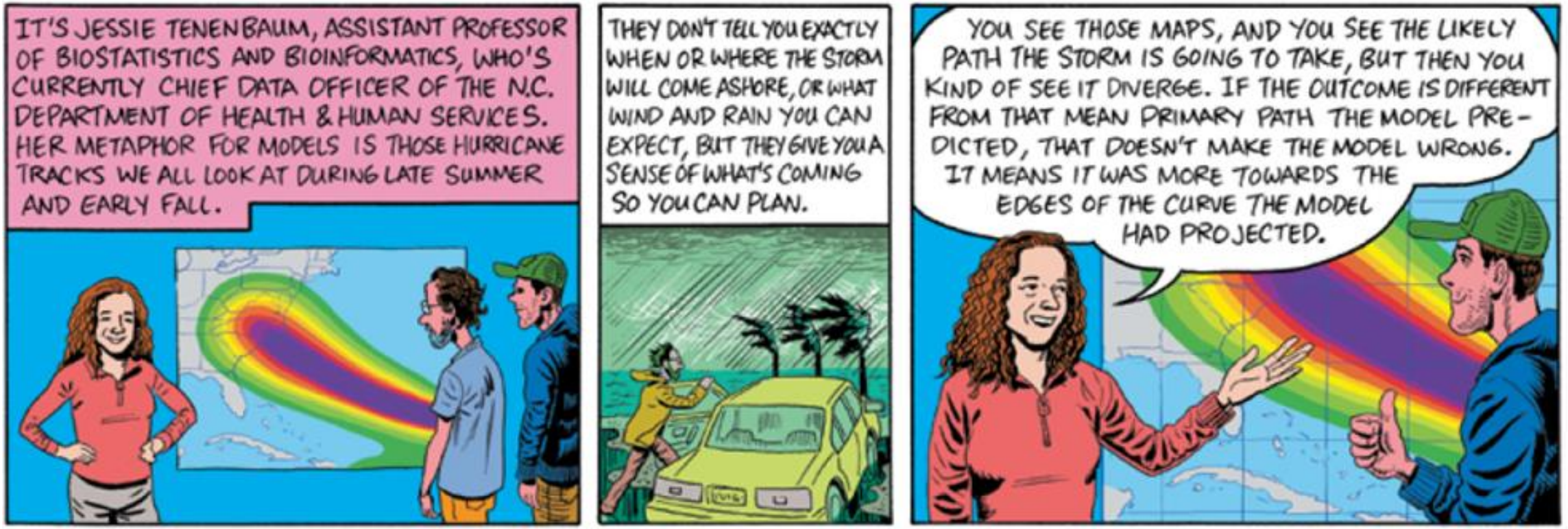



Duke Magazine, Summer 2020

Story by Scott Huler, Illustrations by James Yamasaki

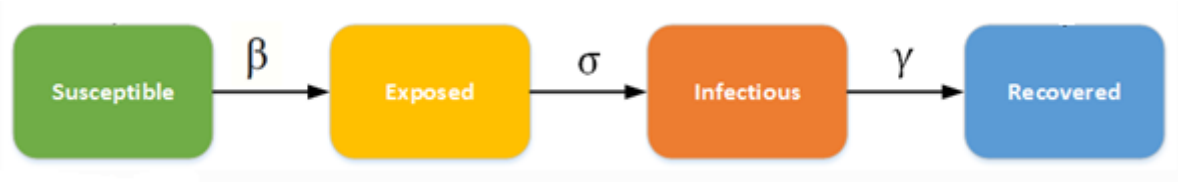
# Geospatially Explicit Agent Based Model (ABM) Framework

- ABM includes ~10.4 million agents
  - Based on the NC synthetic population: Dataset of anonymous synthetic persons and households, located geographically
  - Each agent represents a NC resident and has attributes (e.g., age)
- Each agent's physical location, health status, and life status are simulated daily

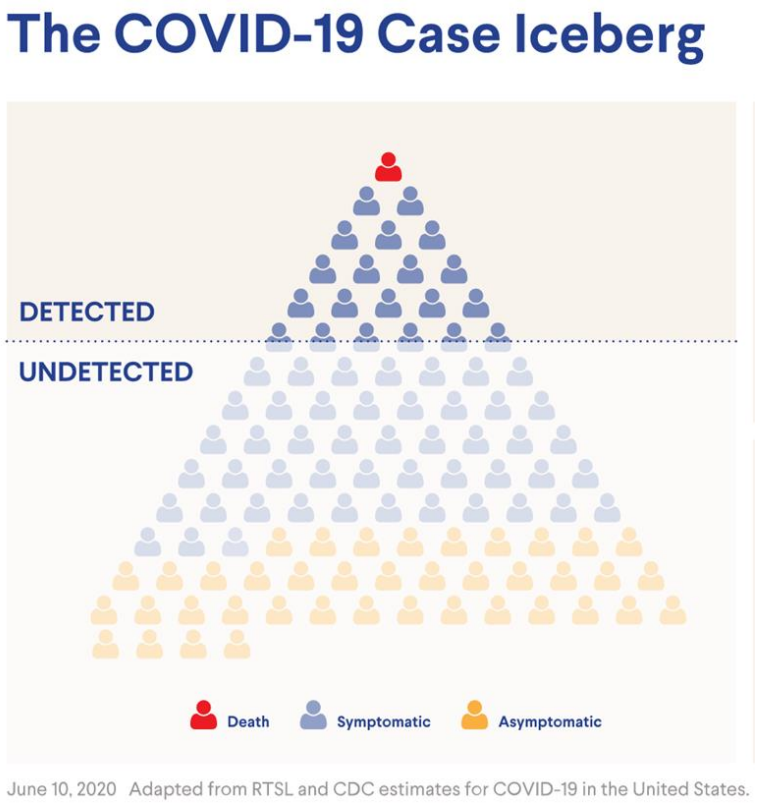
Courtesy of Dr. Sarah Rhea, NC State University & RTI International

# NC County Level SEIR* models

- Predict new SARS-CoV-2 infections for the next 30 days
- Leverage NC county-level reported case data while accounting for unreported infections




*Susceptible-Exposed-Infectious-Recovered Model Diagram
https://institutefordiseasemodeling.github.io/Documentation/malaria/model-seir.html




Source: Prevent Epidemics
https://preventepidemics.org/covid19/science/insights/covid-19-case-iceberg/

Courtesy of Dr. Sarah Rhea, NC State University & RTI International

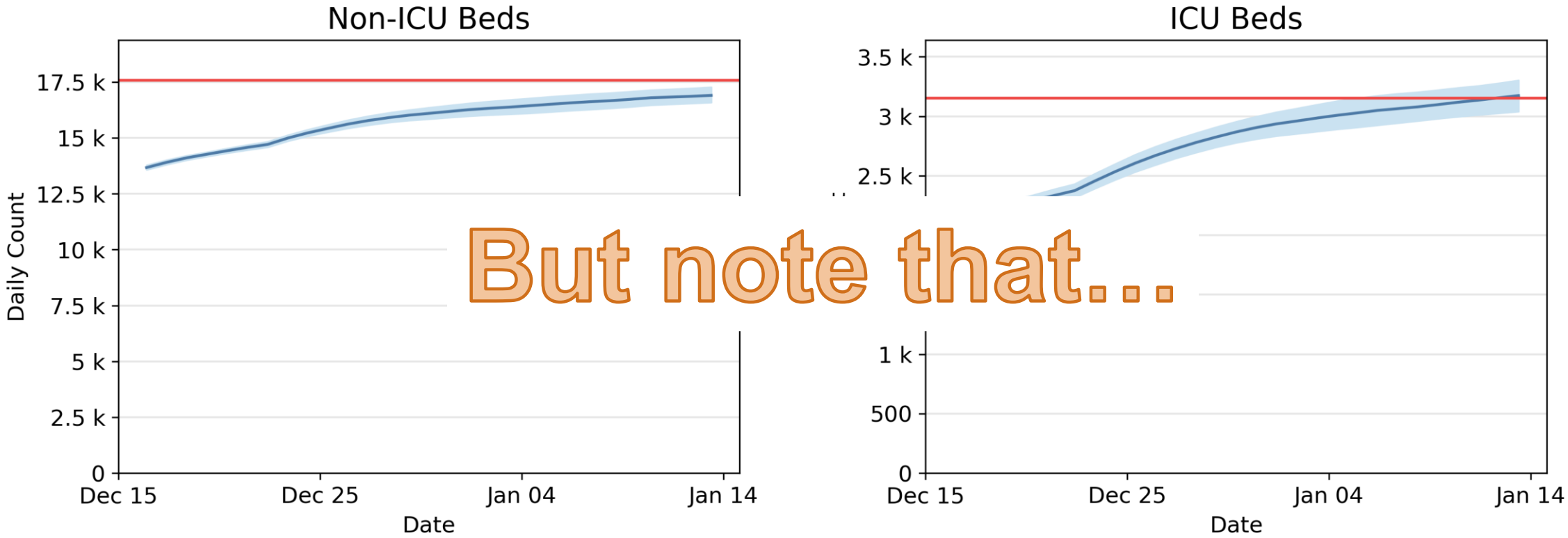
# Model-Projected Patient Demand for Non-ICU & ICU Beds by Day - STATEWIDE

**Statewide**

Model-projected mean number of patients needing a hospital bed on a given day* statewide and by North Carolina flu monitoring region. Modeled scenarios consider an effective reproductive number ($R_e$) range** and a reported cases multiplier to account for unreported/undocumented infections at model initialization and assume 25% of hospitalized patients requiring ICU-level care. Regional demand values are based on the modeled hospitals in each region. See model documentation for additional detail and references.

**$R_e$ = 1.2 - 1.4**

**Updated Dec 17, 2020**




**But note that…**

Light blue area: 25th and 75th percentiles of model output

Red line: Number of non-ICU operational beds or licensed ICU beds, as indicated (per NC DHHS, July 2020); scaled to account for rounding in forecasts

Parameter values and assumptions are subject to change as knowledge of COVID-19 evolves

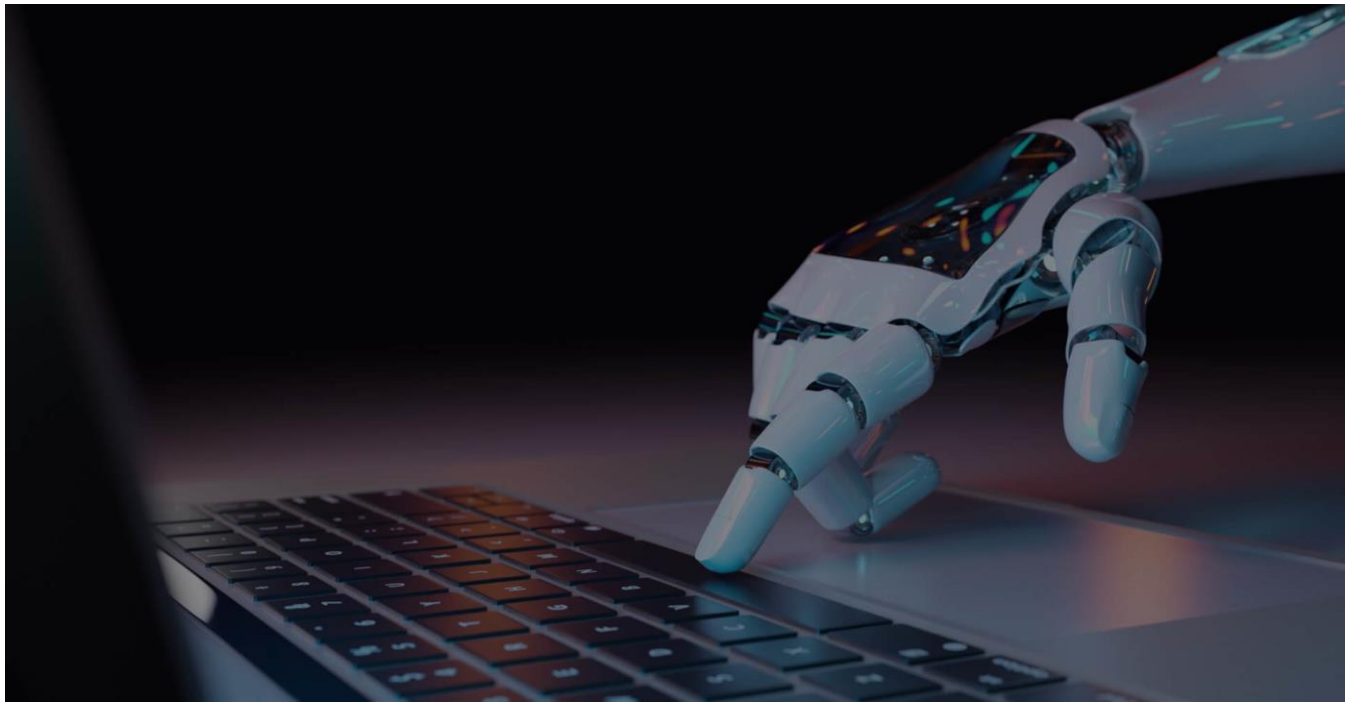
*Based on 100 model runs and using a sample of 2.5 million agents for each run, with results scaled to the 10.4 million agents representing the North Carolina population

**$R_e$ ranges are sampled from a uniform distribution

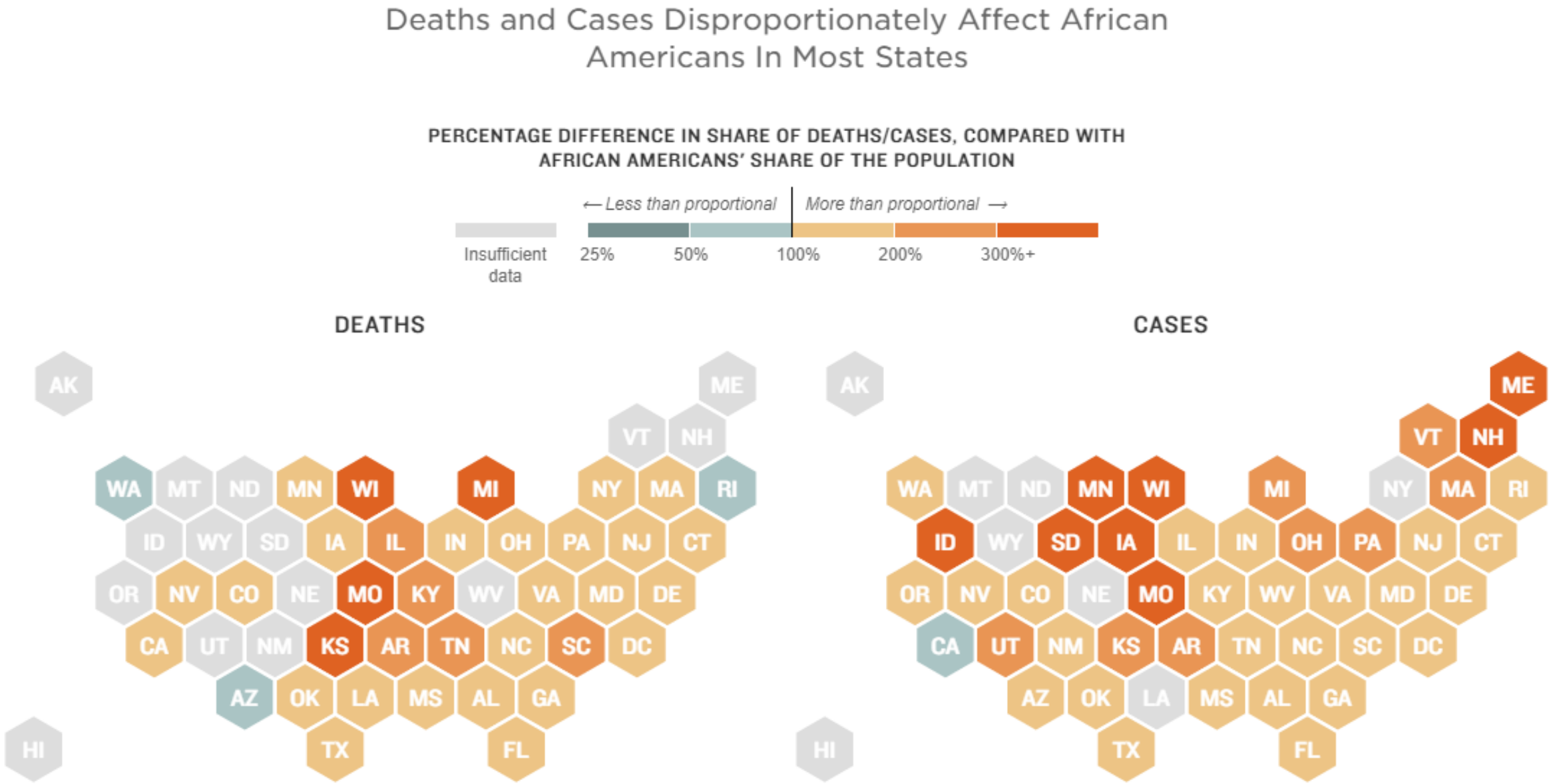
Dr. Sarah Rhea,
NC State University & RTI International

# Notable Exception where AI has proven useful in Public Health

- RPA: Robotic Process Automation
- Software to perform mindless human tasks, often to make up for poorly designed and/or non-interoperable systems



# COVID disproportionately impacted historically marginalized populations



# You can’t improve what you can’t measure

- What is the distribution of race/ethnicity among
  - COVID-19 cases?
  - COVID-19 deaths?
  - People tested for COVID-19?
  - People vaccinated against COVID-19?

Bloomberg

Prognosis

**One U.S. State's Laser Focus on Data Helps Shrink Racial Vaccine Gap**

North Carolina has racial data for 99.6% of people who got a shot in the state

By Angelica LaVito
March 6, 2021, 8:30 AM EST



A health-care worker puts a bandage on man after he received the Moderna Covid-19 vaccine at the Durham County Department of Public Health in Durham, N.C., on Jan. 8. *Photographer: Julia Wall/The News & Observer via AP*

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IG
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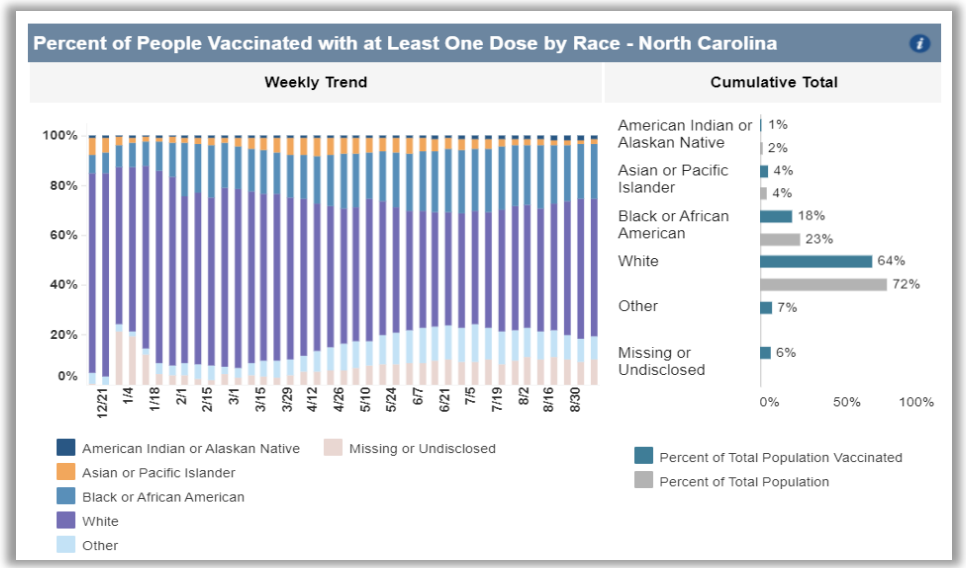
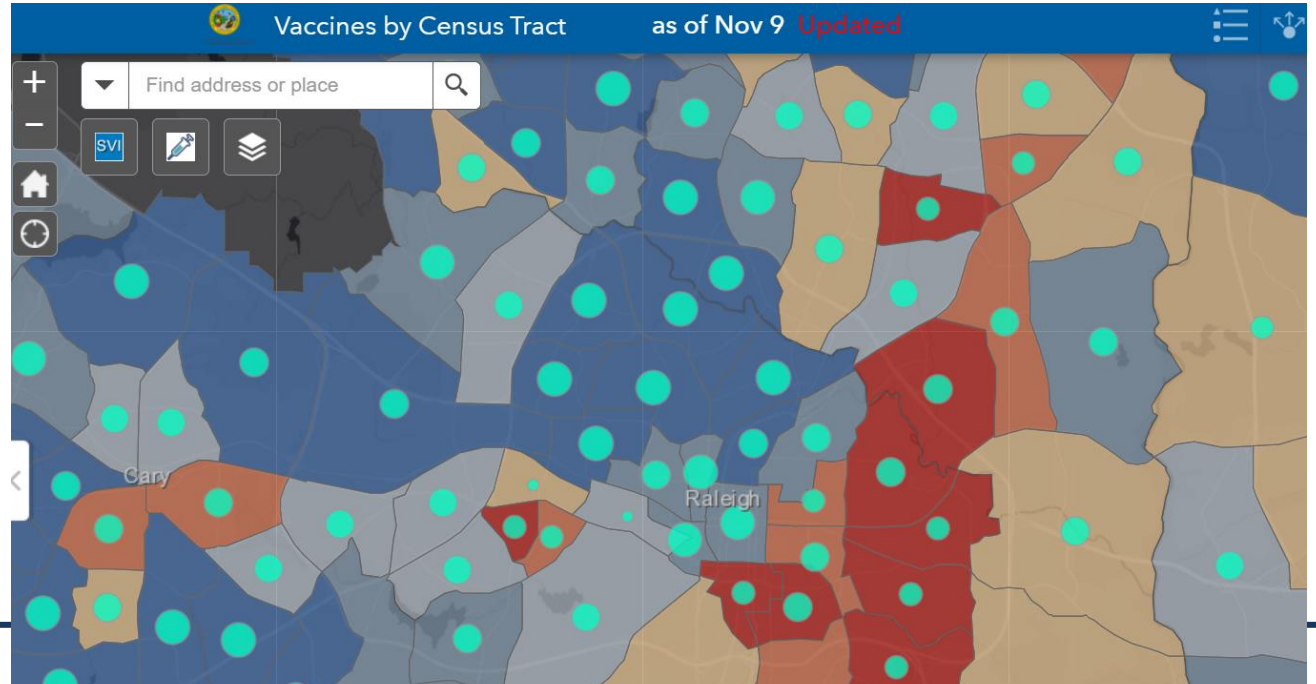
Forex trading involves risk. Losses can exceed deposits.

# NC Leads the Country in Collecting Equity Data

- Data tools built to infuse equity data insights across entire vaccine operation

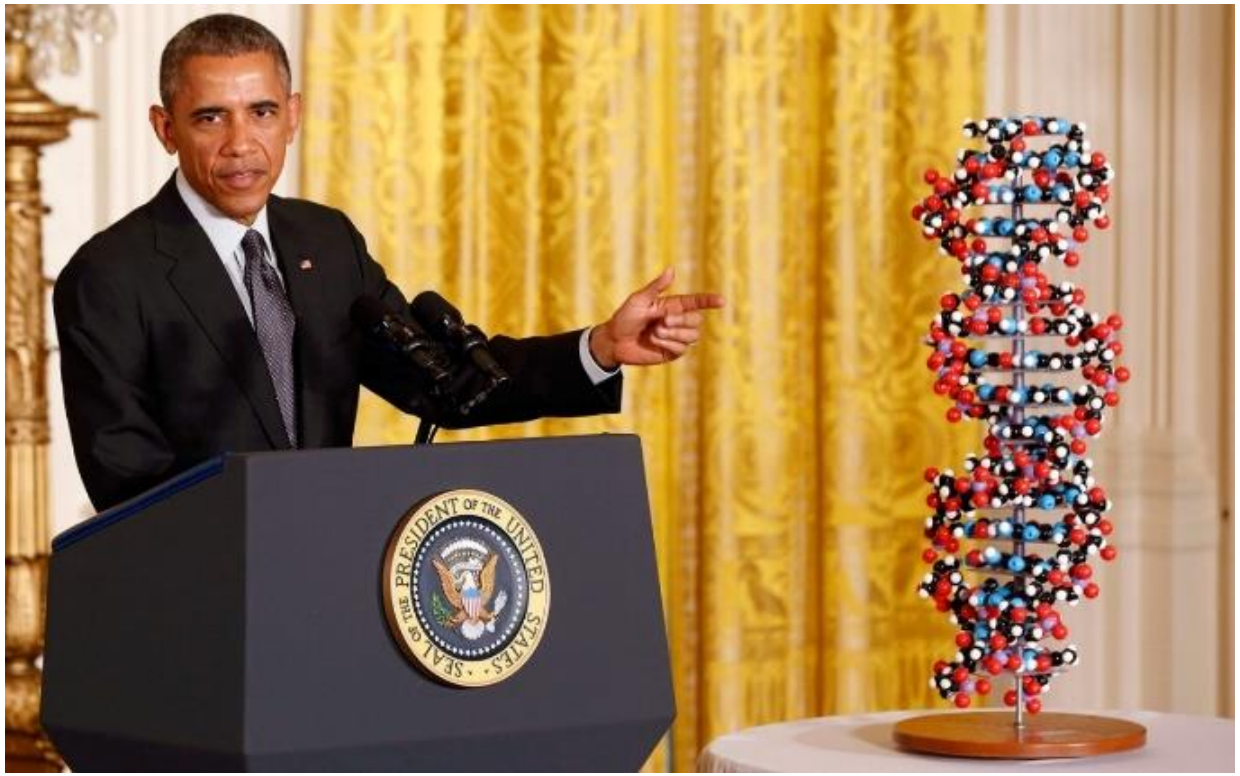



https://covid19.ncdhhs.gov/dashboard

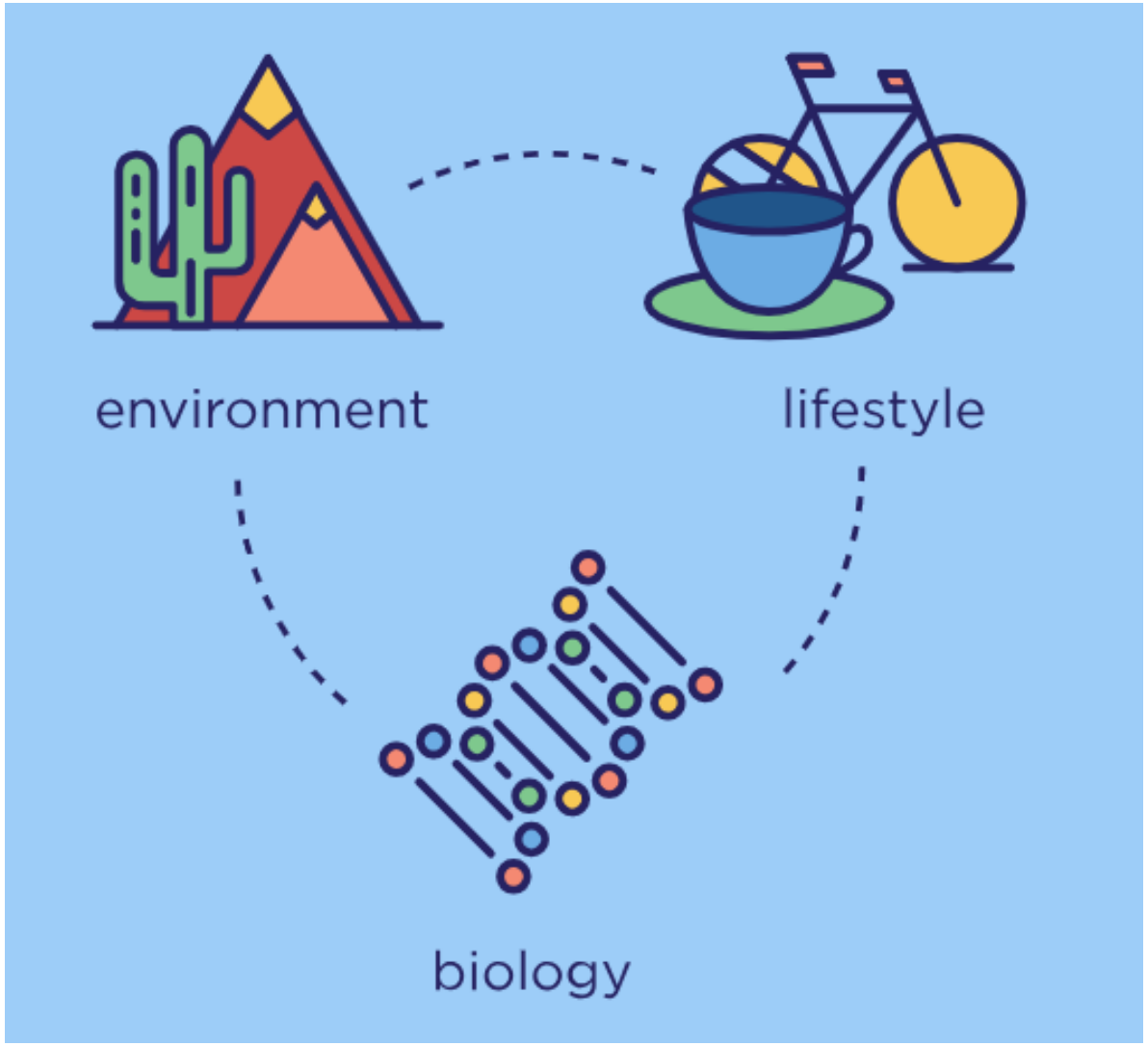


# We now return to our regularly scheduled Data Office business…

# Remember this pic?



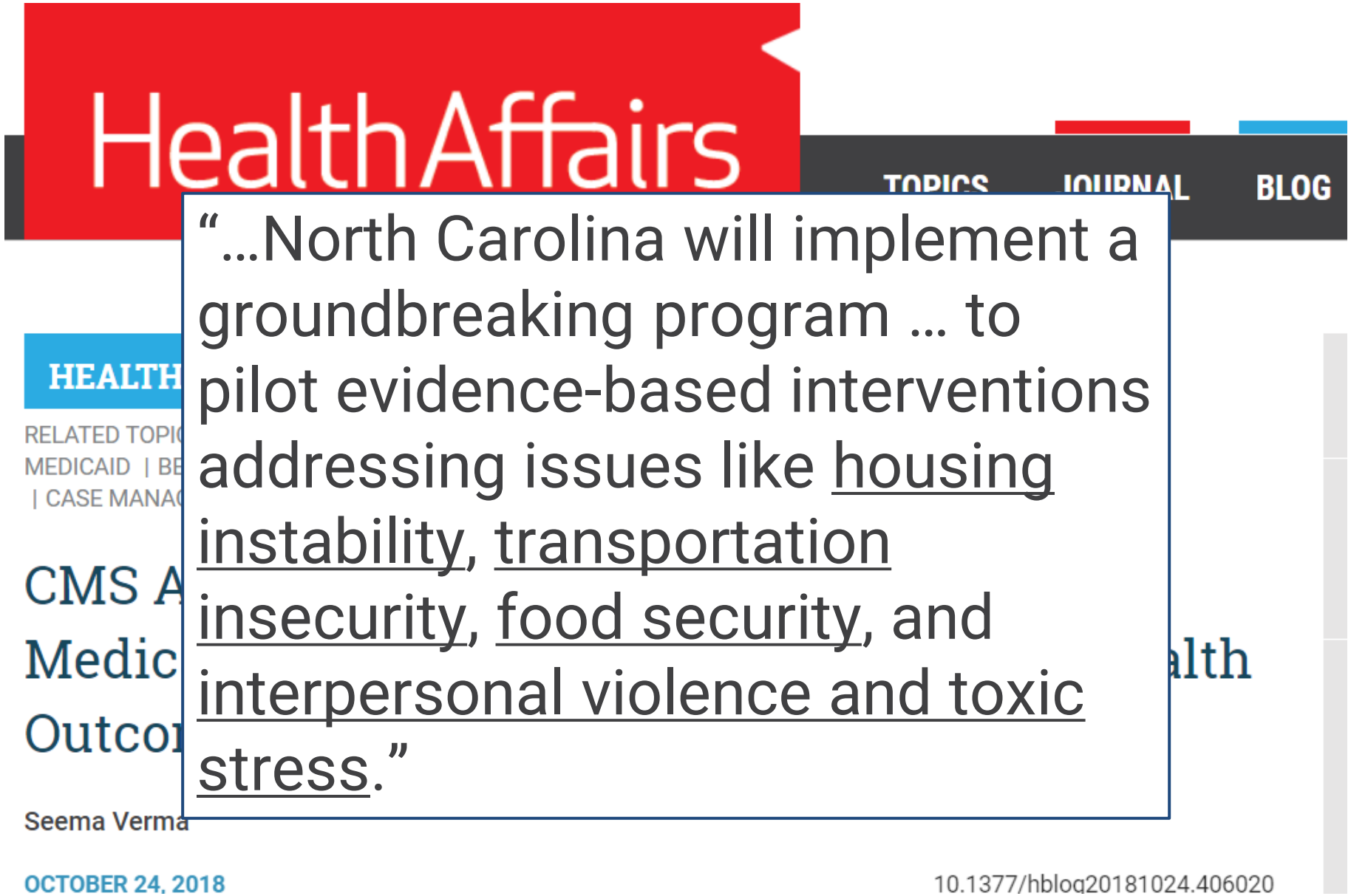
All of Us
RESEARCH PROGRAM




https://allofus.nih.gov/

# Beyond DNA

https://www.publichealthnotes.com/social-determinants-health-sdh/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Seema Verma
OCTOBER 24, 2018
10.1377/hblog20181024.406020
"…North Carolina will implement a groundbreaking program … to pilot evidence-based interventions addressing issues like housing instability, transportation insecurity, food security, and interpersonal violence and toxic stress."

# Homelessness is a medical condition

- **Hospital pays $1,000 per individual per month for housing.**
- **Significant drop in ER use among individuals given housing options.**

09:35

## To Reduce Chronic Homelessness, A Chicago Hospital Is Treating It As A Medical Condition

February 21, 2019 By Jeremy Hobson

HOUSTON CHRONICLE

# Texas lawmakers look to Uber, Lyft to transport Medicaid patients

By Allie Morris, Austin Bureau | March 12, 2019 | Updated: March 12, 2019 3:17 p.m.

# Screening Questions

**Food**

1. Within the past 12 months, did you worry that your food would run out before you got money to buy more? (Y/N)
2. Within the past 12 months, did the food you bought just not last and you didn't have money to get more? (Y/N)

**Housing/Utilities**

3. Within the past 12 months, have you ever stayed: outside, in a car, in a tent, in an overnight shelter, or temporarily in someone else's home (i.e. couch-surfing)? (Y/N)
4. Are you worried about losing your housing? (Y/N)
5. Within the past 12 months, have you been unable to get utilities (heat, electricity) when it was really needed? (Y/N)

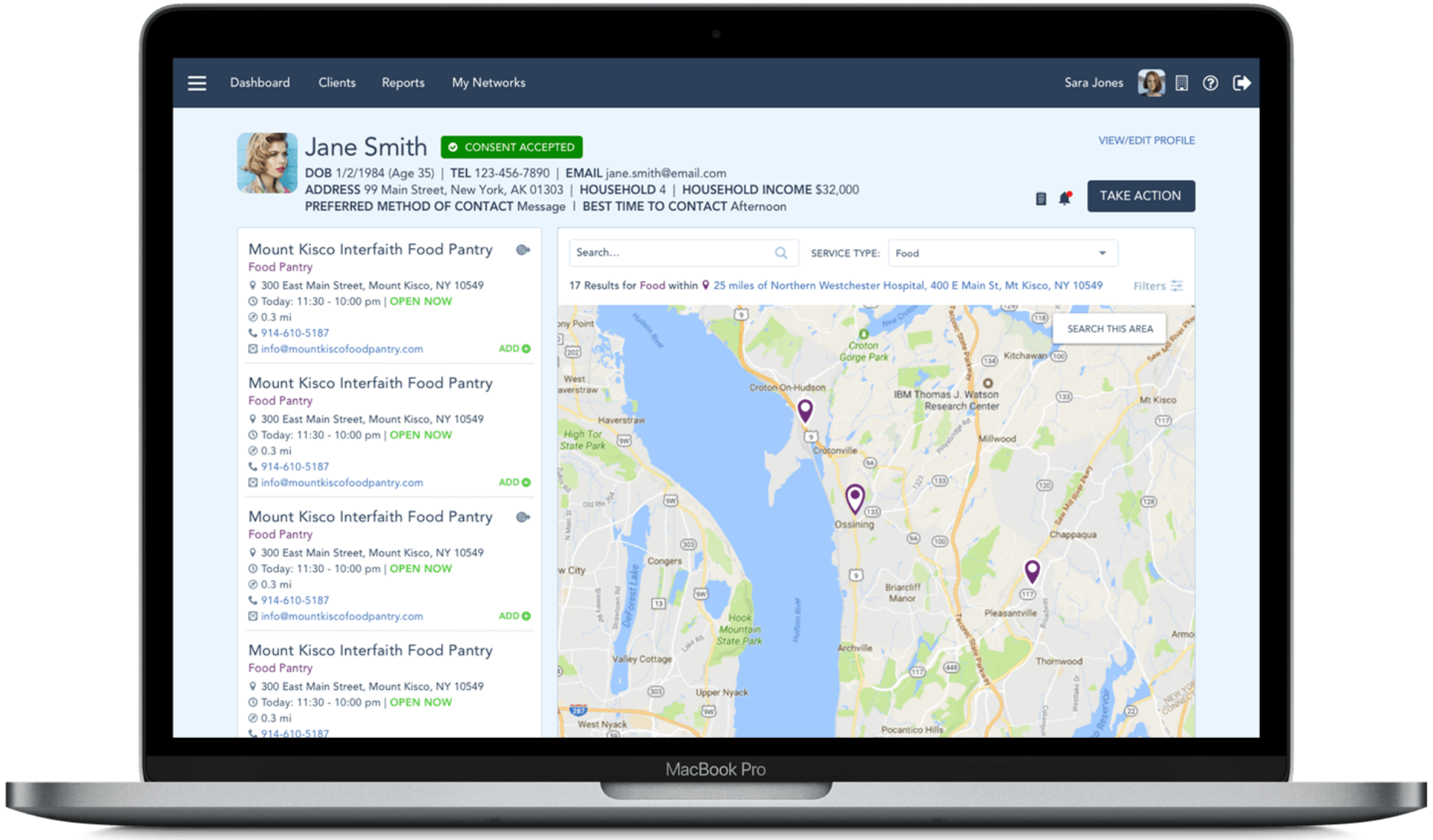
**Transportation**

6. Within the past 12 months, has a lack of transportation kept you from medical appointments or from doing things needed for daily living? (Y/N)

**Interpersonal Safety**

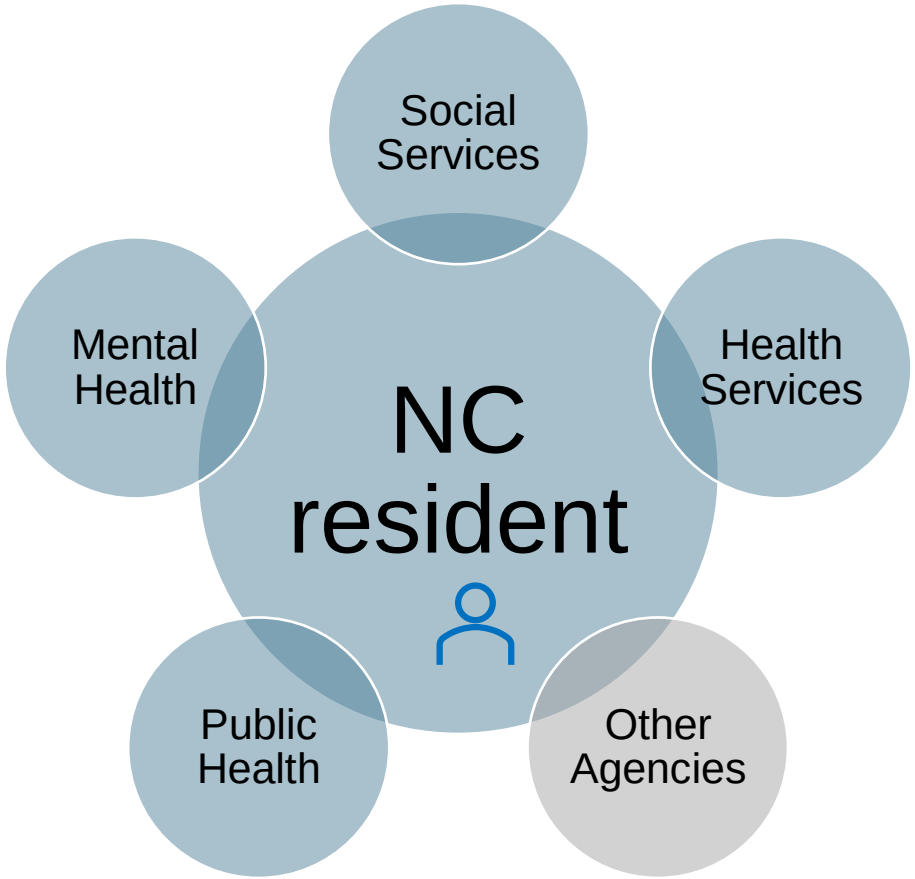
7. Do you feel physically and emotionally unsafe where you currently live? (Y/N)
8. Within the past 12 months, have you been hit, slapped, kicked or otherwise physically hurt by anyone? (Y/N)
9. Within the past 12 months, have you been humiliated or emotionally abused by anyone? (Y/N)

# NCCARE360 Closed Loop Referral Platform



# Whole Person Health

- Goal: link data to facilitate a “Whole Person Health” view of the people we serve.
  - Real-time individual level
  - Aggregate analysis to inform policy
- Requires the ability to integrate data across divisional silos
- Which requires ability to link records between systems



# Motivating Questions (Examples)

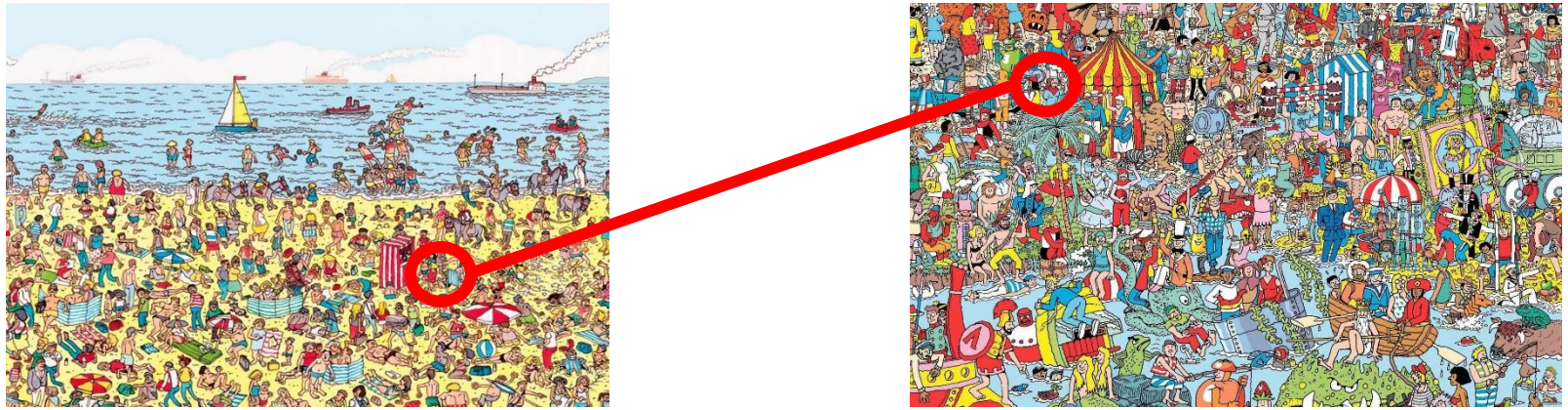
- What % of Medicaid beneficiaries have been vaccinated?
- Which children in foster care have prescriptions for >4 psychotropic medications?
- Who receives regular food assistance referrals and therefore may benefit from SNAP but is not enrolled?
- What % of people experiencing homelessness have been vaccinated?
- What is the relationship between early grade outcomes (e.g., third grade reading) and different early childhood conditions (e.g., early learning, health, housing, child welfare)?

# In order to achieve Whole Person Health, need 2 things:

1. **The ability to integrate data between divisional silos (“Data Integration”)**

2. **The ability to identify and link the same individual from different datasets (“Entity Resolution”)**

ID: 123456
Name: Waldo

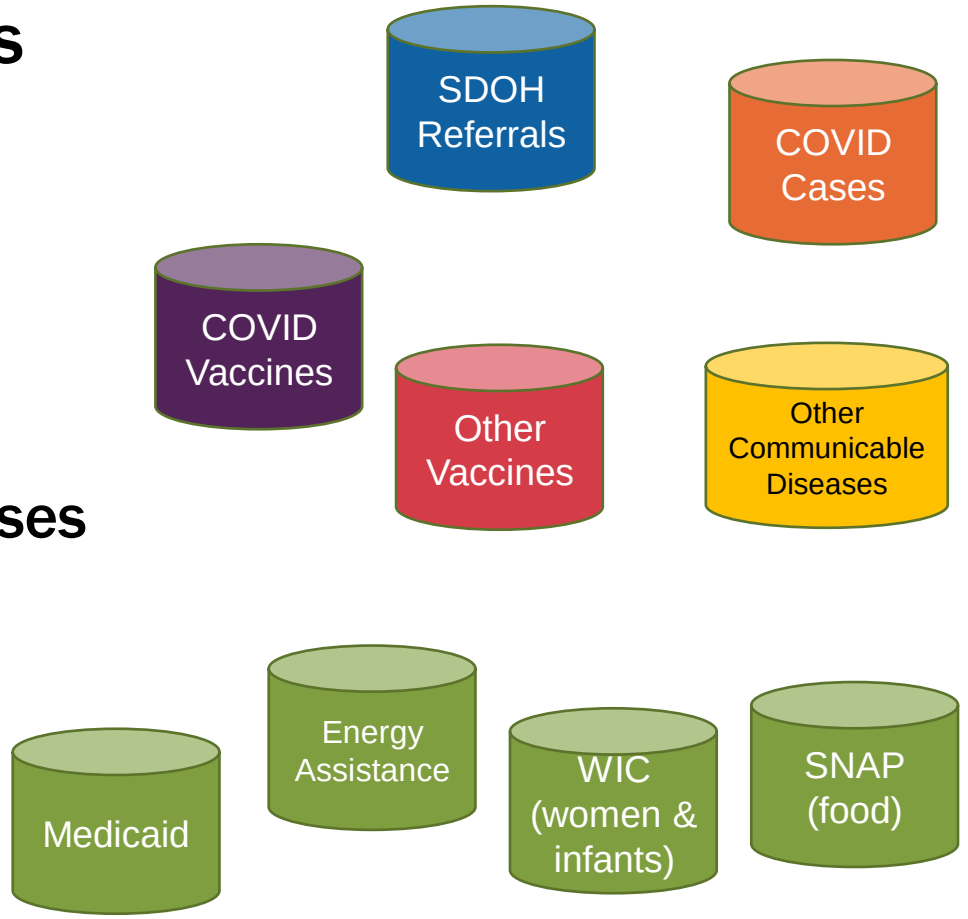


ID: 123456
Name: Waldo

# Answering those questions is currently difficult at best

- Data live in silos that do not share IDs
- Probabilistic match is possible, but
  - Labor-intensive
  - Prone to error

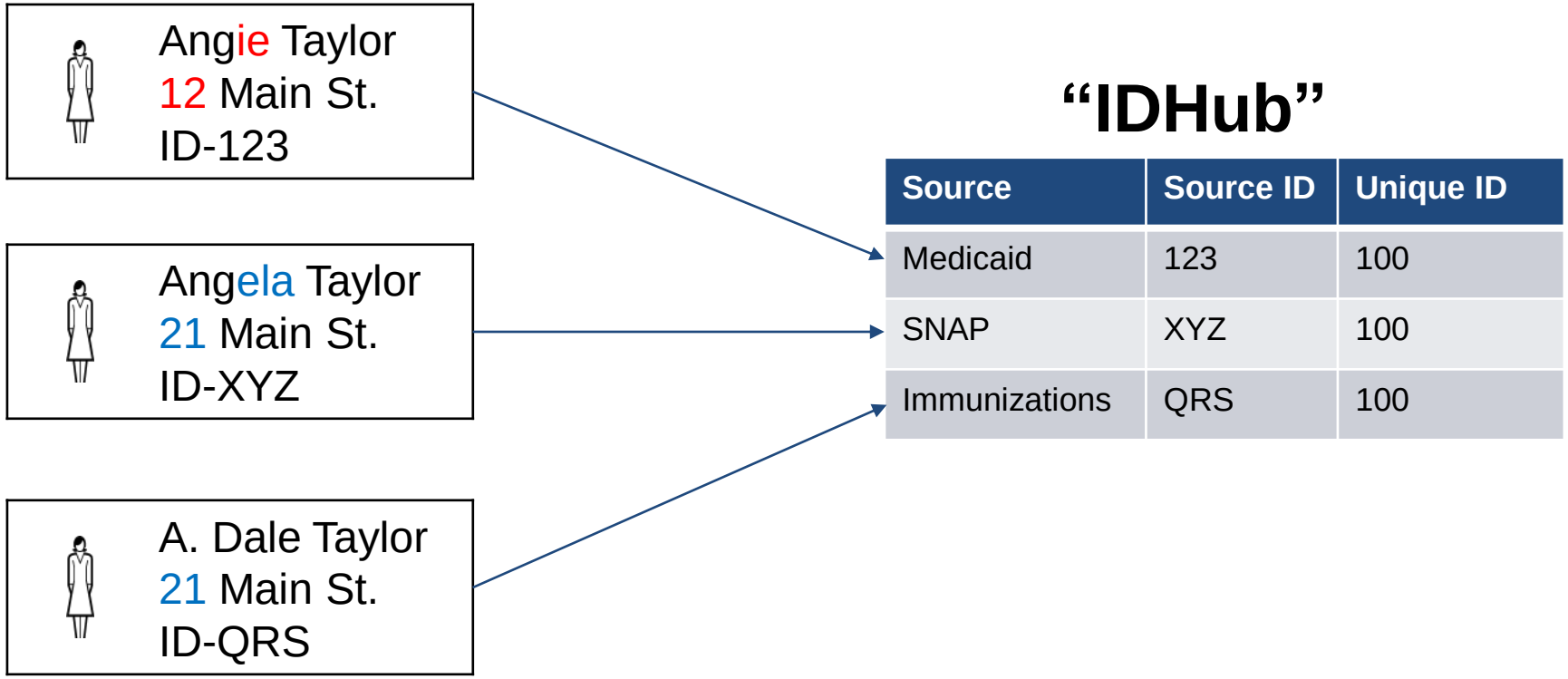
  - Example: initial approach for post-vax cases



# Options for “solving” entity resolution

1. Each system uses its own ID, probabilistic “fuzzy match” between systems as needed
2. One universal ID, e.g. state-wide or National Health Identifier
3. Somewhere in between
   a. Multiple “standard” identifiers
   b. Map them to each other!
   c. Refer to that mapping for efficient data integration

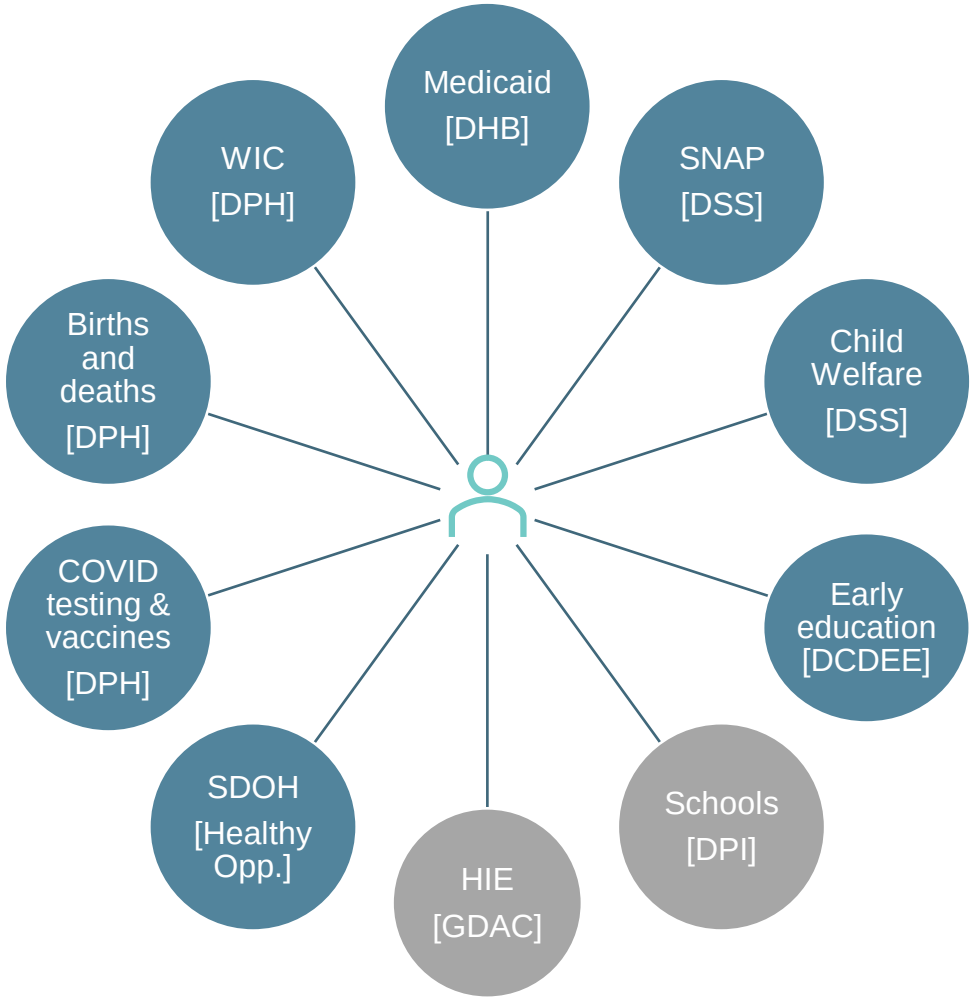
# Map each ID to a universal unique identifier…




## “IDHub”

| Source | Source ID | Unique ID |
|---|---|---|
| Medicaid | 123 | 100 |
| SNAP | XYZ | 100 |
| Immunizations | QRS | 100 |

# …enabling Whole Person Health

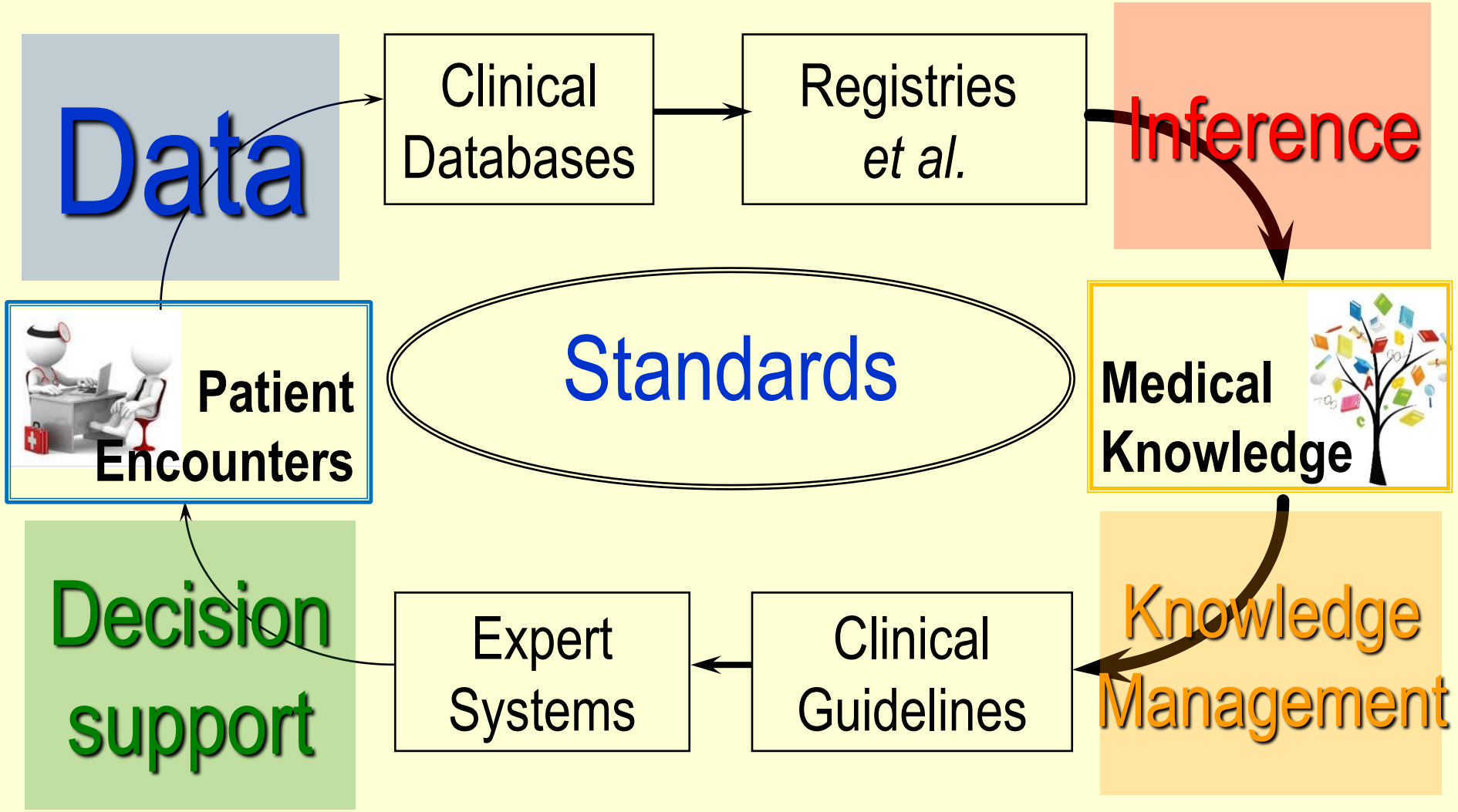


# Thanks!

@jessiet1023

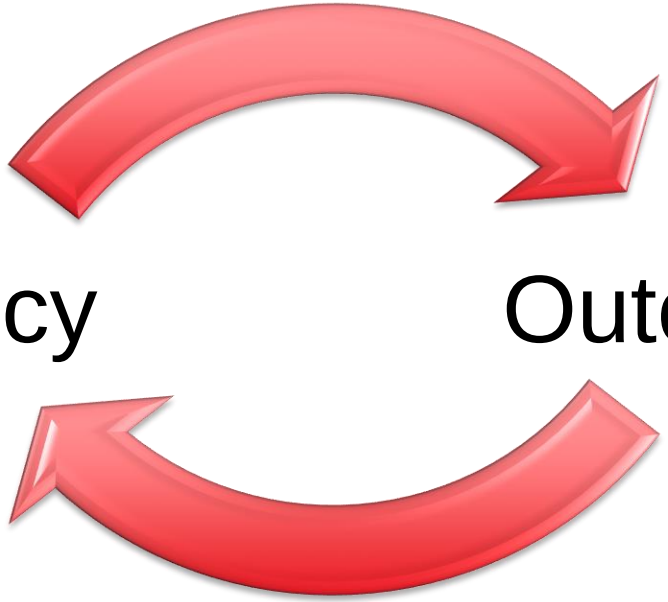
Adapted from Chris Chute

# Foundations for Learning Health System
# From "Evidence-based Medicine" to "Practice-based Evidence"



# The Learning DHHS

Policy impacts outcomes



Policy Outcomes

Outcomes inform policy