Intermountain Health

Developing Dynamic Data-Driven Dashboards

Diversity, Equity, Inclusion and Justice (DEIJ) Task Force Webinar Series

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Intermountain Health

Not-for-Profit Integrated Health System Based in Salt Lake City, Utah

Mission

"HELPING PEOPLE LIVE THE HEALTHIEST LIVES POSSIBLE"

HOSPITALS & CLINICS

33 Hospitals
4800 Beds
385 Clinics
9 States

selecthealth

INSURANCE

1,030,000 Members

OUR TEAM

60,000 Employees
2950 Employed Physicians

REHABILITATION SERVICES

1,900 Employees (PT, OT, SLP, ATC)
Wellness, Acute, IRF, Home Care, Outpatient

OUR MISSION: Helping people live the healthiest lives possible.

OUR VISION: Be a model health system by providing extraordinary care and superior service at an affordable cost.

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A Brief History of Healthcare Data

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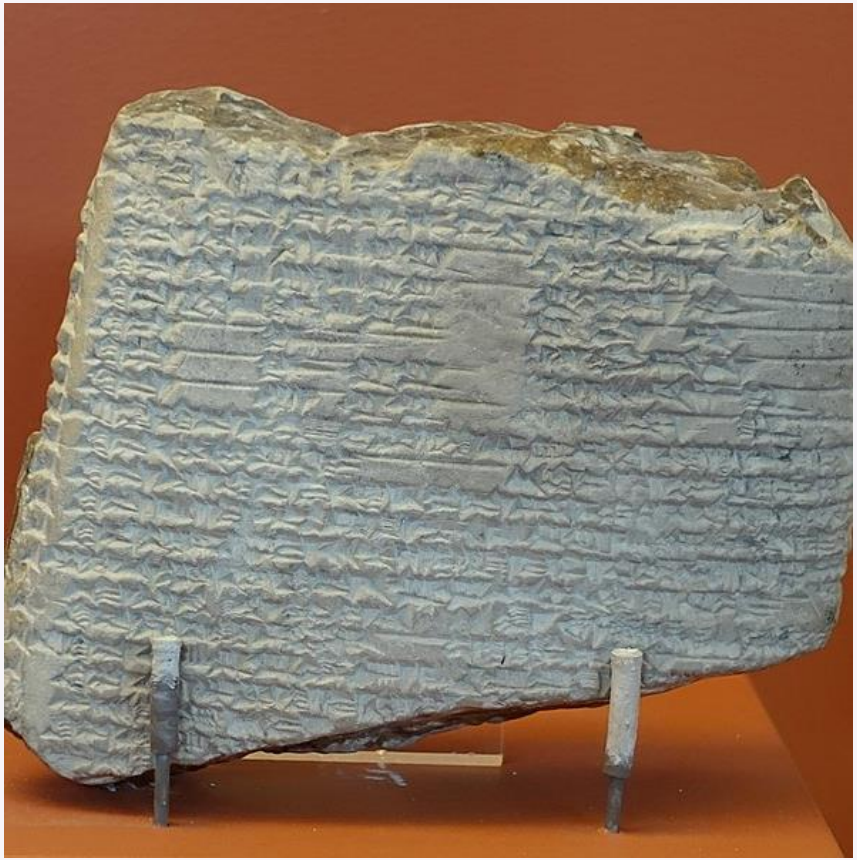
Healthcare Data in the Ancient World

3000 BC – 400 AD

- Recorded on Clay Tablets, Papyrus, etc.
- Contained references to medical information for high class individuals
- Medical problems often ‘fixed’ by spells, sacrifice, or astrology



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Healthcare Data in the Middle Ages

400 AD – 1700 AD

- Case Histories maintained for “Interesting” cases
- Translation of ancient medical texts into Arabic used for teaching purposes

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Healthcare Data in the Age of Enlightenment

1700 – 1900

- 1793 – New York Hospital begins storing admit and discharge information
- 1800s – Selected physician notes were compiled into one volume to include “the history of the disease, the causes producing it, the remedies employed, and the result of the case…” [1]

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Healthcare Data in the Early-Mid 1900s

1900 – 1960s

- Paper Medical Records were widely documented, standardized, and regulated
- Medical Transcriptionists and Stenographers
- First patient identification implemented at St. Mary's Hospital in Rochester, MN in 1907

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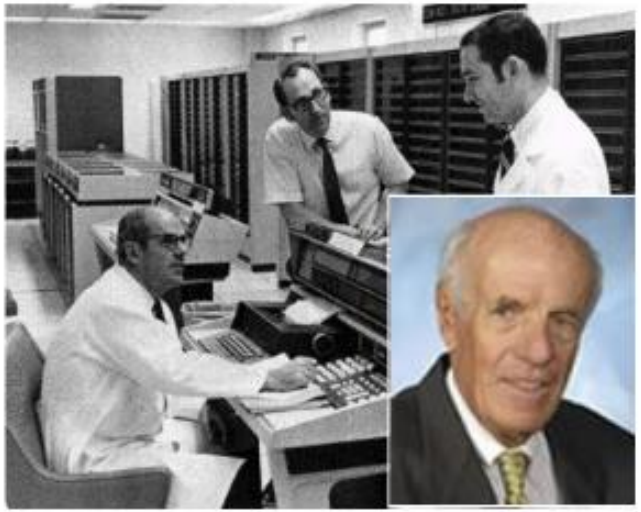
Electronic Medical Record

1960s – Present

- 1968 - Intermountain Healthcare becomes first hospital system in the US to implement an electronic medical record (EMR) system[1], known as HELP (Health Evolution through Logic Processing). Inpatient care only.
- 1983 – Outpatient care setting integrated into medical record at Intermountain Healthcare.
- 1998 – Intermountain Healthcare Establishes Enterprise Data Warehouse (EDW)



*Homer Warner and Brent James, early pioneers in adopting the electronic medical record

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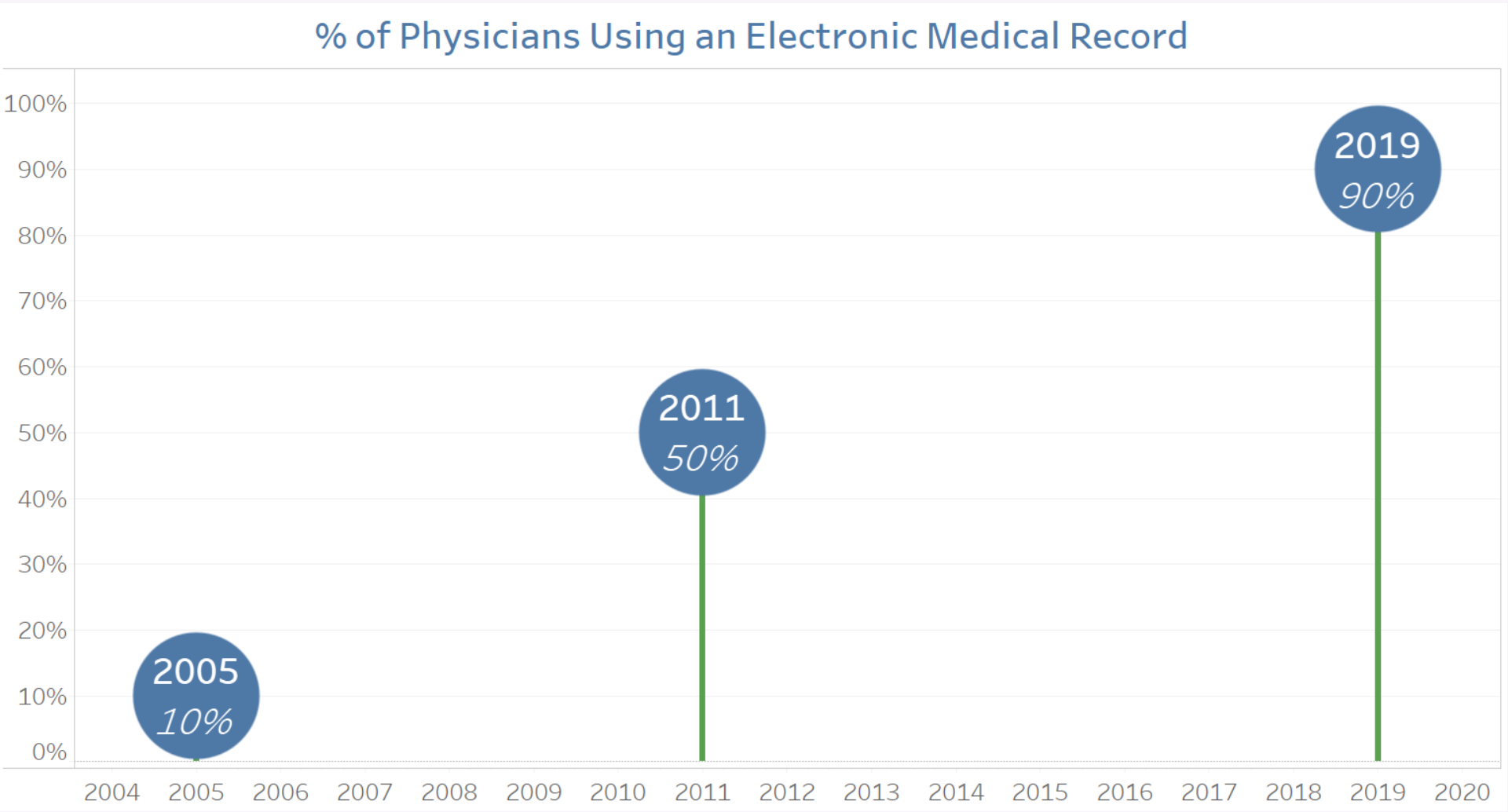
% of Physicians Using an Electronic Medical Record
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2005
10%
2011
50%
2019
90%
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

The Data Journey

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Data Inputs

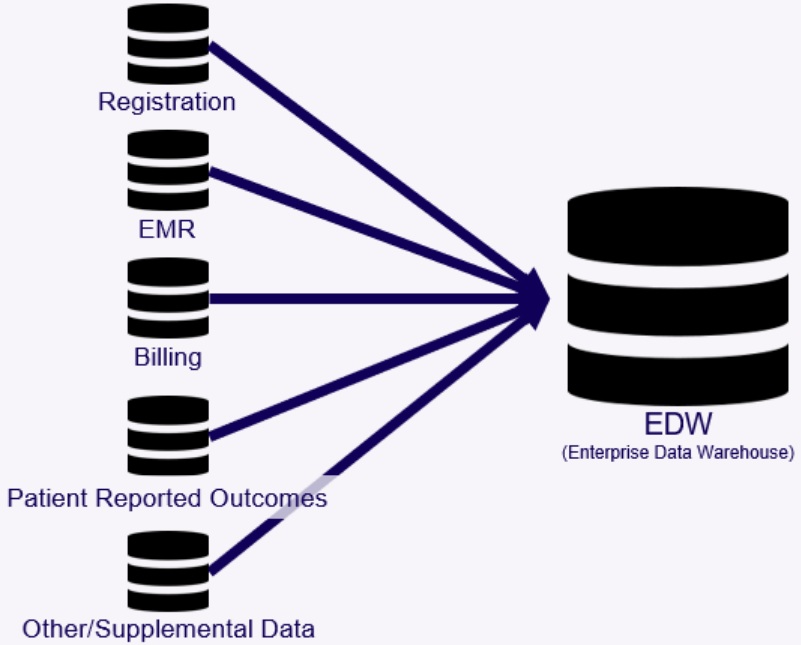
Registration	Electronic Medical Record	Billing	Patient Reported Outcomes	Other/Supplemental Data
Age	Medical Treatment	Insurance	Body Area	Patient Feedback
Gender	Medications	Billed Amount	Chronicity	Distance to Facility
Language	Dates (Admit, Discharge, Surgery, etc.)	Units of Service	Surgical / Non-Surgical	Scheduling Data
Race	Location	Patient Payment		Derived Socioeconomic Variables
Ethnicity	Caregiver(s)	Insurance Payment		
Religion	Diagnosis	Remaining Balance		
Marital Status	Documentation			
City/State/Zip				

EMR Products

- EPIC
- Cerner
- And many more!

The Data Warehouse

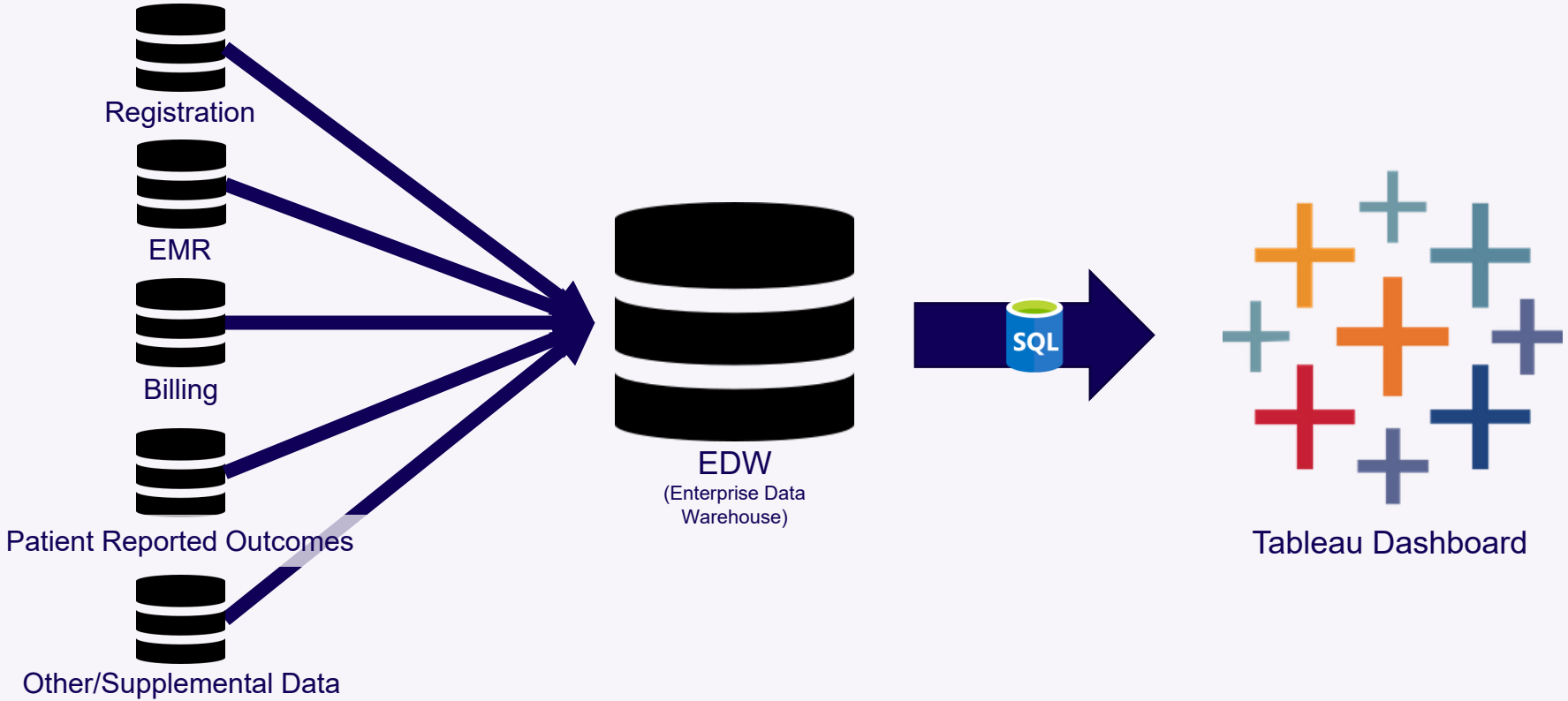
- Data is stored in a data warehouse – a central repository for all the data coming into a data ecosystem
- Can be On Premise or Cloud-Hosted
- Examples Include Amazon Redshift, Google BigQuery, Snowflake, Microsoft Azure, Oracle, etc.
- At Intermountain Health, a team of data architects oversee the process of bringing the data from the source into the EDW.



Data Visualization – Bringing the Data to Life

- Common Tools for Data Visualization:
  - Tableau (Salesforce)
  - Power BI (Microsoft)
  - Looker (Google)
  - Domo
  - Qlik
  - And many more!
- The tools for storing, visualizing and consuming data varies widely for many Healthcare organizations

Data Journey at Intermountain Health



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Working with Data Professionals

Bridging the Communication Gap Between Clinician and Analyst

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Is this Helpful?

	A	B	C	D	E	F	G	H	I
1	SUMMARY OUTPUT								
2									
3	*Regression Statistics*								
4	Multiple R	0.97012							
5	R Square	0.941133							
6	Adjusted R Squa	0.926416							
7	Standard Error	515.7254							
8	Observations	11							
9									
10	ANOVA								
11		*df*	*SS*	*MS*	*F*	*Significance F*			
12	Regression	2	34017672.79	17008836	63.94955	1.20086E-05			
13	Residual	8	2127781.758	265972.7					
14	Total	10	36145454.55						
15									
16		*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
17	Intercept	-1642.04	1151.801633	-1.42563	0.191804	-4298.10333	1014.015	-4298.1033	1014.01533
18	Unit Price	9.909374	0.876228512	11.30912	3.36E-06	7.888787251	11.92996	7.88878725	11.9299604
19	Promotion	8.133162	2.624163278	3.099335	0.014681	2.081830676	14.18449	2.08183068	14.1844934
20									

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Remember

- There’s a lot of jargon out there
- There are too many terms to cover here
- Data terminology is always changing
- Don’t be afraid to ask questions

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Educational Background of Data Professionals

- Mathematics
- Statistics
- Computer Science
- Information Systems
- Finance
- Economics
- Many, Many More

Communication Tips

- Explain the “Why”
- Be Specific
- Avoid Jargon and Acronyms
- Give enough time for the data to be collected, queried, and analyzed
- Dashboard development is cyclical and iterative.
- Be clear about prioritization of work

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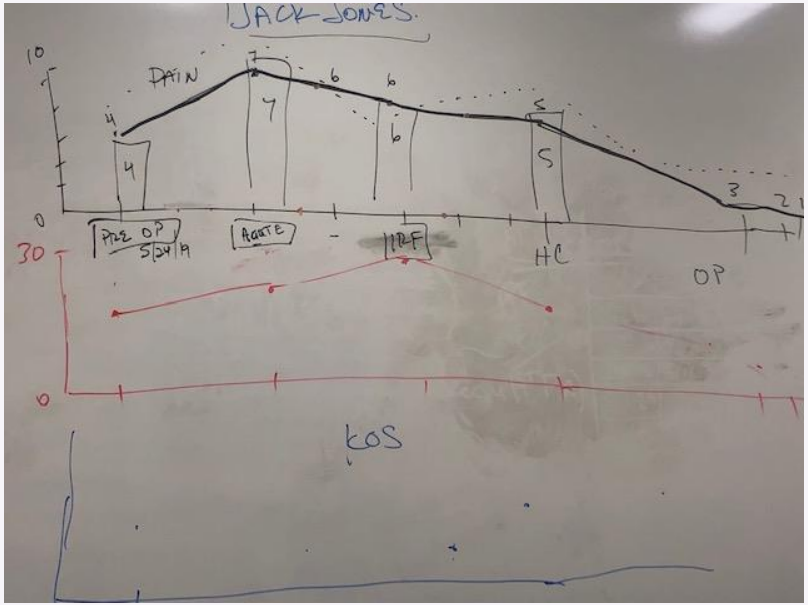
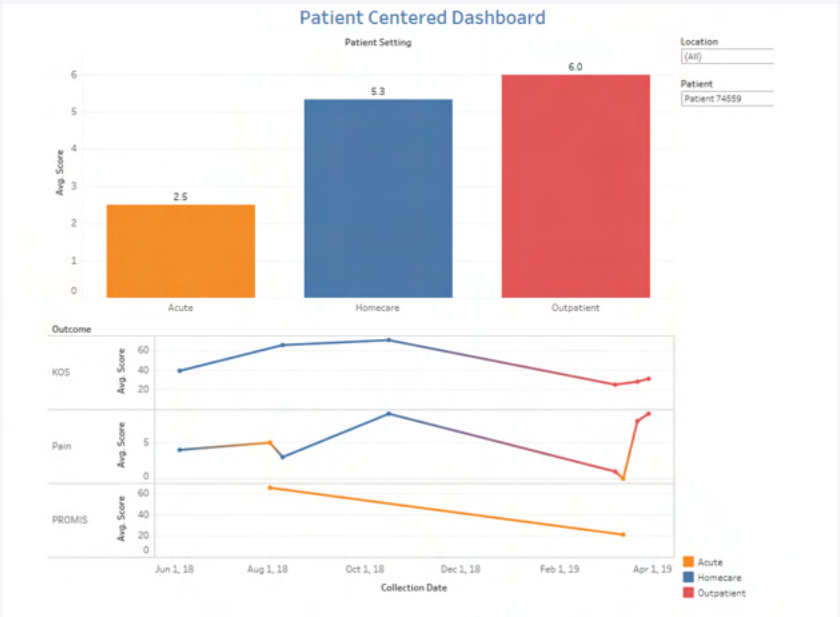
Whiteboard → First Draft





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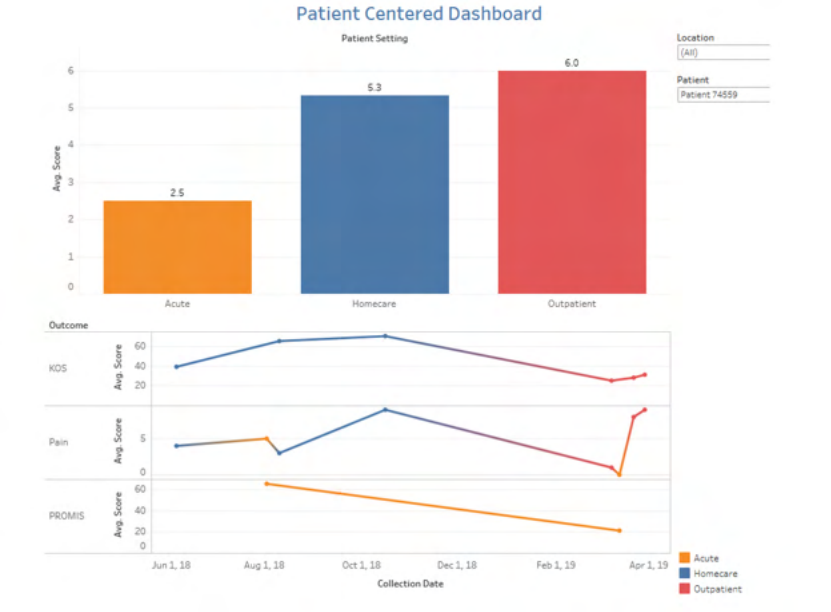
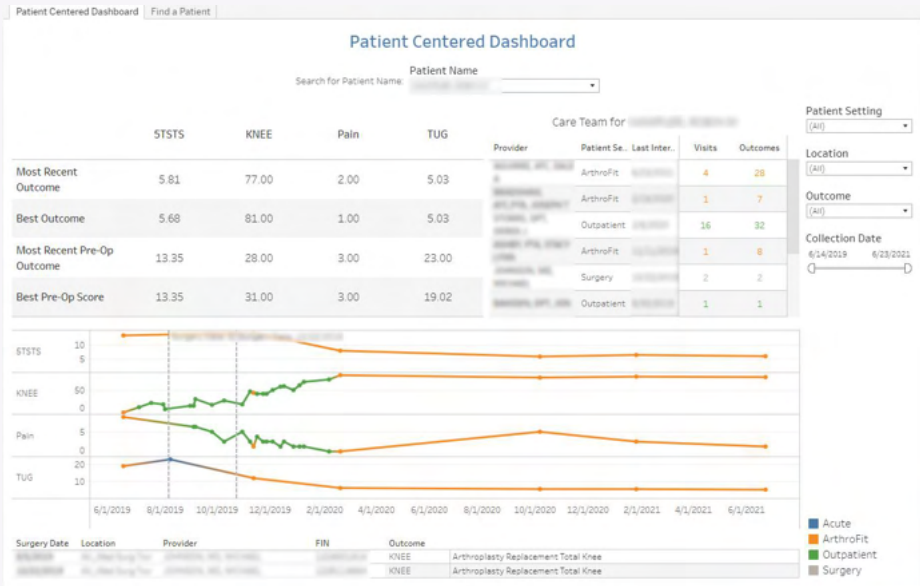
First Draft → 2nd → 3rd → …. → Current ~~Final~~ Version





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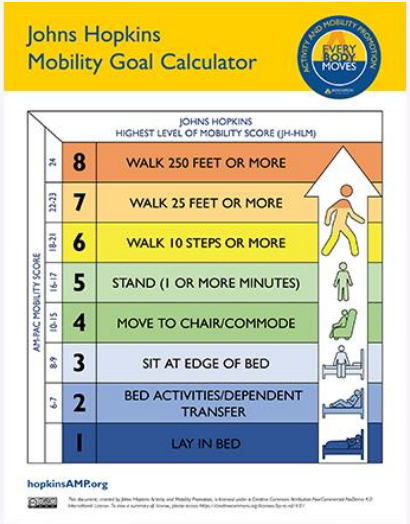
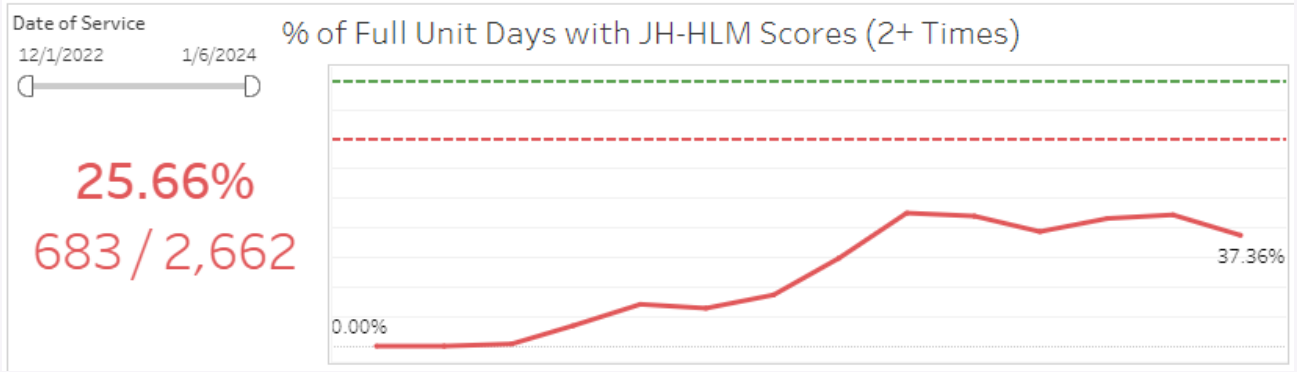
Data

Who, What, When, Where, How, Why

Who does Data Collection?

- Nurse
- Doctor
- Therapist
- Front Desk
- Patient





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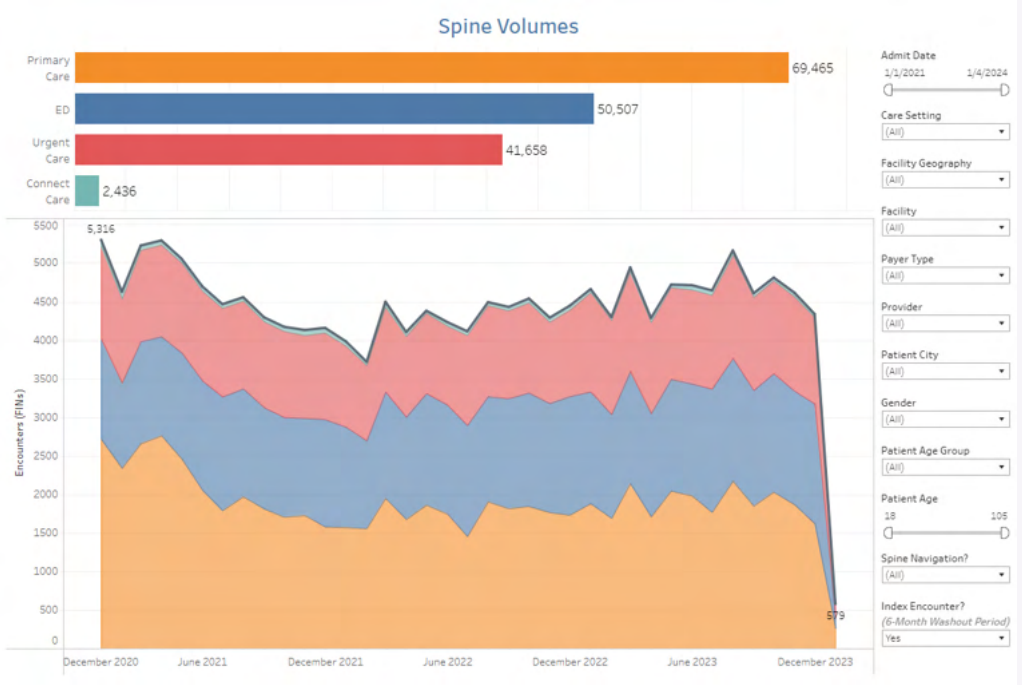
Who is the Population of Interest?

- Timeframe of Data Collection
- What are the inclusions and exclusions?
- What variables will be used to define the population?



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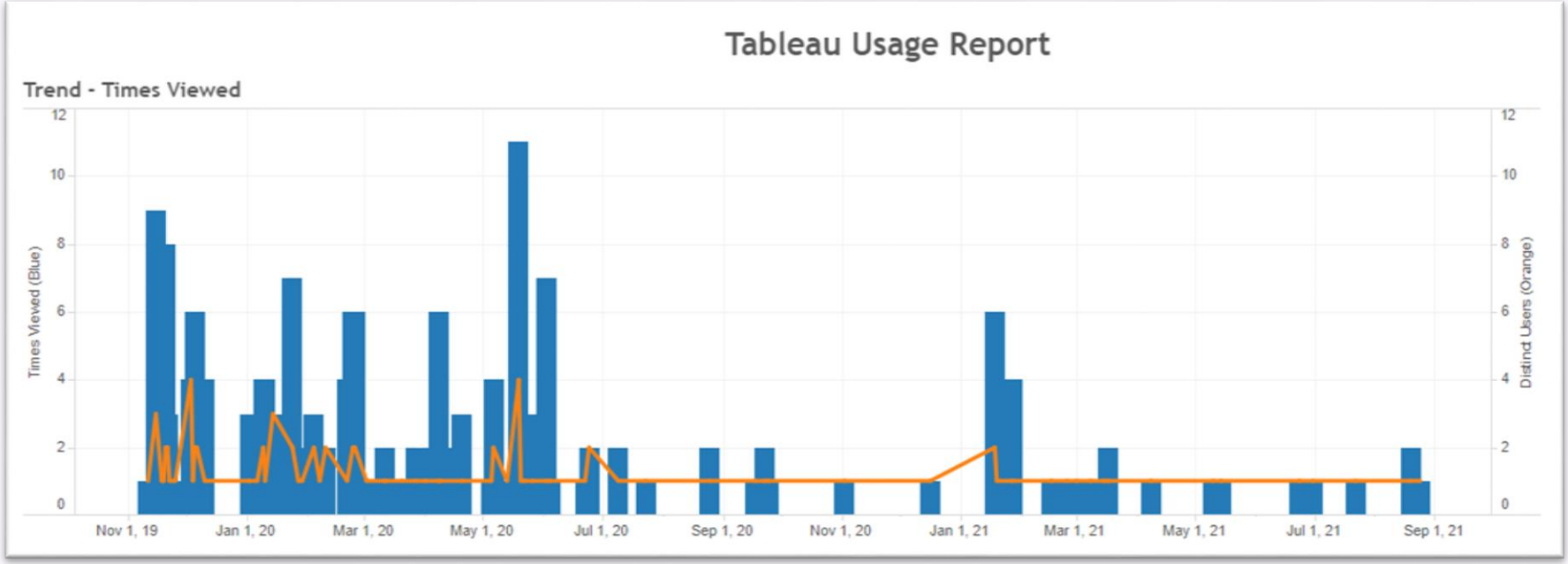
Who will be using this Data?



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What Data?

What are the variables?

How are the variables defined?

What is the metric?

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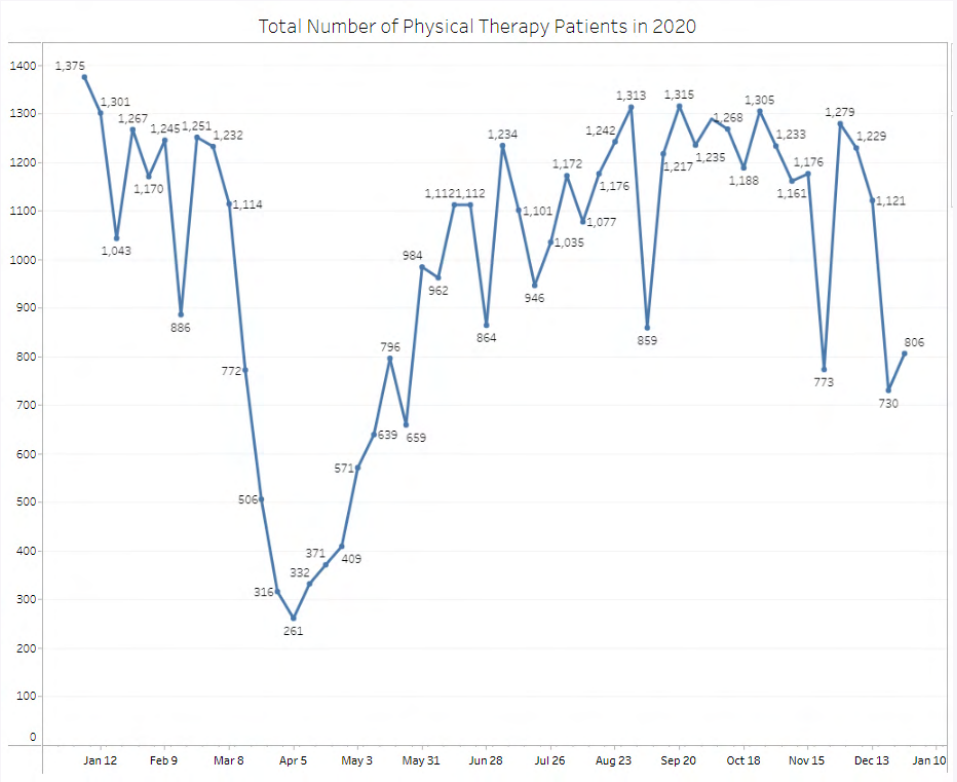
When?

- What time of day is the data collected?
- When in relation to the patient visit?
- Are there temporal influences in the data?



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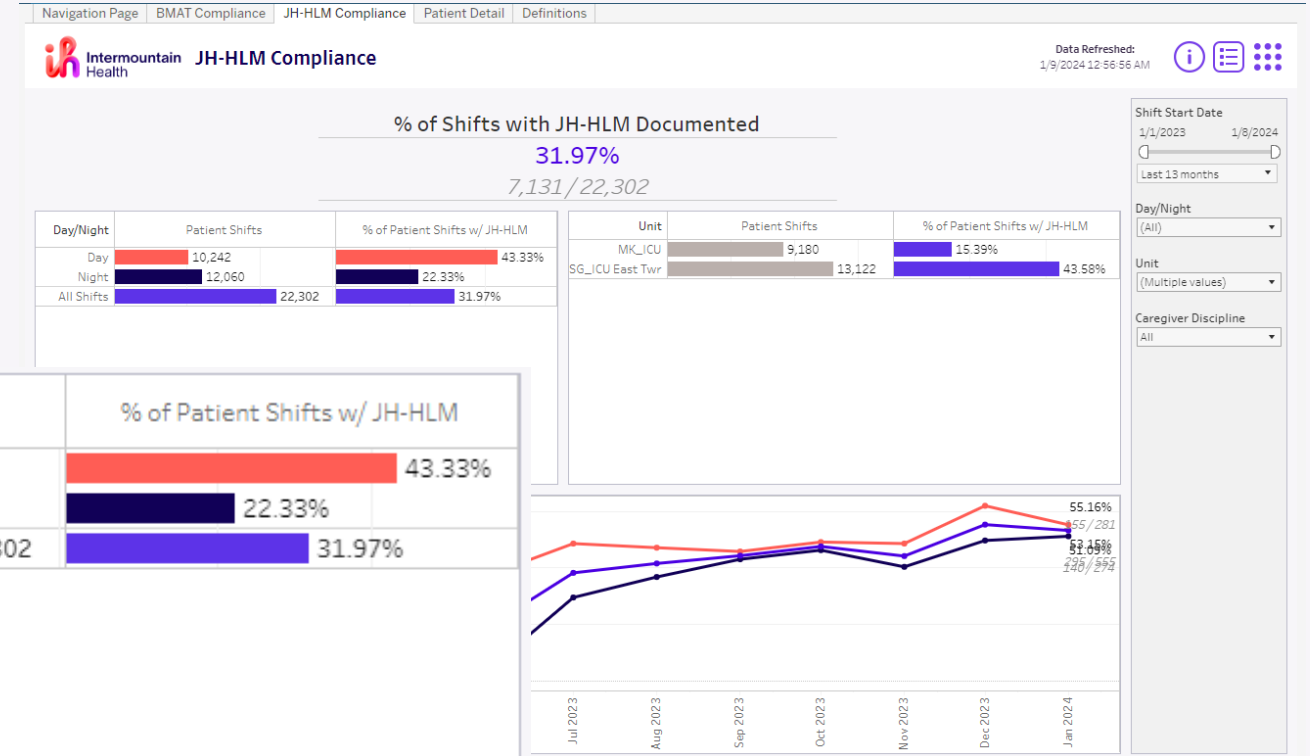
When?



Day/Night	Patient Shifts	% of Patient Shifts w/ JH-HLM
Day	10,242	43.33%
Night	12,060	22.33%
All Shifts	22,302	31.97%

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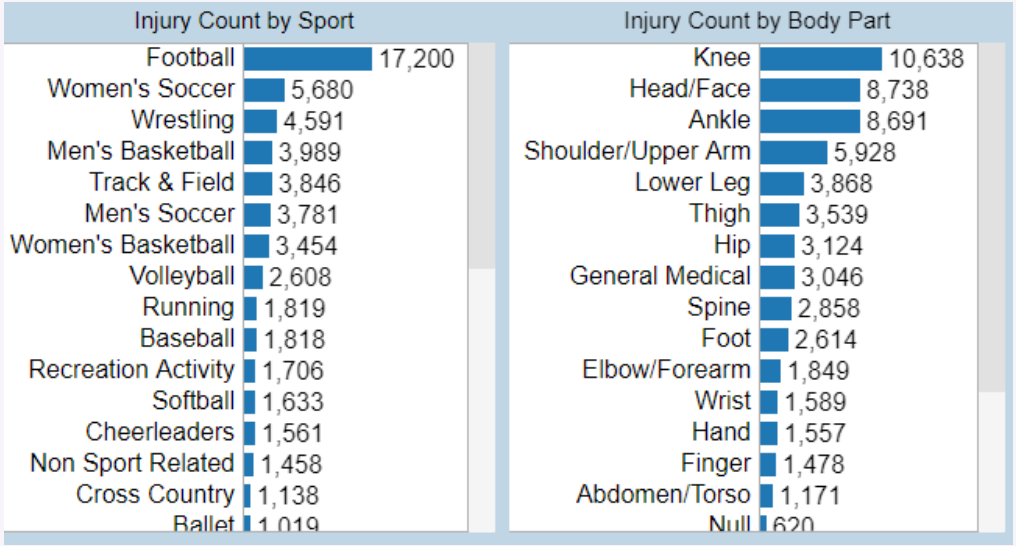
Where?

- Where is the data physically collected?
- Where is the data collected electronically?
- Where is the data stored?
- Where will the data be analyzed?



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Where?

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How will the data be collected?

- Paper vs Electronic
- Random Sample vs Retrospective
- What software is used?
- How is the data stored/aggregated?
- Dictation, Transcription, Automation, Manual Entry?

How will the data be analyzed?

- Data must be:
    - Valid
    - Accurate
    - Accessible
- Analysis must account for Variation

Challenges with Data **Validity**

- **Invalid data recorded (e.g., numeric field allows text)**
- Data is queried incorrectly
- Unusable at scale (example: free-text)

WARNING! The data points you are about to view are real and may be painful to see. Viewer discretion is advised

		Score	Pain
Correct Data!	Lower extremity function scale (LEFS)	55	2
Total Possible Shown as Denominator	Lower extremity function scale (LEFS)	59/80	2
Score/Pain Format Used	Lower extremity function scale (LEFS)	60/4	
73%? Does that mean 73/80 or 58/80=73%	Lower extremity function scale (LEFS)	73%	
94 is above max score of 80	Lower extremity function scale (LEFS)	94	1
NR? = Not Rated? No Result? Nuclear Reactor?	Lower extremity function scale (LEFS)	NR	5
My personal favorite	Lower extremity function scale (LEFS)	785	

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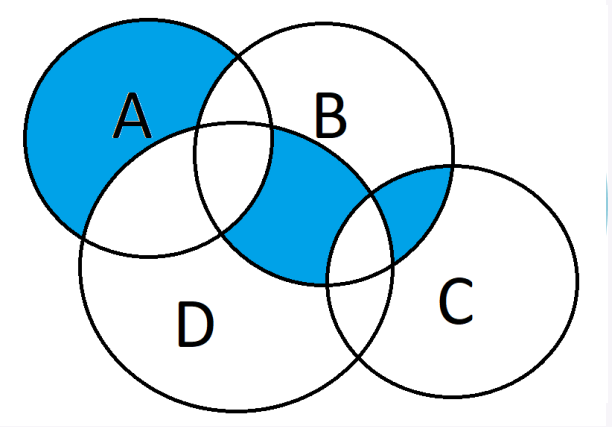

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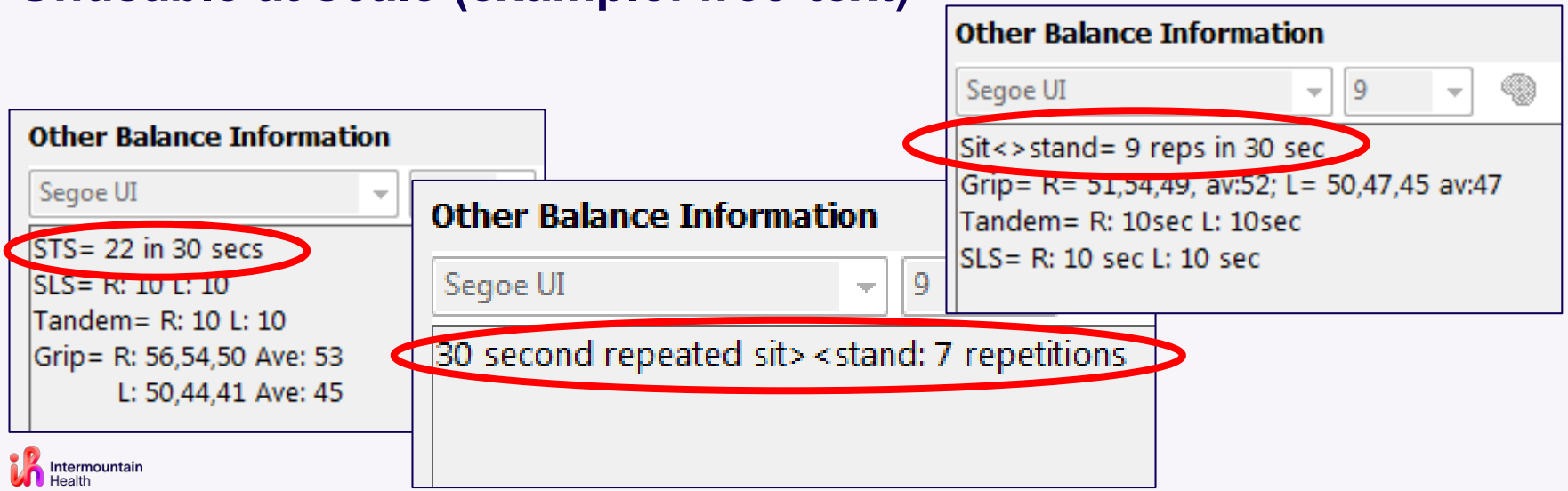

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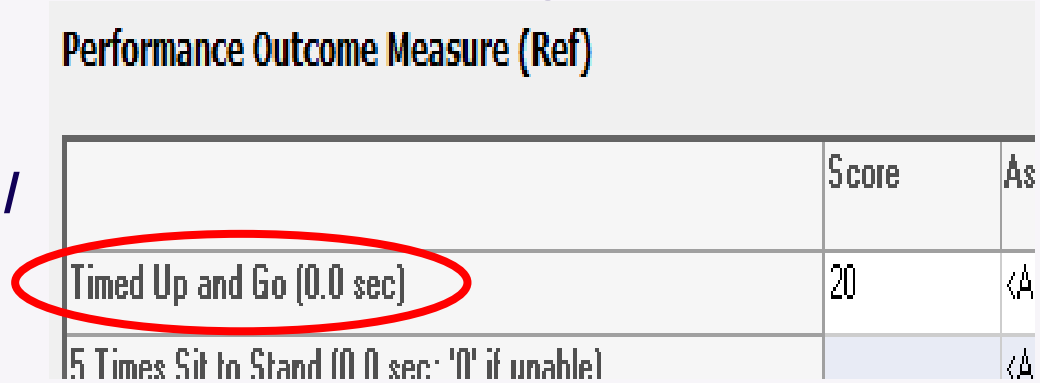
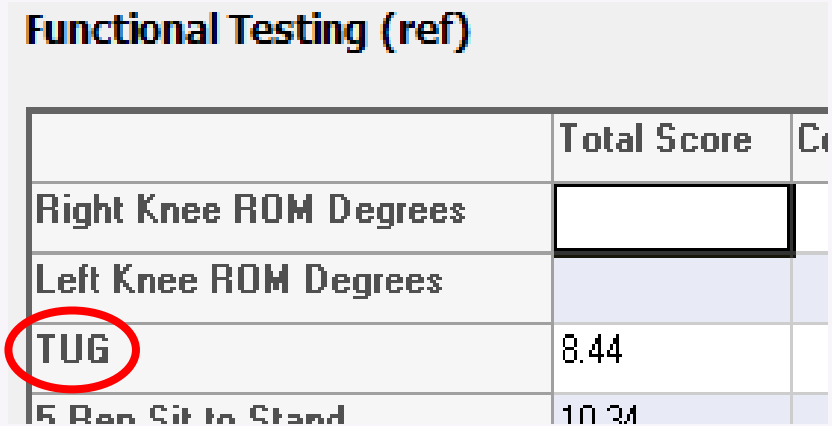
Challenges with Data **Accuracy**

- **Data collection / definitions / metrics not standardized**
- Data recorded incorrectly
- EMR does not reflect current/accurate data





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- EMR does not reflect current/accurate data

Patient-Reported Score

Survey Type	Survey Completed	Survey Score
LEFS	In Clinic	51

≠

Documented Score

Lower extremity function scale (LEFS)	55

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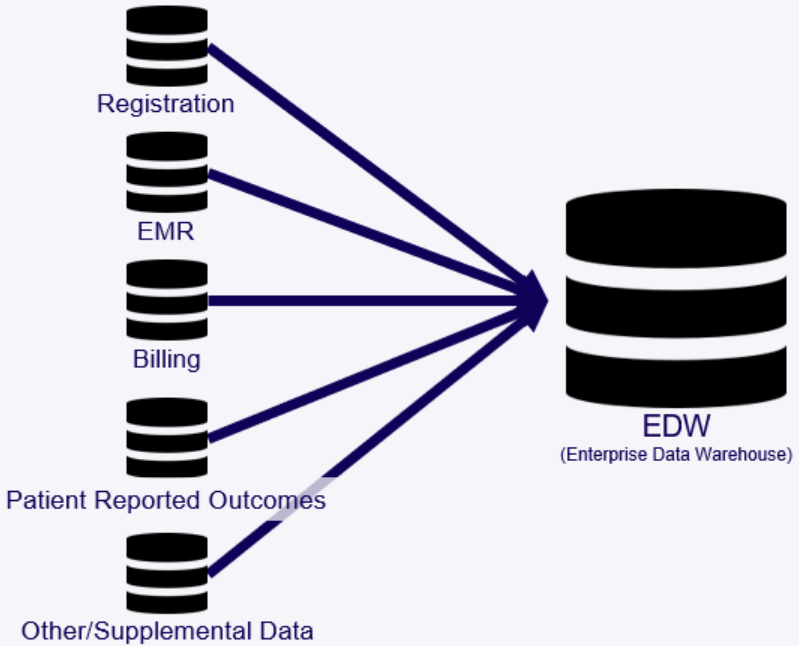
Challenges with Data **Accuracy**

- Data collection / definitions / metrics not standardized
- Data recorded incorrectly
- **EMR does not reflect current/accurate data**

Patient Home Address Heatmap for Physical Therapy Visits

Challenges with Data **Accessibility**

- **Disparate data systems (multiple EHRs, 3rd-party apps, etc.)**
- Failure to capture data at time of visit
- Patient exits system prematurely



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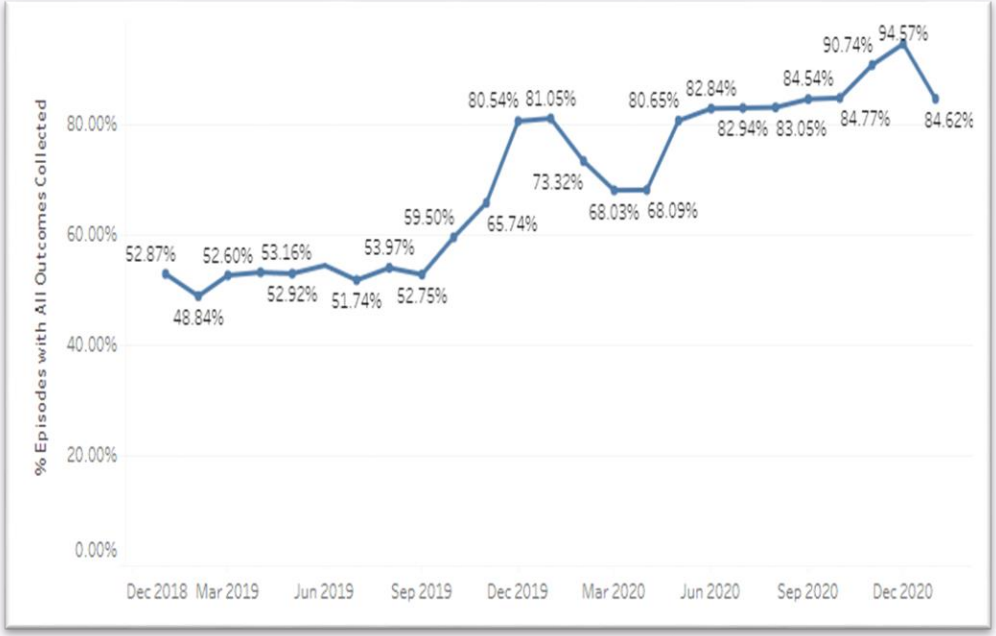

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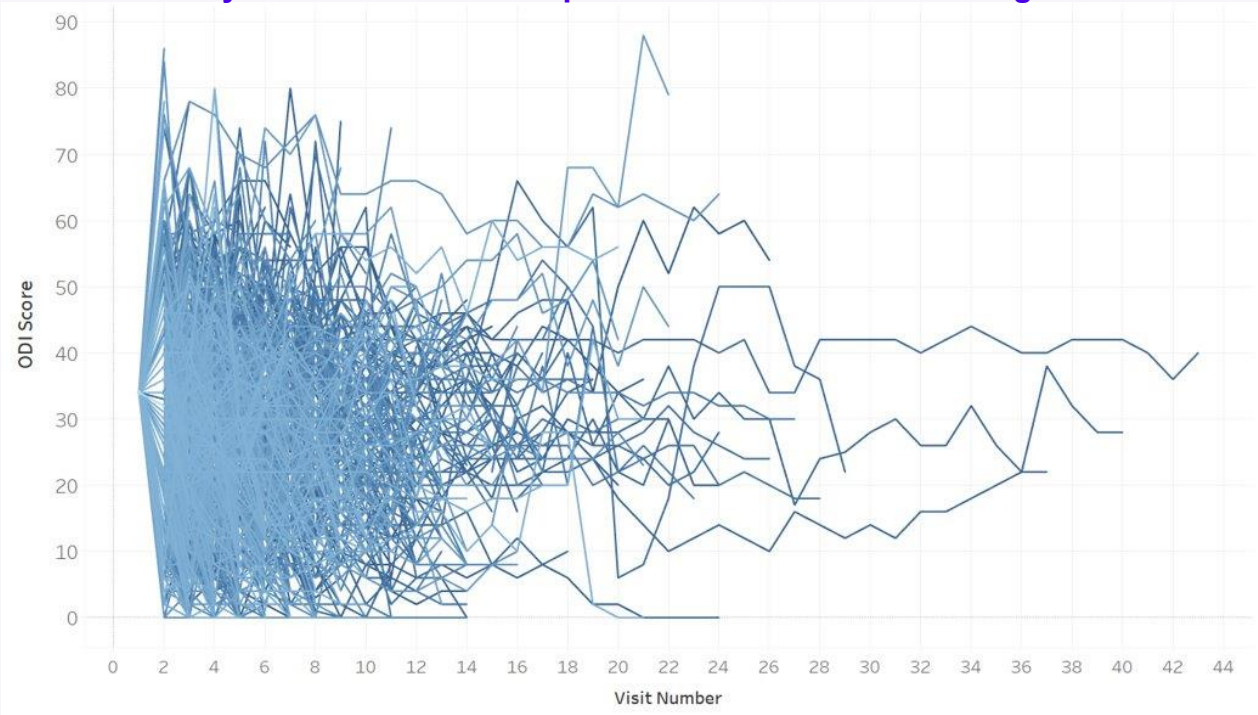
Account for **Variation** in the Data

Survey scores over time for patients with the same starting score



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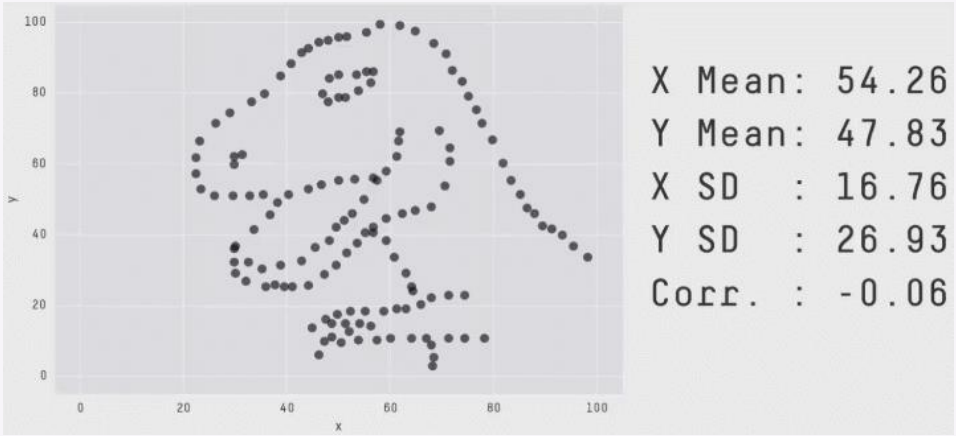
Account for **Variation** in the Data

- **Common aggregations do not accurately describe data**
- **Outliers**
- Statistical methods are used incorrectly; model assumptions aren’t valid.
- Confounding Variables
- Correlation ≠ Causation



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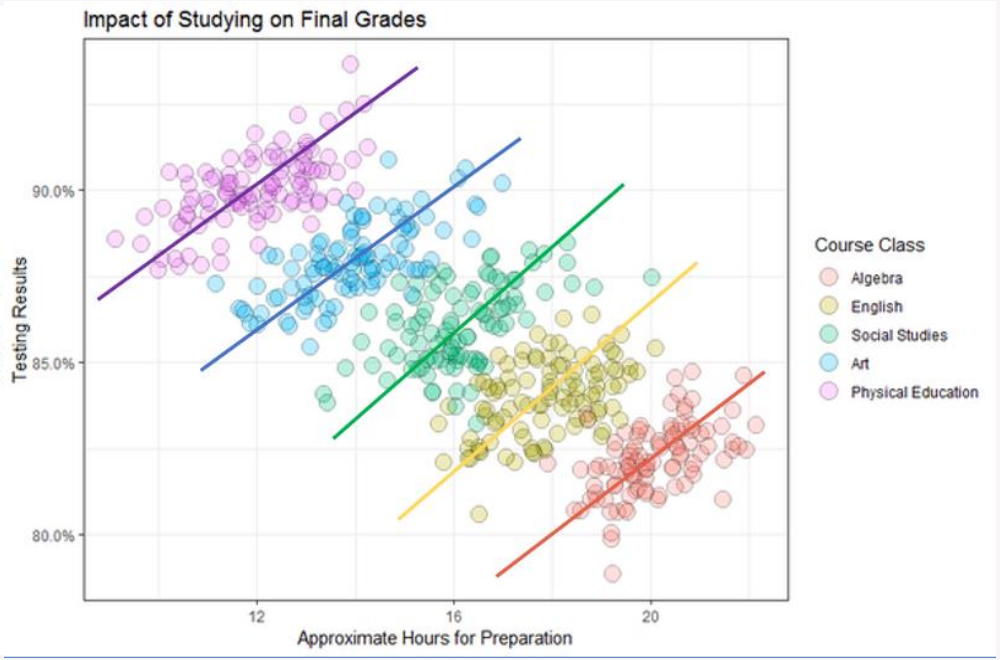

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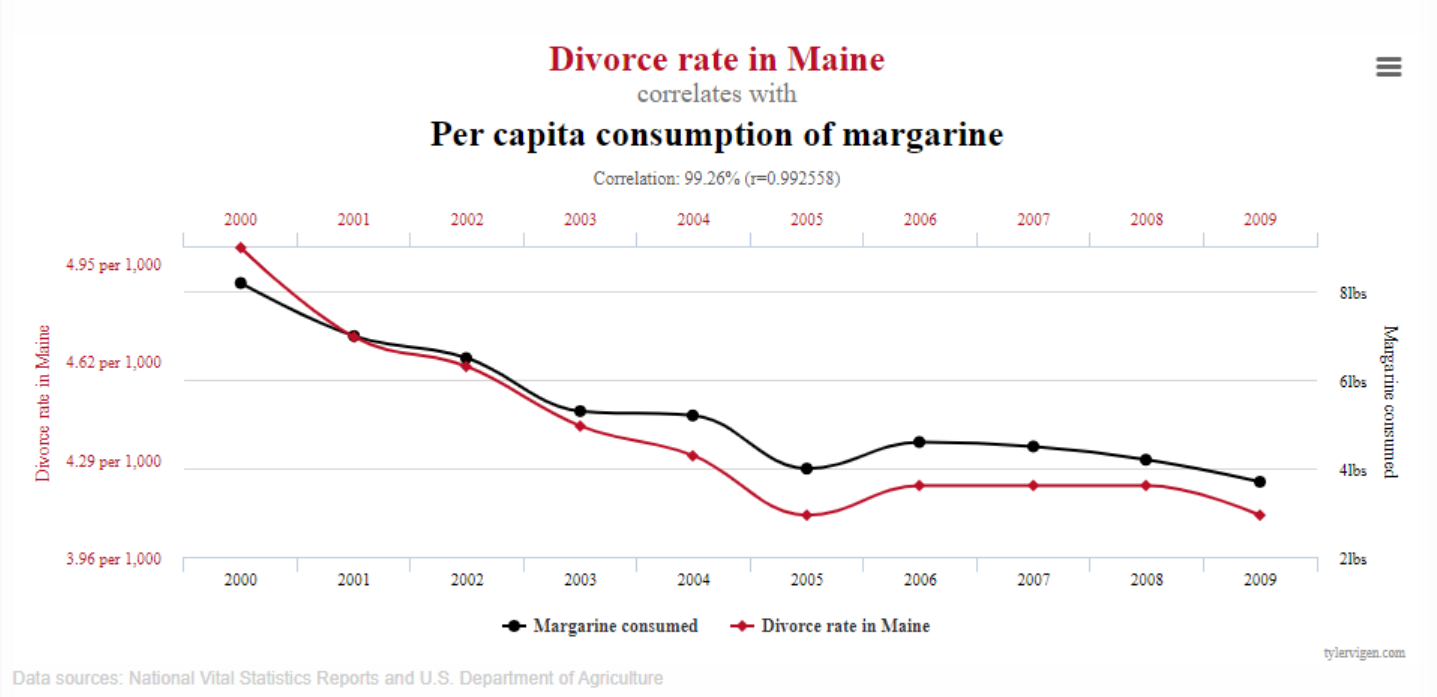

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Why?

We’ll get to this one at the end…

Building Dashboards that Drive Change

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Keys to Dashboard Design

- *Define Target Audience*
- *Define the Question/Problem*
- *Keep it Simple*
- *Choose the Right Visualization*
- *Tell a Story*
- *Allow Data Exploration*

Define Target Audience – Available Eval Slots

- Audience: Rehab Leadership, Schedulers, Therapists

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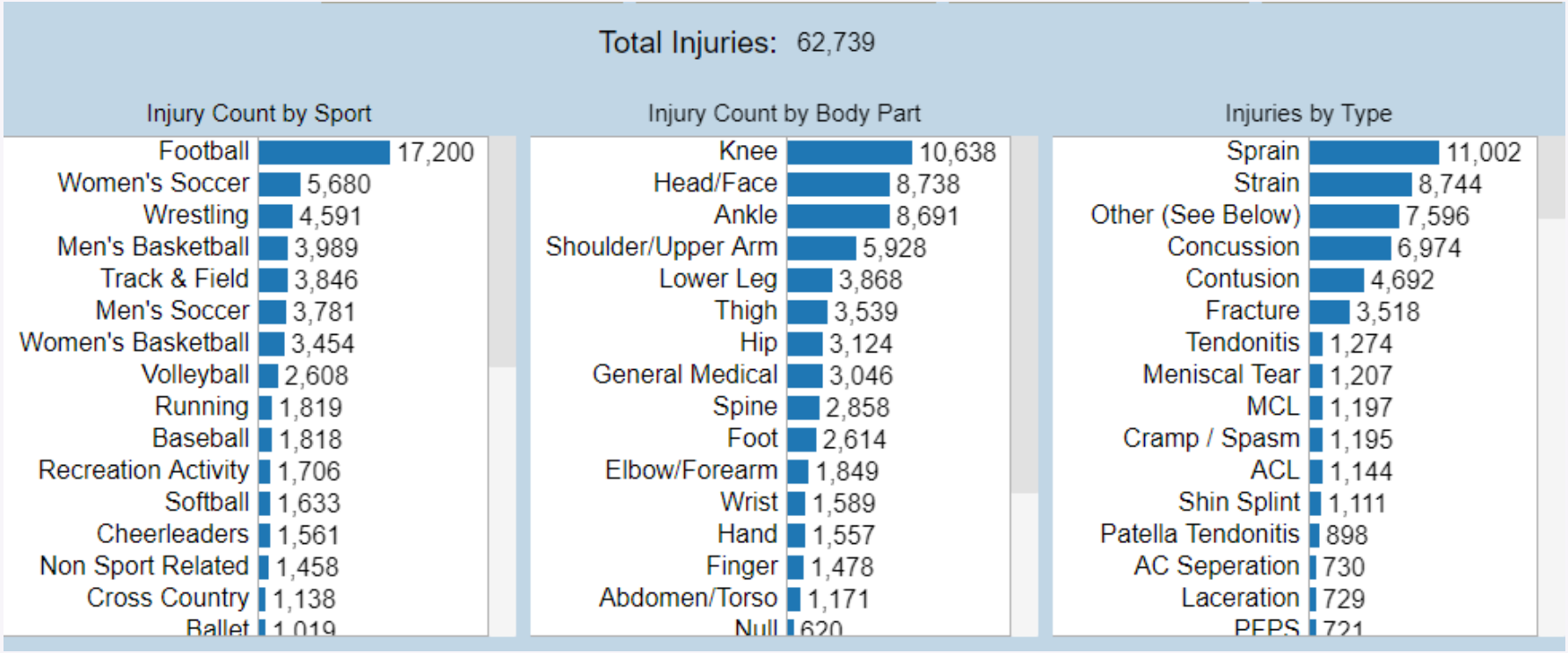
Define Target Audience – Athlete Injuries

- *Audience: Coaches and Athletic Trainers*



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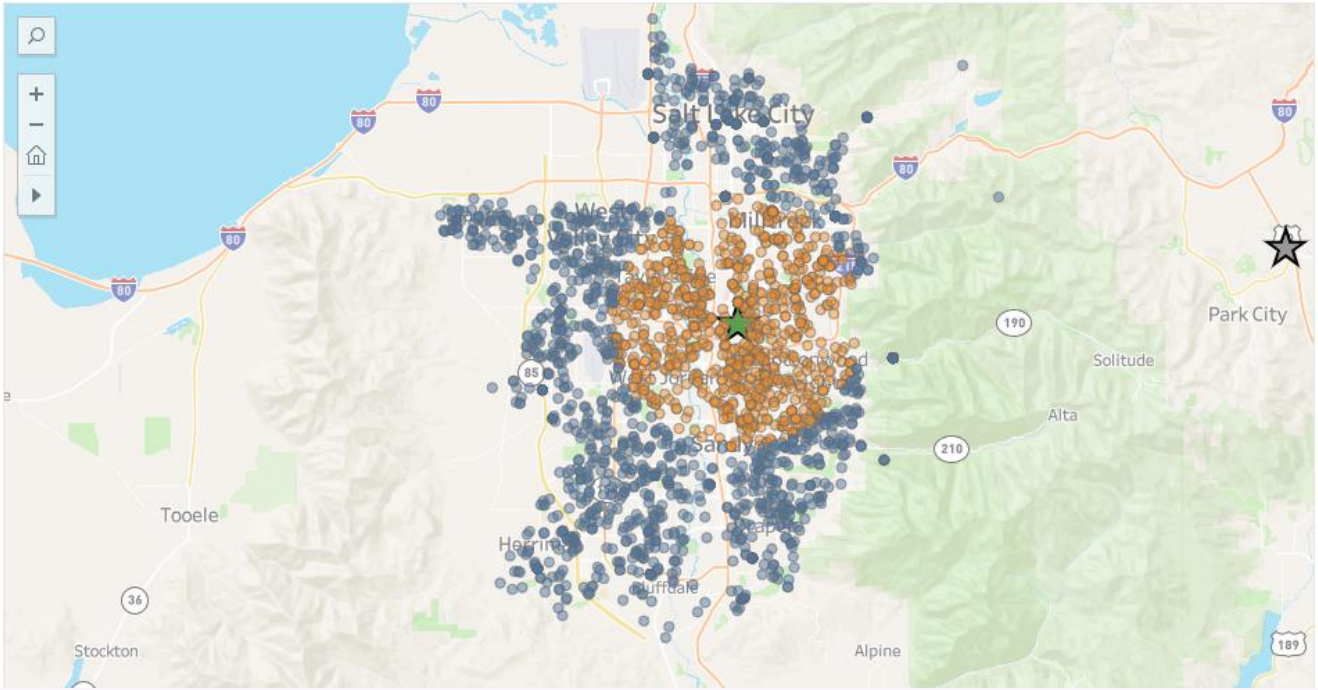
Define the Question/Problem

- How far are our patients traveling?
- Where should we build a new clinic?
- What is the Metric?
  - Patient Travel Time/Distance

Episodes	Patients	Avg Distance to TOSH	% of Patients within 5 Miles of TOSH
3,381	2,247	5.93	39.74%



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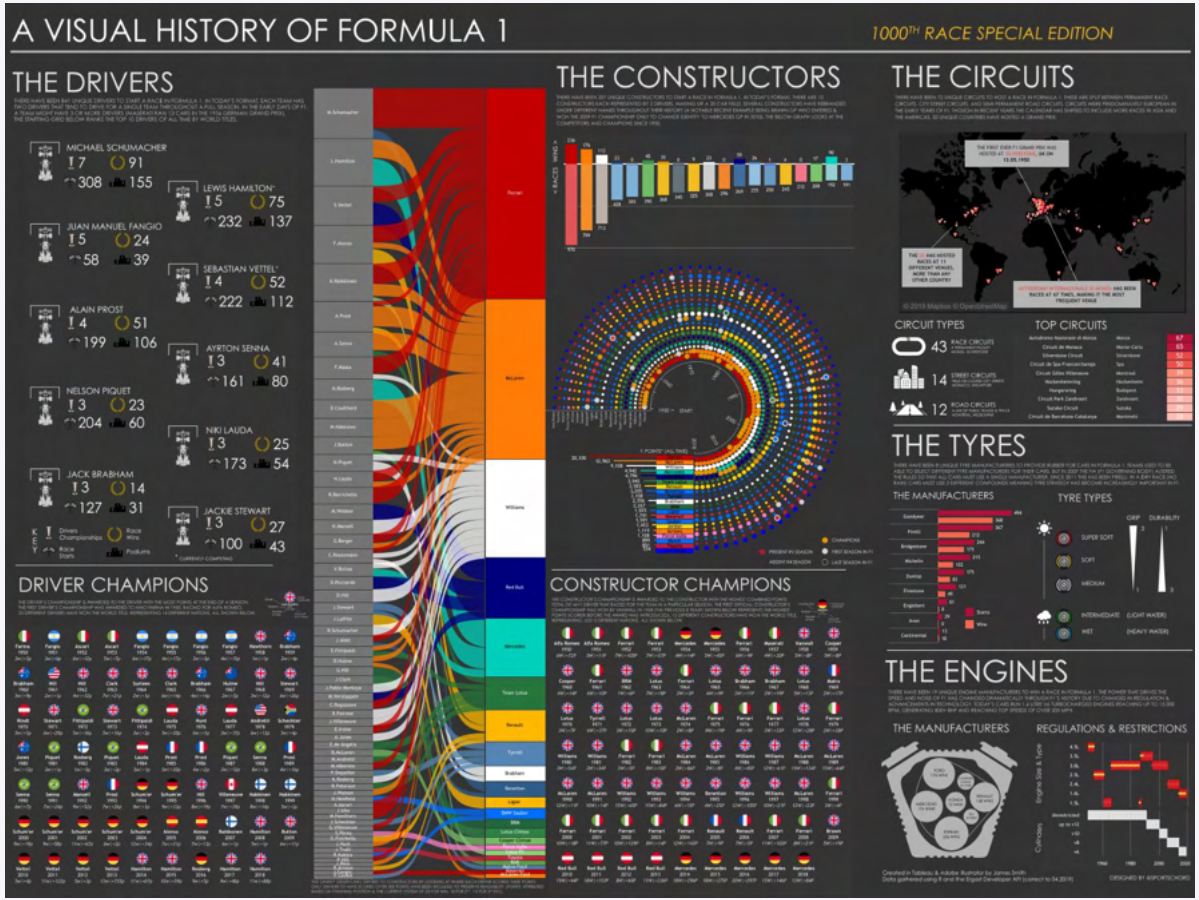
Keep it Simple – Which is Better?



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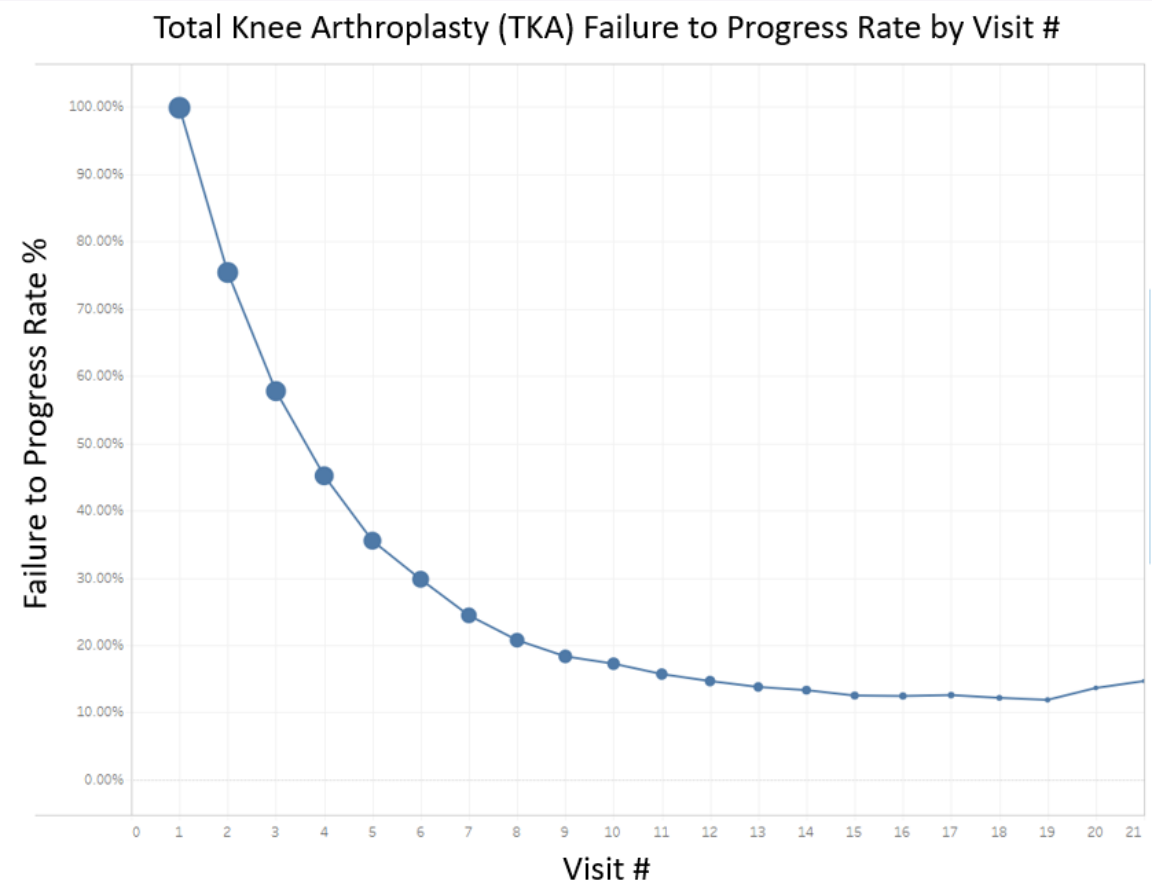

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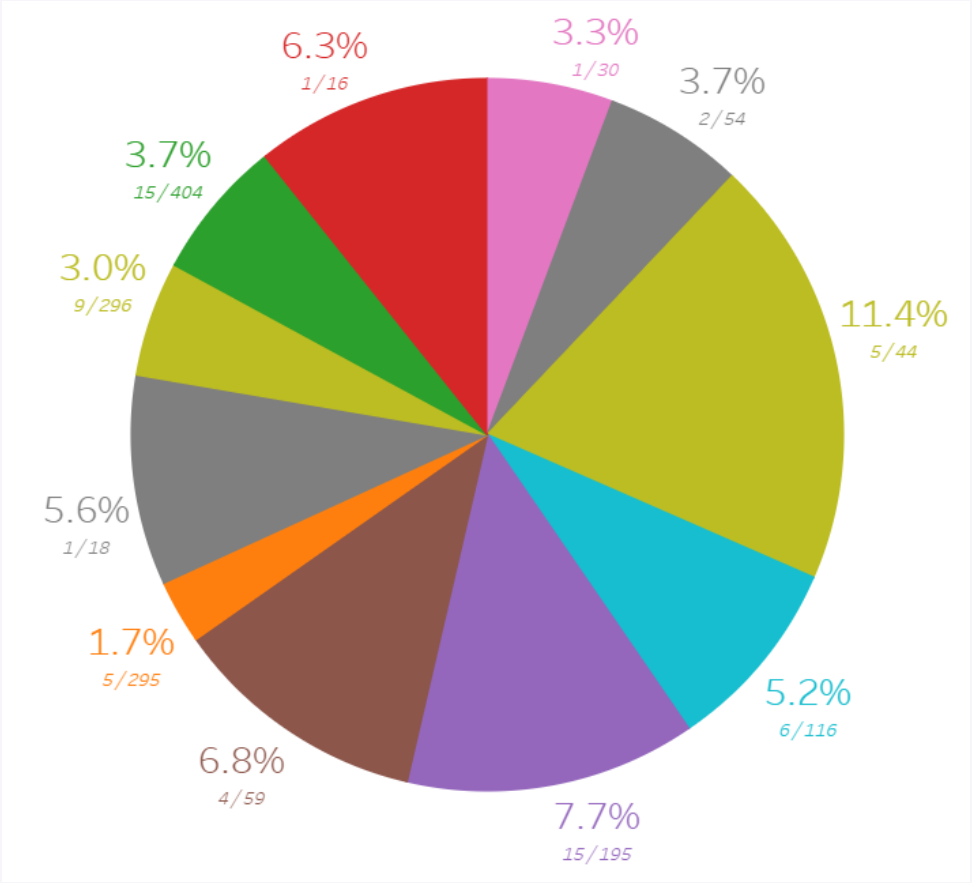
Choose the Right Visualization

Which Clinic had the 2nd Highest Failure Rate?



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Choose the Right Visualization

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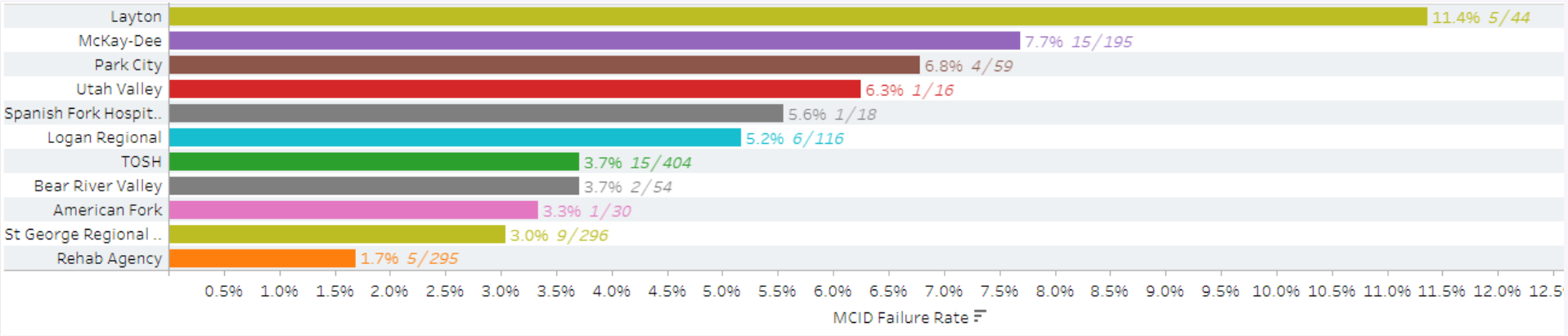

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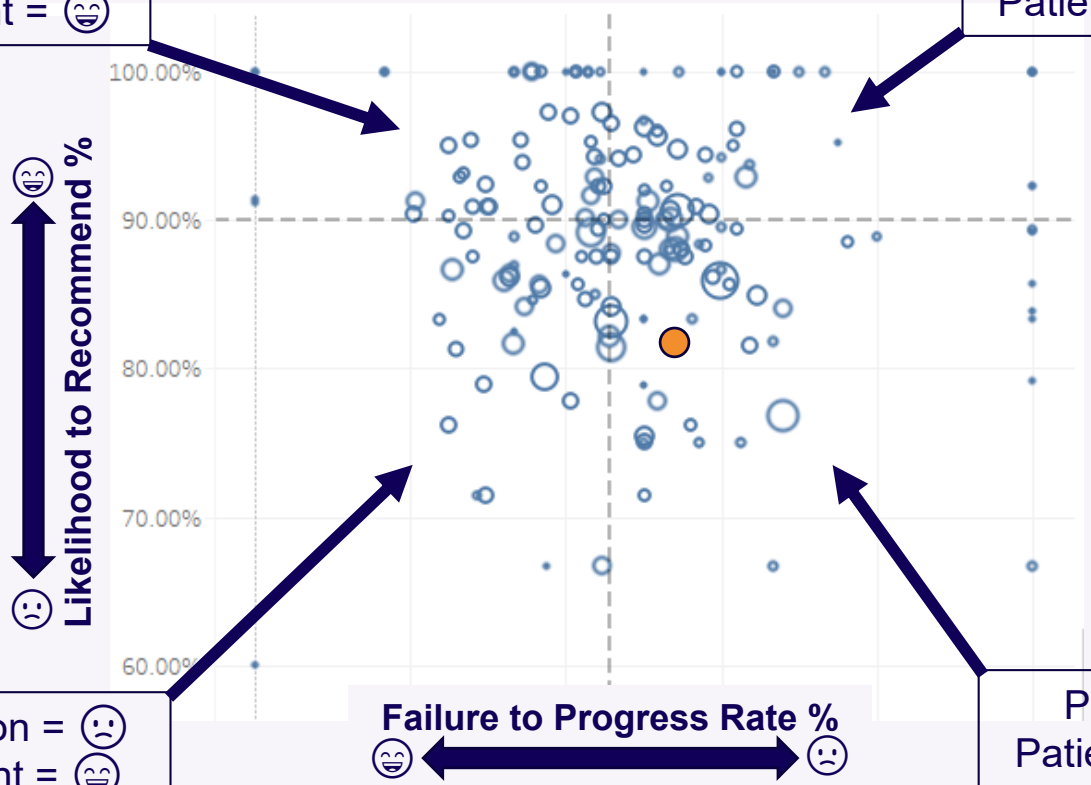
Tell a Story with Your Data

Therapist Name	Failure to Progress Rate	Likelihood to Recommend %
Therapist A	23%	86%
Therapist B	45%	42%
Therapist C	65%	72%
Therapist D	12%	81%
Therapist E	19%	32%
Therapist F	27%	30%
Therapist G	33%	74%
Therapist H	25%	92%
…	…	…

Tell a Story with Your Data

Patient Perception = 😄
Patient Improvement = 😄

Patient Perception = 😄
Patient Improvement = ☹

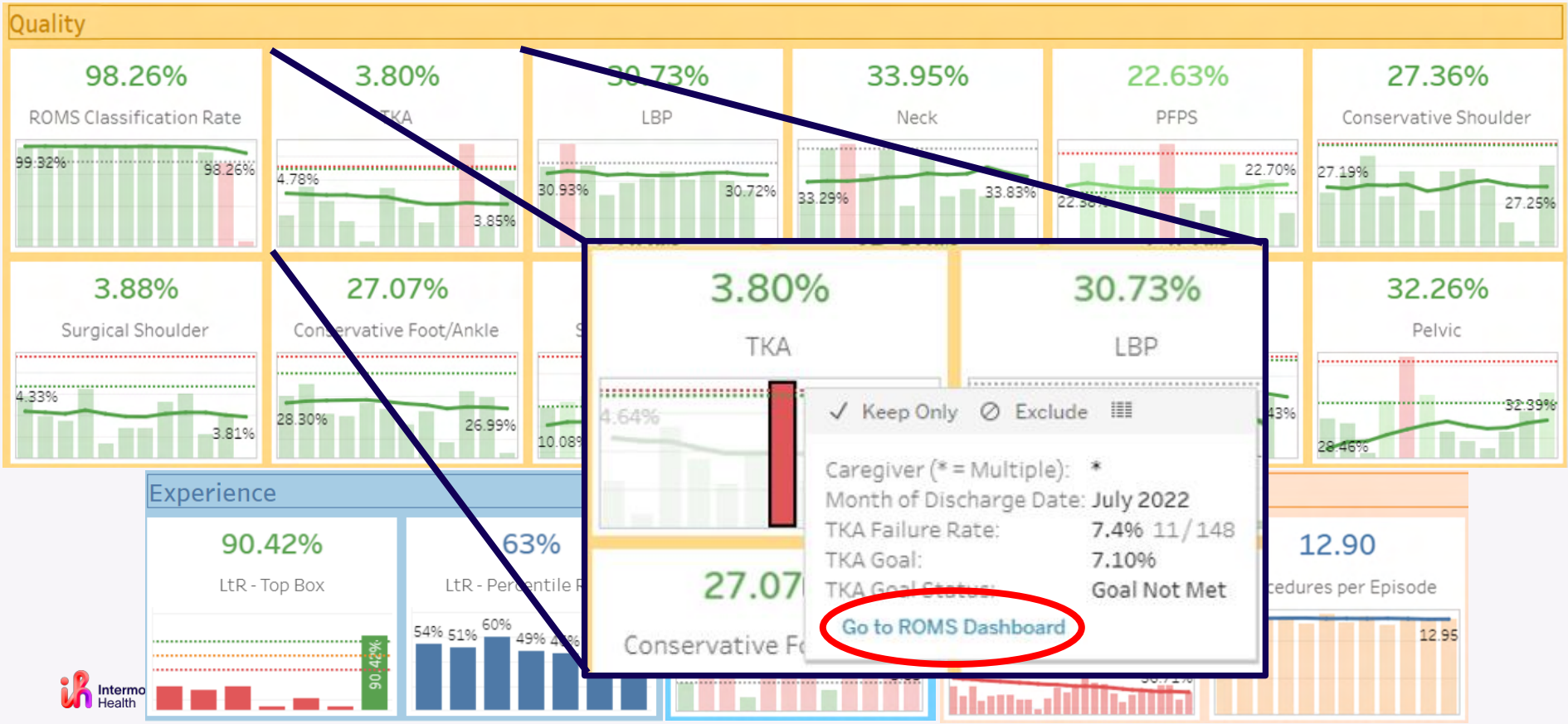


- Each Dot is a Therapist
- The size of the dot indicates patient volumes

Patient Perception = ☹
Patient Improvement = 😄

Patient Perception = ☹
Patient Improvement = ☹

Allow for Data Exploration/Validation

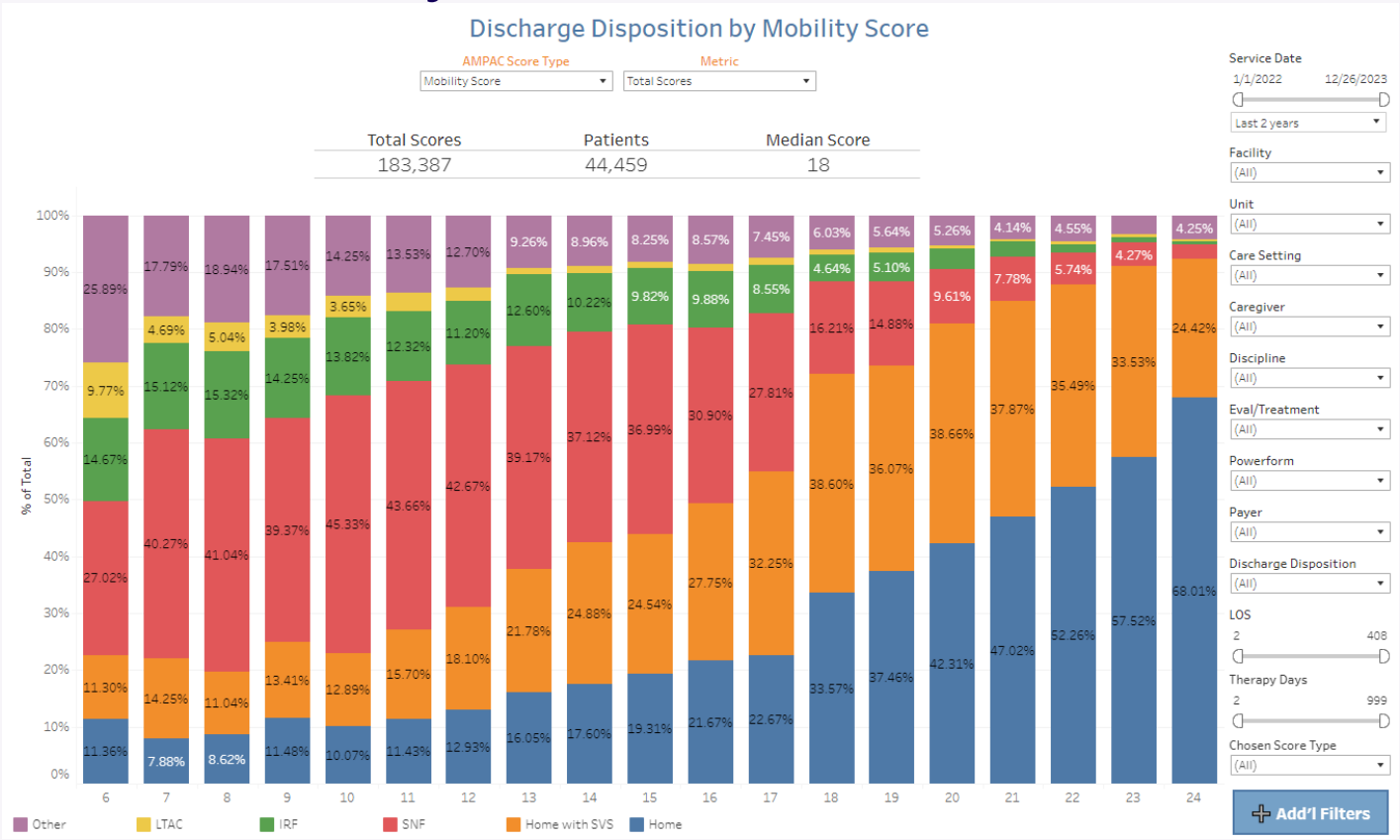


Keys to Dashboard Design

- *Define Target Audience*
- *Define the Question/Problem*
- *Keep it Simple*
- *Choose the Right Visualization*
- *Tell a Story*
- *Allow Data Exploration*

Dashboard Examples

Acute Rehab Analytics



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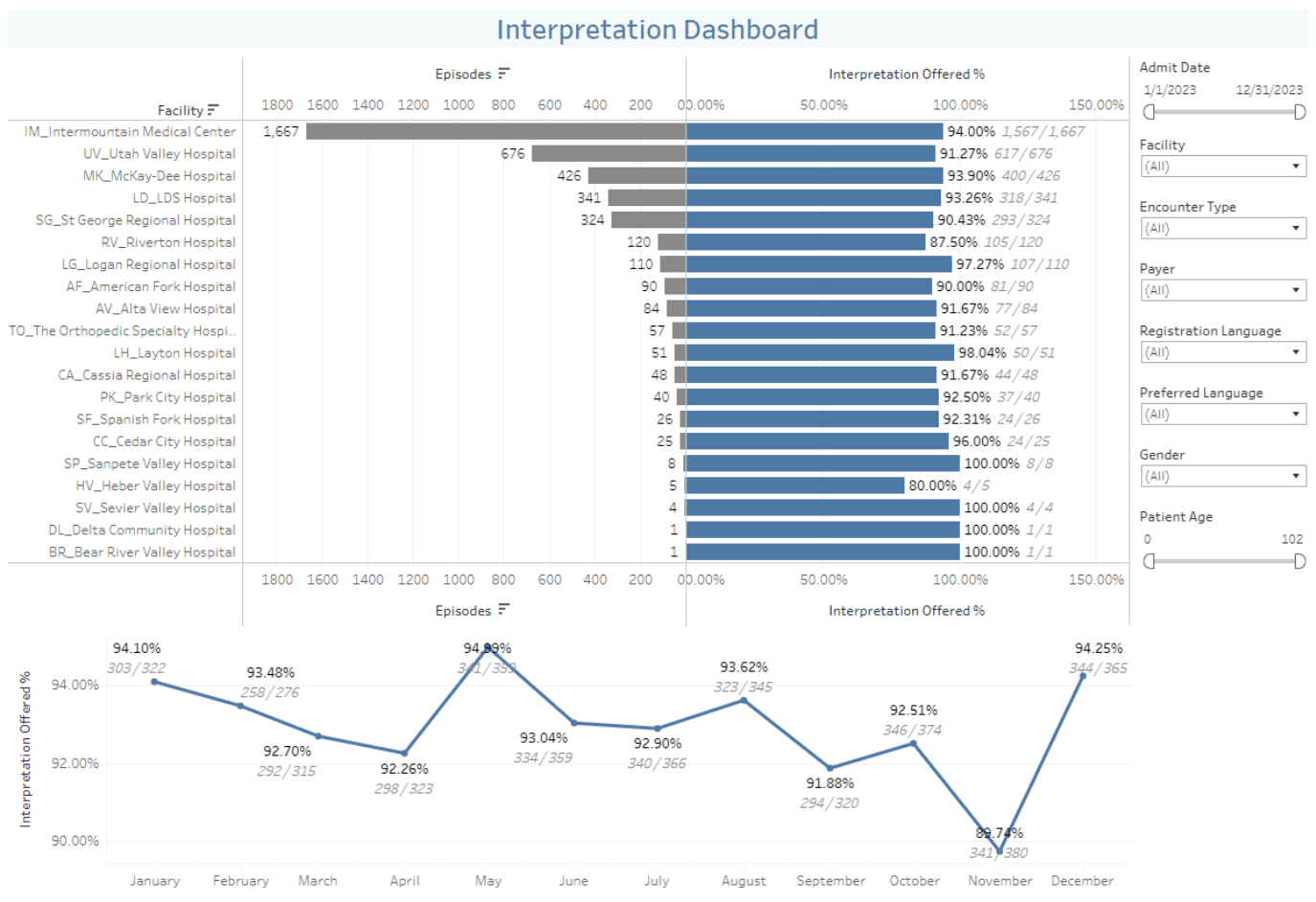
Acute Rehab Analytics



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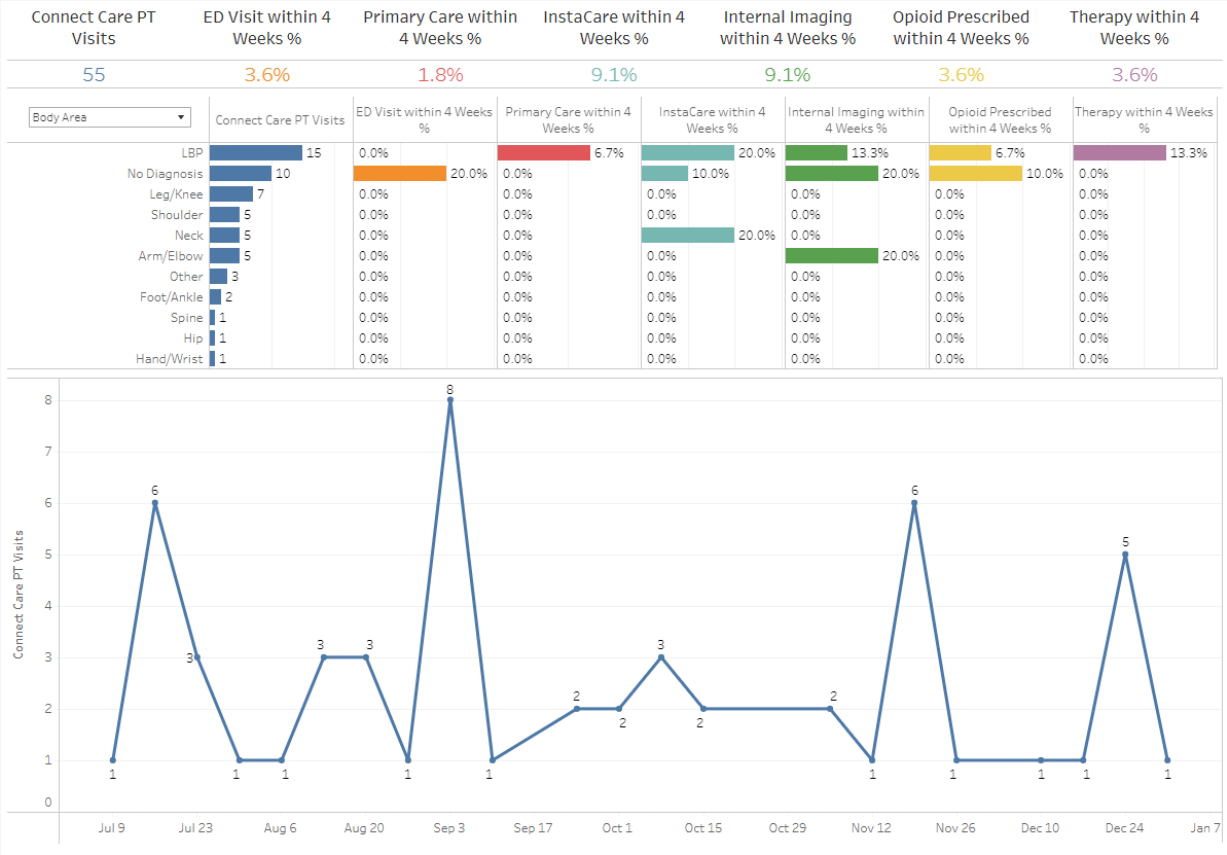
Connect Care PT



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Intermountain Health Rehab Equity Dashboard

Rehab Equity | Definitions

Intermountain Rehabilitation Services Equity Dashboard

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Patient Demographic Filters

Patient Age: 0 – 123
Gender: (All)
Language Filters
Race: (All)
Ethnicity: (All)
Religion: (All)
Marital Status: (All)
ADI Quintile/Value: (All)
-40.0 – 139.4
City: (All)
County: (All)
Zipcode:

Facility Filters

Facility: (All)
Unit: (All)
Dist. to Facility (mi.): 0.03 – 6,301.04

Encounter Filters

Admit Date: 1/1/2022 – 3/1/2023
Rehab Setting: (All)
Encounter Type: (All)
Payer: (All)
Admit Source: (All)
Admit Type: (All)
Admitted Through ED: (All)
Discharge Disposition: (All)
Telehealth?: (All)
LOS in Days (Admit to Discharge): 0.00 – 450.71
LOS in Days (First to Last Charge): 0.00 – 738.96
Disciplines Involved: (All)

Diagnosis Filters

Diagnosis Category: (All)
Primary Diagnosis: (All)
IRF RIC: (All)
IRF PIC: (All)
ROMS Class. Group: (All)
ROMS Classification: (All)
ROMS Body Area: (All)
ROMS Treatment Type: (All)

Outpatient Filters

ROMS Outcome: (All)
Successful Outcome?: (All)
FTP (MCID)?: (All)
FTP (30%)?: (All)
Chronic?: (All)

Additional Filters

Billing Filters
AMPAC Filters

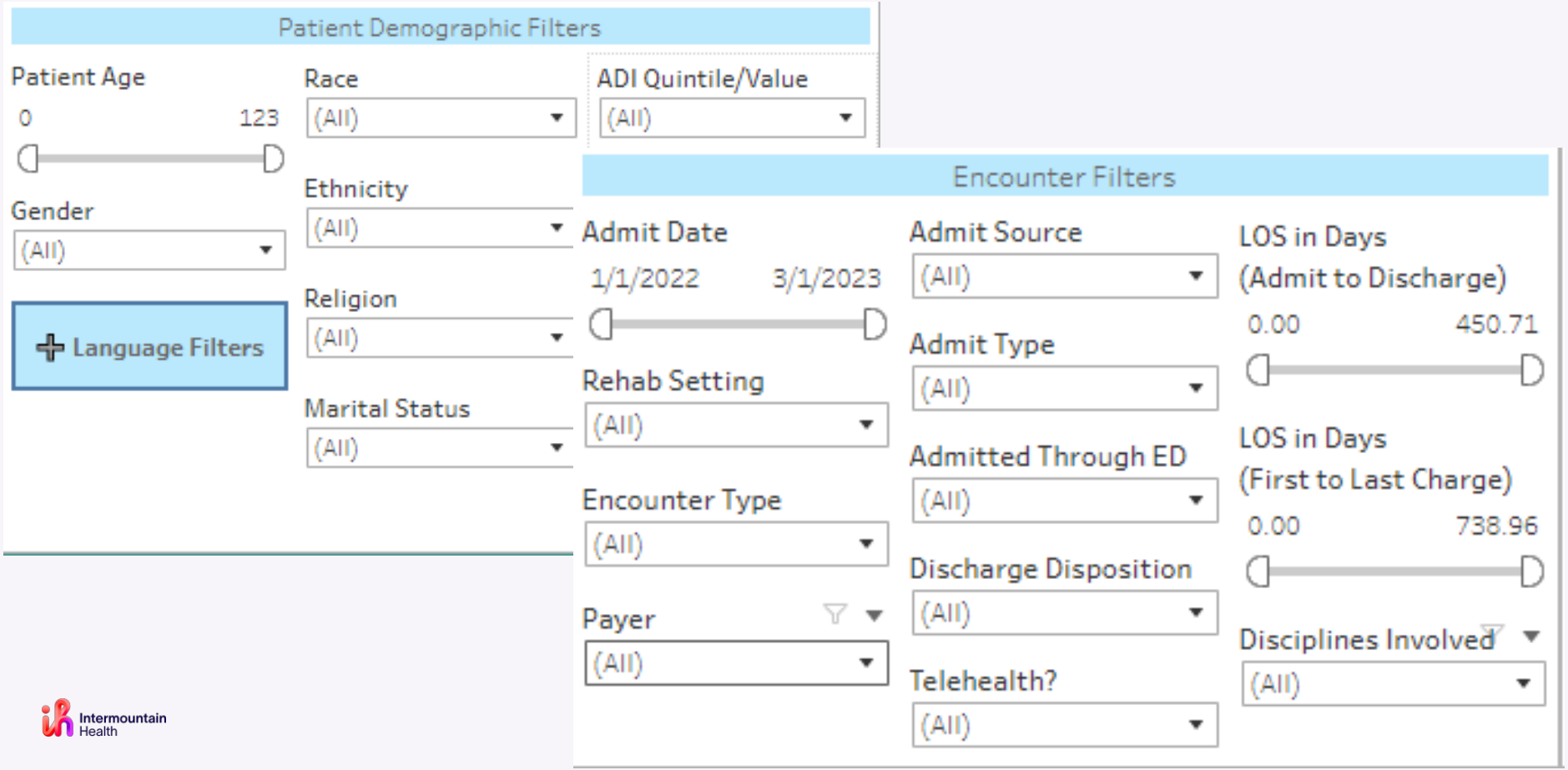
Choose Variable 1: None
Choose Variable 2: None
Choose Variable 3: Race
Choose Metric: Avg Billed Patient Days

Avg Billed Patient Days Broken Down by Race

Chosen Variable 1	Chosen Variable 2	Chosen Variable 3	Number of Patients	Chosen Metric
Grand Total			154,523	4.908
None	Total		154,523	4.908
	None	Total	154,523	4.908
		White	136,756	4.888
		Unavailable	6,522	4.946
		Patient Declined	3,689	4.782
		Asian	2,321	4.861
		Native Hawaiian or Pacific Islander	1,829	5.481
		Black or African American	1,671	5.501
		American Indian or Alaska Native	1,280	5.768
		Multiple	430	4.558
		Null	25	12.000

Number of Patients: 0K 20K 40K 60K 80K 100K 120K 140K 160K 180K
Chosen Metric: 0 2 4 6 8 10 12 14

Rehab Equity Dashboard - Filters



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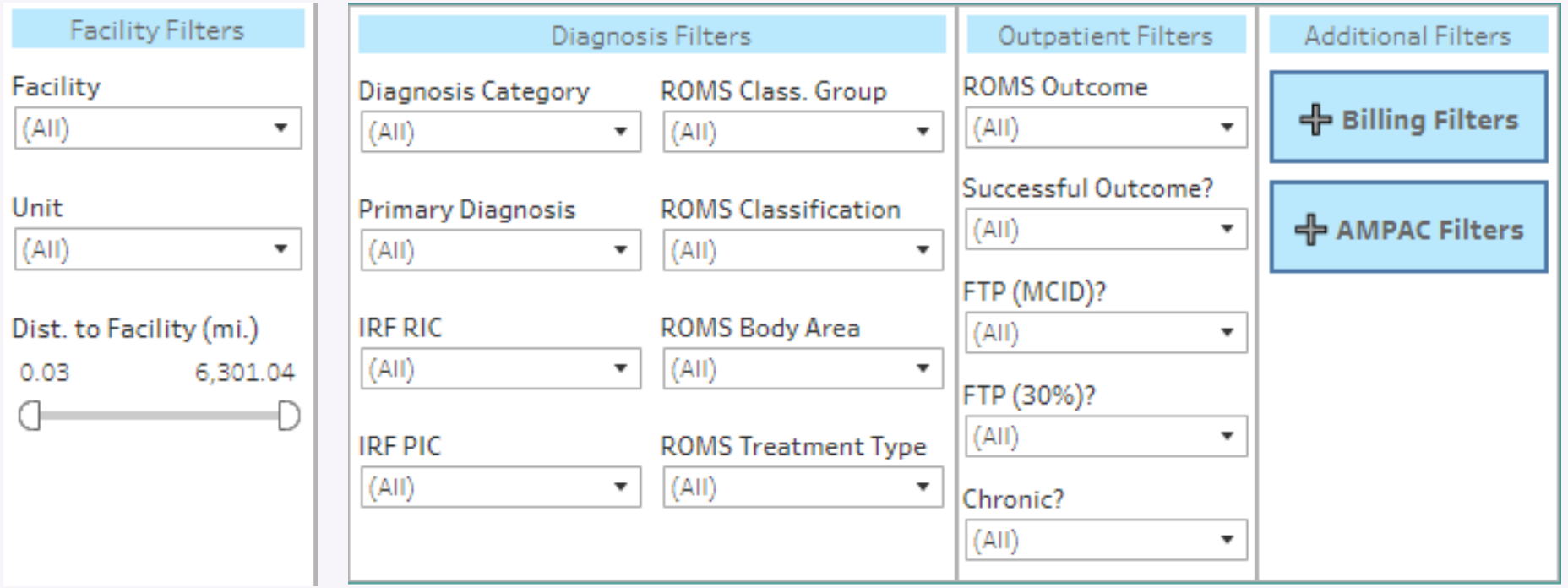
Rehab Equity Dashboard - Filters



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Rehab Equity Dashboard - Variables

38 Variables Total

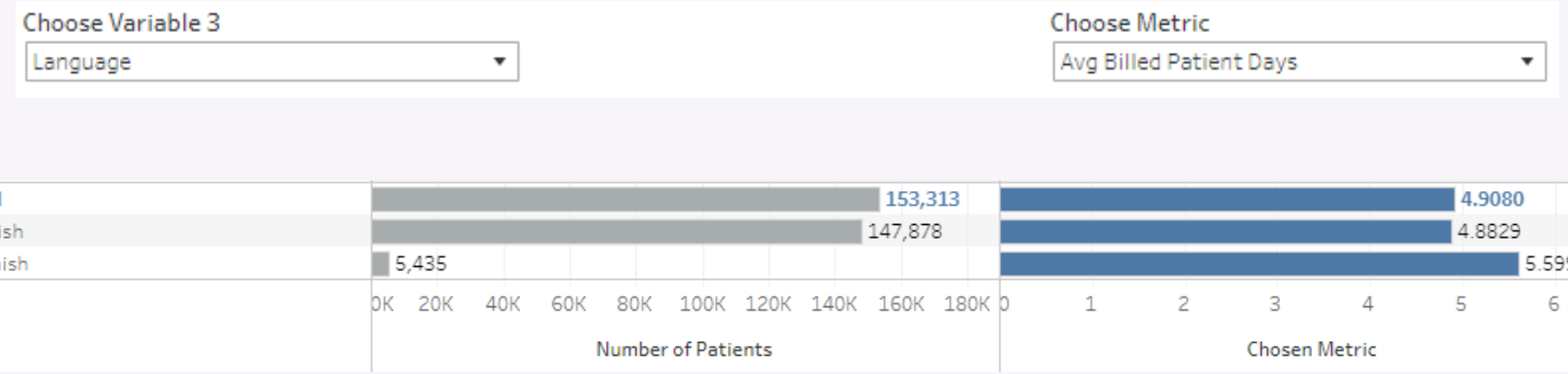
- Admit Year
- Admit Month
- ADI Quintile
- Admit Source
- Admit Type
- Admitted Through ED
- Age
- Chronic
- City
- County
- Diagnosis Category
- Discharge Disposition
- Discipline
- Encounter Type
- Ethnicity
- Facility
- Gender
- Interpretation Needed
- Interpretation Offered
- Interpretation Missed
- Language
- Marital Status
- Payer
- IRF Impairment Codes
- Preferred Language
- ICD-10 Diagnosis
- Race
- Rehab Setting
- Religion
- PRO Survey
- PRO Classification
- PRO Class. Group
- PRO Body Area
- PRO Treatment Type
- Telehealth Present
- Unit
- Zipcode

Rehab Equity Dashboard - Metrics

55 Metrics Total

- Number of Patients
- Number of Episodes
- Total Visits/Patient Days
- Avg ADI Value
- Avg Age
- Avg Billed Amount
- Avg Billed Patient Days
- Avg Insurance Payment
- Avg LOS (Admit to DC)
- Avg LOS (First Charge to Last Charge)
- Avg Outpatient Visits
- Avg Patient Payment
- Avg Procedures per Episode
- Avg Admit PRO
- Avg Admit Pain
- Avg Discharge PRO
- Avg Discharge Pain
- Avg PRO Change
- Avg Pain Change
- Avg Travel Distance
- Failure to Progress (MCID)
- Failure to Progress (30%)
- Median ADI
- Median Billed Amount
- Median Billed Patient Days
- Median Insurance Payment
- Median LOS (Admit to DC)
- Median LOS (First Charge to Last Charge)
- Median Outpatient Visits
- Median Patient Payment
- Median Procedures per Episode
- Median Travel Distance
- Median Admit PRO
- Median Admit Pain
- Median Discharge PRO
- Median Discharge Pain
- Median PRO Change
- Median Pain Change
- Successful Outcome %
- AMPAC Mobility Scores
- Avg First Mobility Score
- Avg Last Mobility Score
- Avg Mobility Score Change
- AMPAC Activity Scores
- Avg First Activity Score
- Avg Last Activity Score
- Avg Activity Score Change
- AMPAC Cognitive Scores
- Avg First Cognitive Score
- Avg Last Cognitive Score
- Avg Cognitive Score Change
- JHHLM Scores
- Avg First JHHLM Score
- Avg Last JHHLM Score
- Avg JHHLM Score Change

Rehab Equity Dashboard



38 Possible Variables for Variable 1
38 Possible Variables for Variable 2
38 Possible Variables for Variable 3
55 Possible Metrics

$$38 \times 38 \times 38 \times 55 \approx 3\ Million$$

Possible Combinations

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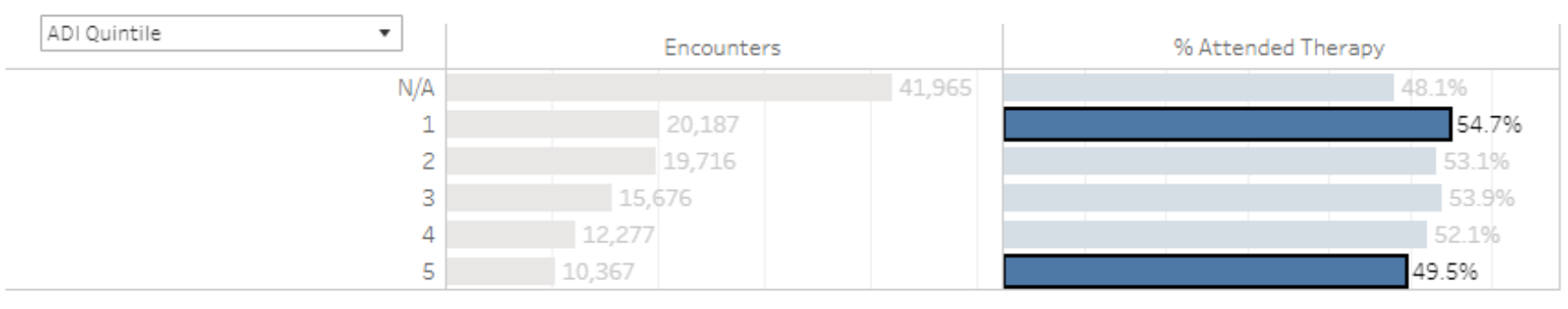
Rehab Equity – Next Steps



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Rehab Reports at Intermountain Health

Acute Rehab Caregiver Scorecard
Acute Rehab NICU Orders
Acute Rehab NICU Visits
Acute Rehab Orders
Acute Rehab Payer Mix
Acute Rehab Volumes
AMPAC Dashboard
AMPAC Nursing Dashboard
Arthritis Dashboard
Athletic Trainer Dashboard
Athletic Training Cost Avoidance
Authorization Tracker
CBC Rehab Billing Review
CBC Rehab Caregiver Dashboard
CBC Rehab Eval Calendar
CBC Rehab Likelihood to Recommend
CBC Rehab Procedures Dashboard
CBC Rehab Scheduling Dashboard
CBC Rehab Third Next Available
CBC Rehab Time Analysis
CI Portal Ideas
Clinical Services Caregiver Injuries
Concussion Dashboard
Custom ROMS Patient List
Dashboard Instructions and Troubleshooting
Dry Needling Report
Falls Dashboard
Glucose Management Dashboard
Hearing Aid Volumes
High Value Provider Network
iCentra Discharge Call List
iCentra Document Search
iCentra Outcome Measures Utilization
IMC Stroke Patient List
Inpatient Rehab Dashboard
Inpatient Rehab Readmissions
Insurance Utilization
IRF Audit Dashboard
IRF CI Portal Thumbnails
IRF Discharge Orders
IRF Falls with Injury
IRF Family Education
IRF Heatmap
IRF Outcomes Dashboard
IRF Readmissions
IRF Therapy Times
IRF Wound Dashboard
MedBridge Utilization
Medicare Cert Letter Audit
Missed Therapy Dashboard
Modified Barium Swallow Dashboard
Newborn Hearing Screens
NOMS Dashboard
NSRU Social Determinants of Health
Optimize Fidelity Report
Optimize Patient List
OPTIMIZE Patient Schedule
Patient Centered Dashboard
PCH Inpatient Rehab Dashboard
PCH IRF Therapy Times
PCH Rehab Patient List
PCH Rehab Patient List Custom
PCH Rehab Patients
Pelvic Health Dashboard
Previous 3 Days Low Glucose
Provider Patient Management Report
PT/OT Eval Complexity
Rehab Agency Encounters
Rehab Agency Encounters with GL Adjustments
Rehab Agency Medicare Encounters
Rehab Con Ed Requests
Rehab ED Dashboard
Rehab Efficiency Dashboard
Rehab Equity Dashboard
Rehab Evals Dashboard
Rehab Likelihood to Recommend
Rehab Missing Charge Report
Rehab Outpatient No Shows/Cancellations
Rehab Outpatient Payer Mix
Rehab Previous 3 Days Low Glucose
Rehab Progress Note Dashboard
Rehab Readmissions
Rehab SafetyNet Dashboard
Rehab Services Daily Charging Report
Rehab Services Outcomes
Rehab Services PMPM
Rehab Services Productivity Stats
Rehab Services Referring Physician Report
Rehab Telehealth Dashboard
ROMS Data Cleanup Report
ROMS Data Export
ROMS Discharge Call List
ROMS ED Referral Patient List
ROMS Eval Audit
ROMS Patient Heatmap
ROMS Patient Heatmap Test
ROMS Provider Lookup Report
ROMS SelectHealth Paneling
ROMS TKA Admissions
Sports Medicine Downstream Encounters
Therapy Referrals
TOTR - Missing EMPI
Stroke Study Patient List
WorkMed Post Offers

100+ Analytic Reports for Rehab!

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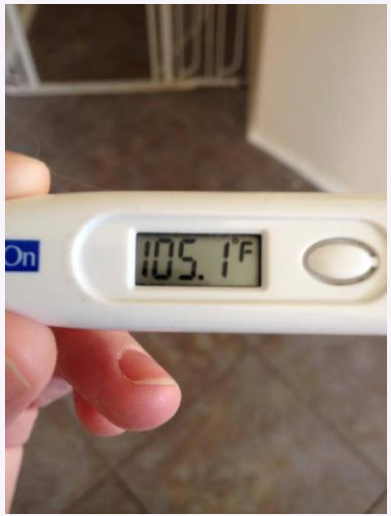
Why?

Helping People Live the Healthiest Lives Possible



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Questions?

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Thank you!

Devyn.Woodfield@imail.org

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