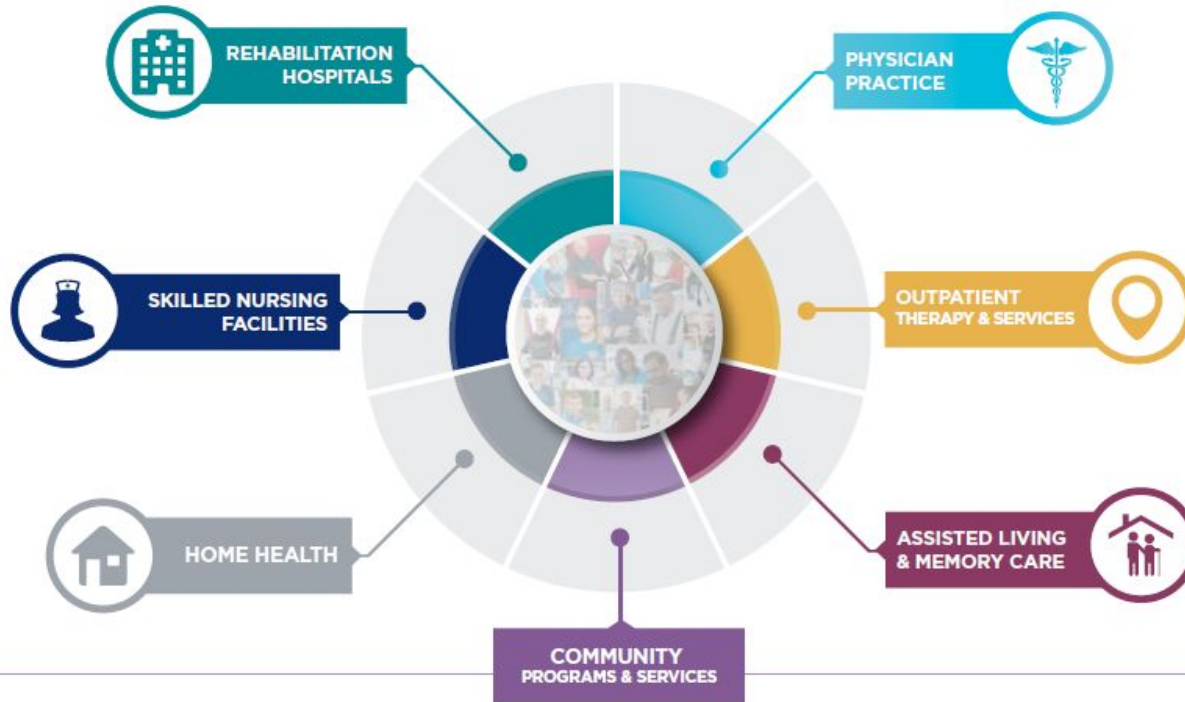


Integrating Data from Multiple EMRs to Enhance a Learning Health System

LeaRRn Summit – Building Data Infrastructure
2024

Mindi R. Manes, PhD
Director, Center for Outcomes Analytics & Research (COAR)
Brooks Rehabilitation

Brooks Rehabilitation System of Care



ADAPTIVE SPORTS & RECREATION • APHASIA CENTERS • BRAIN INJURY DAY TREATMENT PROGRAM • BRAIN INJURY CLUBHOUSE
CONTRACT THERAPY SERVICES • HELEN'S HOUSE • INSTITUTE OF HIGHER LEARNING • NEURO RECOVERY CENTERS • PEDIATRIC RECREATION
RESEARCH • SCHOOL RE-ENTRY PROGRAM • SPINAL CORD INJURY DAY TREATMENT PROGRAM • SUPPORT GROUPS • WELLNESS

Complex Patient Care Pathways

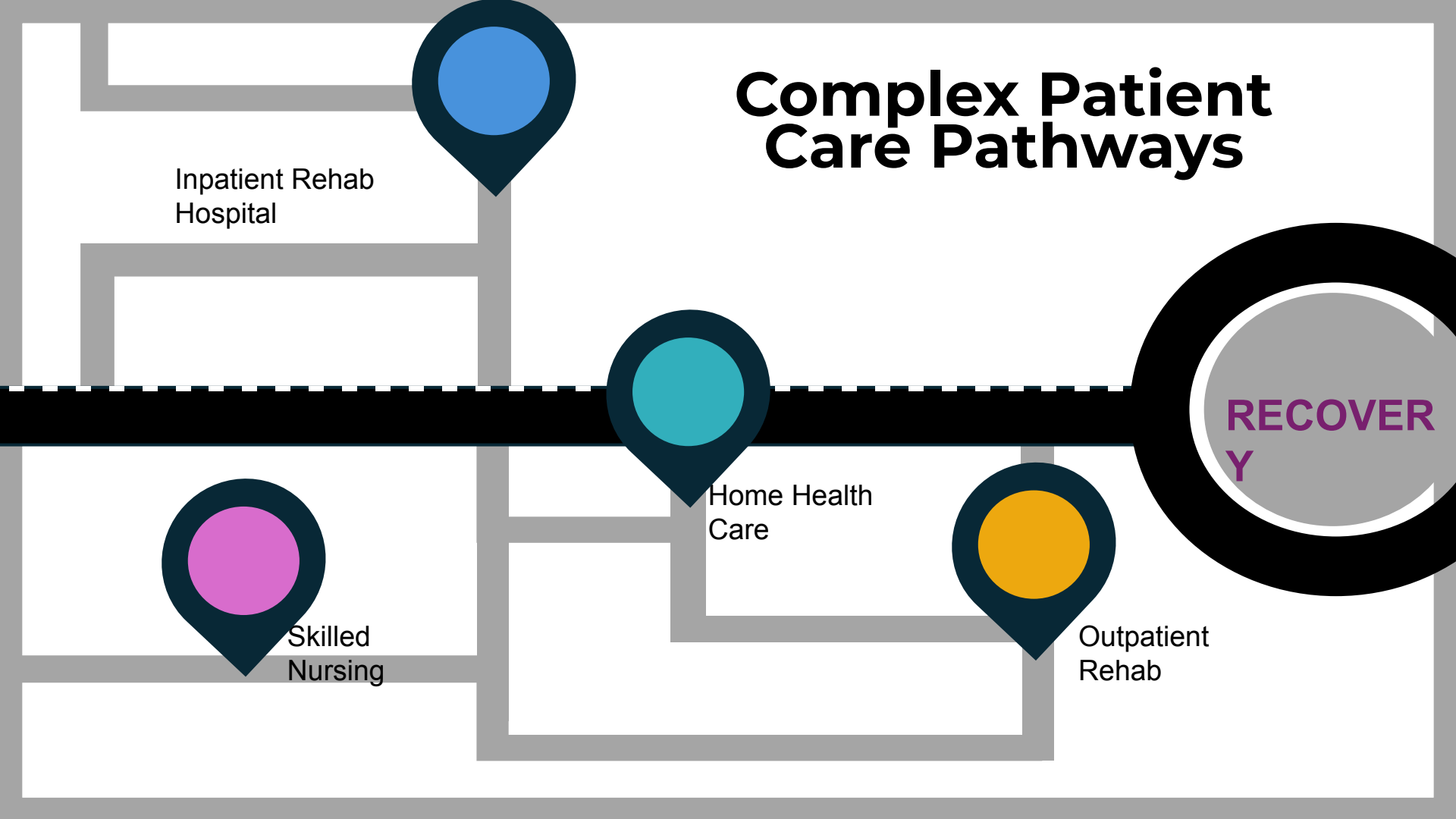
Inpatient Rehab
Hospital

Home Health
Care

Skilled
Nursing

Outpatient
Rehab

RECOVER
Y



Disparate EMRs



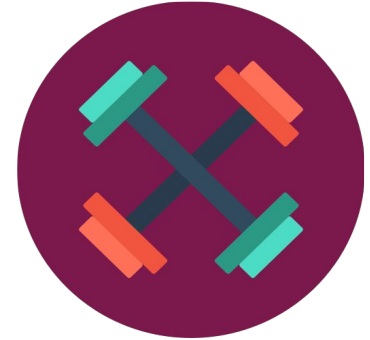
**IRF & Physician
Practice EMR(s)**



**Skilled Nursing &
Assisted Living
EMR**



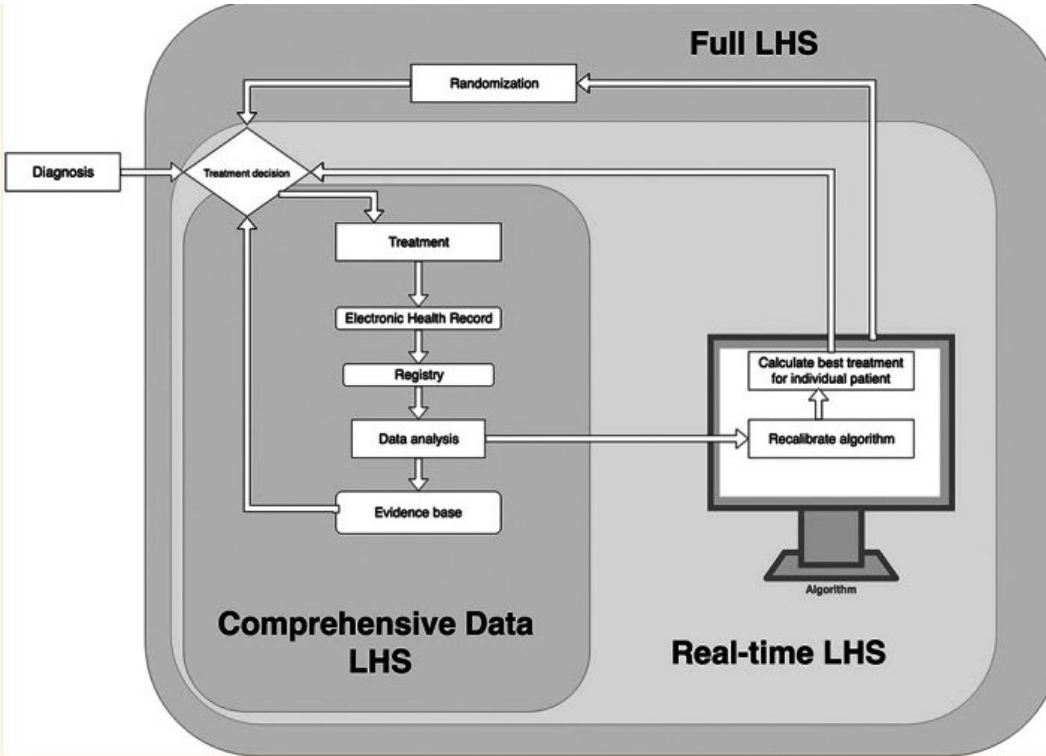
**Home Health
Care EMR**



**Outpatient
EMR**

“...Establishing infrastructure for digital data capture is central to LHS implementation and therefore, researchers and health systems leaders may want to prioritize this aspect of implementation for advancing LHS transformation.” (Somerville et al. 2023)

LHS Models



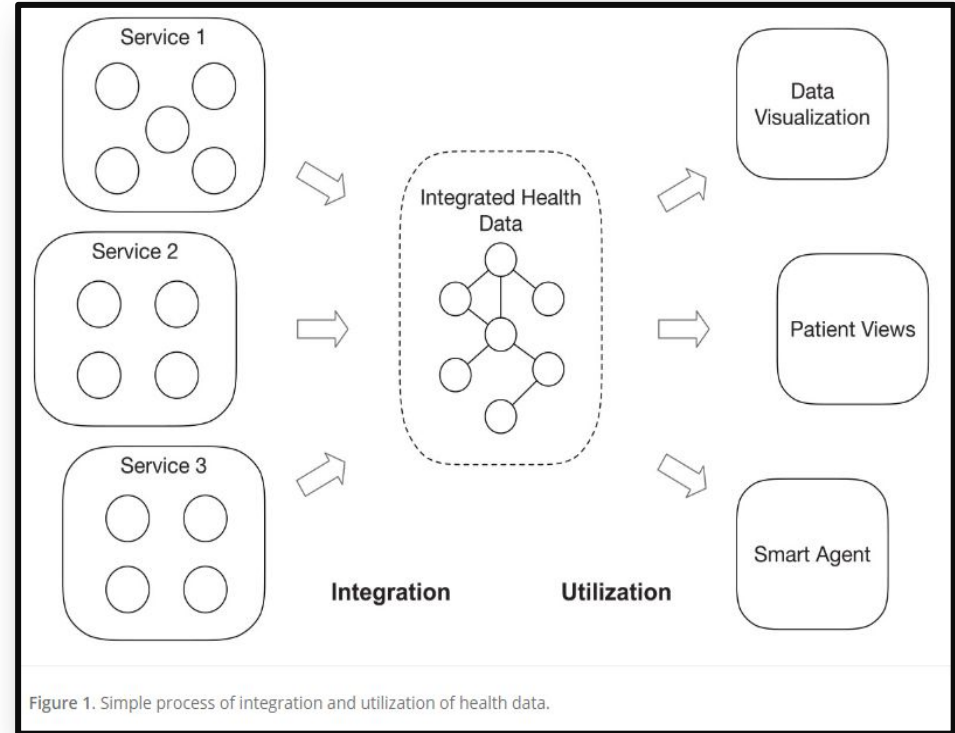
(Wouters et al. 2020)

- Comprehensive Data LHS: Continuous stream of systematically captured clinical data that can be analyzed
- Real-time LHS: Provides real-time feedback at point of care
- Full LHS: Typical trial methodologies should be embedded in clinical care

LHS models rely on a foundationally robust data infrastructure!

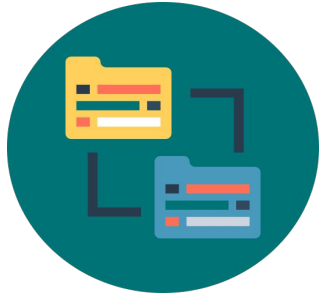
Health Data Integration

- Integration is *“health data from heterogeneous or distributed sources processed by a certain approach to act as they come from one source in a seamless way”* (Peng & Bai, 2020)
- Discovering, moving, and combining data from multiple sources to drive insights and power machine learning and advanced analytics (Google Cloud)



Key Components of Data Infrastructure

Data Integration



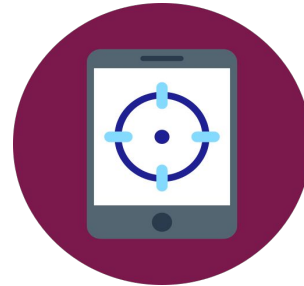
Combining data from various EMR (and other) data systems

Data Standardization



Ensuring data consistency across different EMRs

Data Security



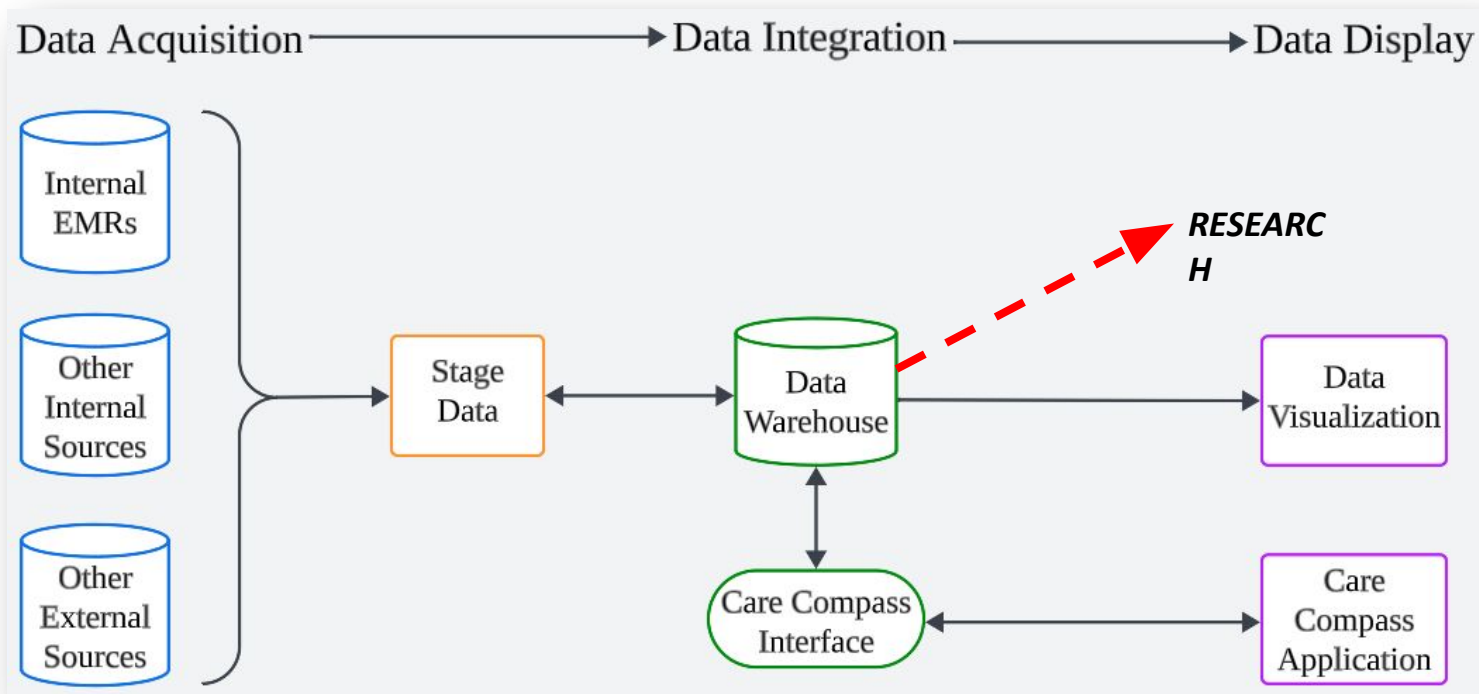
Protecting sensitive patient information

Data Management



Efficient storage, retrieval, processing and analysis of integrated data

Brooks Data Infrastructure



Key Challenges in Data Integration






- Data Silos & Interoperability
- Data Transformation & Standardization
- Data Quality and Integrity
- Data Privacy and Security
- Cost and Complexity
- Data Governance and Change Management


New challenges arise when integrating data for research rather than operational purposes

Solutions: Data Silos & Interoperability

- Enterprise Master Patient Index (EMPI)
 - Algorithm for matching records across systems
- Centralized Data Warehouse (CDW)
 - SQL relational database following a star schema storage format
 - Data transformation and normalization
 - Robust
 - Scalable and flexible
 - Data projections for analytics and reporting

Patient Services Tracking

 Keeping patients in the System    1 

 Summary Data YTD data Discharge by Month and year Discharge Details Discharge Details by



YTD Brooks to Brooks Admissions

DischargeYear ▼	YTD BrooksToBrooks Admissions ▲	Previous Year YTD	Percent Difference from Previous year	
2021	2,020.00	1,994.00	1.3%	
2022	2,245.00	2,020.00	11.1%	
2023	2,541.00	2,245.00	13.2%	
2024	2,582.00	2,541.00	1.6%	

Brooks Care Compass

Patient Details

Test, Patient

Brooks Rehab Hospital University 5/23/2019 - 6/7/2019

Room 3602-A |

J96.21 ACUTE AND CHRONIC RESPIRATORY FAILURE WITH HYPOXIA

FollowEdit

Comorbidities

R11.11

N17.9

E03.9

Z79.02

I42.8

F32.0

I13.0

Z79.01

O64.9

Z51.89

F41.9

E66.01

T21.12XD

Z86.71B

E78.5

G47.33

N18.4

Z68.43

T31.0

R53.1

Z79.51

I50.43

M19.072

I44.7

J96.22

Activity

New ▾Filter ▾Viewing all activity

Admission

Outpatient | 6/10/2019 - 12/14/2019

Diagnosis unknown

Referred by

Documentation

Inpatient Leader Rounding - Mid Stay

Brooks Rehab Hospital University - 5/23/2019

Documentation

Inpatient Leader Rounding - Beginning of Stay

Brooks Rehab Hospital University - 5/23/2019

Admission

Brooks Rehab Hospital University | 5/23/2019 - 6/7/2019

ACUTE AND CHRONIC RESPIRATORY FAILURE WITH HYPOXIA

Referred by

Activity

New Activity ▾Filter ▾Viewing all activity

Rounding

All well during patient rounds, no issues noted

Mindi.Manes@Brooksrehab.org on 2/28/2020 12

Patient reported no issues or concerns at this

Rounding

Issue Noted

Mindi.Manes@Brooksrehab.org on 2/28/2020 12

Nursing - Delayed response to call bell

Wait time longer than expected.

Resolve

Inpatient Hospital - Readmission Review

Patient Test,

Halifax/Brooks Hospital JV - Test Room

8/30/2022 -

Return to Acute Date

Planned

Yes

No

Originating Hospital

LOS

Symptom from chart

Transfer Readmitting Dx (if known)

Solutions: Data Standardization



Backend Data Transformation

- Normalize, formatting, organizational structure, granularity
- Industry standards



Front End Data Transformation

- Modification of front end of EMRs
- Add discrete fields, where possible
- Additional data collectors

Standardizing Outcomes Across the System

Phase 1

- Completed December 2023
- Systematic review of outcome measures collected across all EMRs
- Considerable variability in what and how outcomes data are collected in the different systems

PT	OT
Stroke/BI	Stroke
Functional In Sitting Test (FIST) or Berg Balance Test (BBT) or Functional Gait Assessment	Required
Stroke Impact Scale-16 (SIS) or Activities Specific Balance Confidence Scale (ABC) - self	Patient-Specific Functional Scale (PSFS)
Modified Ashworth Scale (MAS)	Vision Screening Question Battery
PPROM - data point	Fugl-Meyer UE - Motor Subsection (FMA)
Tone - data point	Neuro Quality of Life- UE subscale (Neuro-QOL)
AROM - data point	Grip Strength
Movement Strategy - data point	Optional
	Modified Ashworth Scale (MAS)
	Canadian Occupational Performance Measure (COPM)
	Behavioral Inattention Test (BIT)
	Brain Injury Visual Assessment Battery for Adults (BIVABA)
	Q-log & mentation section
	BI
	Required
	Patient-Specific Functional Scale (PSFS)
	Vision Screening Question Battery
	Neuro Quality of Life- UE subscale (Neuro-QOL)
	Grip Strength
	Optional
	Dermatomes
	Modified Ashworth Scale (MAS)
	Canadian Occupational Performance Measure (COPM)
	Behavioral Inattention Test (BIT)
	Brain Injury Visual Assessment Battery for Adults (BIVABA)
	Q-log & mentation section
	SCI
	Required
	Patient-Specific Functional Scale (PSFS)
	Spinal Cord Independence Measure (SCIM-III) ADL Subscale
	Myotomes C5-T1
	Optional
	Dermatomes
	Modified Ashworth Scale (MAS)
	Canadian Occupational Performance Measure (COPM)
	Behavioral Inattention Test (BIT)
	Brain Injury Visual Assessment Battery for Adults (BIVABA)
	Q-log & mentation section
	Movement Disorders (MS, PD, etc.)
	Required
	Patient-Specific Functional Scale (PSFS)
	Neuro Quality of Life- UE subscale (Neuro-QOL)
	Grip Strength
	3-Hole Peg Test (3-HPT) or Box & Blocks (BBT)
	Optional
	Canadian Occupational Performance Measure (COPM)
	Behavioral Inattention Test (BIT)
	Brain Injury Visual Assessment Battery for Adults (BIVABA)
	Q-log & mentation section

Standardizing Outcomes Across the System

Phase 2

- Completed July 2024
- Identify required & recommended outcome measures
- Programmatic approach (Stroke, BI, SCI)
- Buy-in from leadership from all service lines



Psychometric properties

- Reliable, valid, normative data, minimal clinical differences, etc



System of Care

- Can track patient progress across the system







Reasonable

- Can be performed in all settings with minimal time/resources required



Informative

- Informs clinical practice and helps us learn how to improve care for our patients

Required for ALL patients				
Gait Speed: 6-meter walk test (6MWT)	✓	✓	✓	✓
Cardiorespiratory: 2-minute walk test (2MWT)	✓	✓	✓	✓
Balance/Falls: BERG balance assessment	✓	✓	✓	✓

Solutions: Data Quality and Integrity

- Clinical and operational SMEs participate in data reviews to ensure accuracy
- Automated alert emails for missing data collection
- Proactive, real-time documentation “auditing”

Patient's Missing Diagnosis Groupings in Domain Data

Diagnosis Codes Without Diagnosis Groupings

PrimaryDX	PrimaryDXDesc	PrimaryDXCategory	DiagnosisSubCategory	DiagnosisCodePrefix	DiagnosisCategory	DiagnosisSubCategory
D07.5	Carcinoma in situ of prostate					
W20.8XXA	Other cause of strike by thrown, projected or falling object, initial encounter					

Patients Without Any Diagnosis Data

PatientAccountNumber	AdmissionDate	PrimaryDX	PrimaryDXDesc	PrimaryDXCategory	DiagnosisSubCategory	DiagnosisCodePrefix	DiagnosisCategory	DiagnosisSubCategory

There are no miss-matched diagnosis.

Floor 4 Fall QCAs that need to be completed as of 08/23/2024

University Hospital

Patient Account Number	Patient Name	Patient Room Number	Date of Fall	Number of days after fall	floor	Facility
			22AUG2024	1	FLOOR 4	University Hospital

There are no Floor 4 Fall QCAs for Bartram Hospital

Proactive Data Quality

Therapy Minutes Tracking

Dashboard

Week Projections Daily Details Percent Compliance Calculation

Friday, August 23, 2024 06:56:02 AM On Target for Current Week

		SubUnit	On Target for Current Week	WeekStartDate	Week Start Day	Current Week Since Admission	Days Count through Yesterday	Therapy Days left this week[...	Expected Mins Today	Projected Mins to be Complete b...	Projected Mins Needed by EOW	Yesterday Active	YesterdayT otal
		3S	No	08/21/2024	Wednesday	1	2	5	180	750	150	150	180
		3S	No	08/21/2024	Wednesday	1	2	5	180	770	130	170	180
		2N	Yes	08/21/2024	Wednesday	1	2	5	180	900	0	180	180
		3N	No	08/20/2024	Tuesday	1	3	4	180	810	90	210	210
		3S	No	08/21/2024	Wedn	1	2	5	180	750	150	150	180
		3N	No	08/19/2024	Monday	1	3	4	180	810	90	210	210
		2N	No	08/19/2024	Monday	1	3	4	180	810	90	210	210
		3N	Yes	08/18/2024	Sunday	1	3	4	180	810	90	210	210
		2N	Yes	08/18/2024	Sunday	1	3	4	180	810	90	210	210
		2N	Yes	08/17/2024	Saturday	1	3	4	180	810	90	210	210
		3N	No	08/20/2024	Tuesday	1	3	4	180	810	90	210	210
		3N	Yes	08/17/2024	Saturday	1	3	4	180	810	90	210	210
		2N	Yes	08/17/2024	Saturday	1	3	4	180	810	90	210	210
		2S	Yes	08/23/2024	Friday	1	3	4	180	810	90	210	210

Therapy CareTool Tracking Dashboard

Key: Yellow: No score change, Red: Score Decrease, Orange: Discharged patient missing discharge score, Blue: Active patient missing discharge score

Mobility CareTool Scores (Meditech)

▲	P at	A d	D is	UseWalkFlag	Mobility Score ADM	Mobility Score DIS	Mobility Score CHG	Roll Left Right - ADM	Roll Left Right - DIS	Sit to Lying - ADM	Sit to Lying - DIS	Lying to Sit - ADM	Lying to Sit - DIS	Sit to Stand - ADM	Sit to Stand - DIS	Chair Transfer - ADM	Chair Transfer - DIS
			.	1	15	15	0	88	.	1	.	1	.	1	.	1	.
			.	1	47	15	-32	4	.	4	.	4	.	4	.	3	.
			.	0	23	15	-8	1	.	1	.	1	.	88	.	1	.
			.	0	17	26	9	1	4	1	3	1	3	1	1	1	1
			.	0	15	41	26	1	3	1	3	1	2	1	3	1	3
			.	1	18	15	-3	2	.	2	.	2	.	1	.	1	.
			.	0	15	15	0	88	.	88	.	88	.	88	.	1	.
			.	0	15	15	0	1	.	1	.	1	.	88	.	1	.

Next Steps – Research focus

- Establish data use agreements (DUA) and standardized operating procedures to cover all LHS-related data sharing activities
- Continue with standardized outcomes initiative – Phase 3: EMR build and data integration into CDW
- Complete a systematic data review of health equity/ SDOH data
- Develop a dedicated data warehouse specifically designed for research-specific purposes
 - Common data model (CDM) structural format

References

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