CENTER FOR HEALTH INFORMATION AND ANALYSIS

Pediatric All-Payer Readmissions In Massachusetts:

SFY 2017-2022

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Technical Appendix

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TECHNICAL APPENDIX

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Introduction

This technical appendix provides details on the methodology used for the inaugural pediatric readmissions report, *Pediatric All-Payer Readmissions in Massachusetts SFY 2017-2022,* released by the Center for Health Information and Analysis (CHIA) in October 2023. This appendix comprises of three sections: a detailed description of the readmissions methodology, a table listing the characteristics of Massachusetts acute care hospitals, and a section with details on several of the categorizations used in the report.

Readmissions Methodology

Overview of the Pediatric Readmission Measure

This report leverages the Pediatric All-Condition Readmission Measure (PACRM) created by the Center of Excellence for Pediatric Quality Measurement (CEPQM) at Boston Children's Hospital. The CEPQM is funded through the Pediatric Quality Measures Program (PQMP) by the federal Agency for Healthcare Research and Quality (AHRQ) and the Centers for Medicare and Medicaid Services (CMS). The pediatric readmission measure calculates unadjusted and risk-adjusted, 30-day all-condition readmission rates for the pediatric population (under the age of 18 years old). The measure excludes admissions from specific types of specialty hospitals and non-acute care institutions including rehabilitation and long-term care facilities. Additionally, admissions for obstetric conditions, mental health conditions, and birth of healthy newborns, as well as readmissions for planned procedures and chemotherapy are excluded from the measure. This report includes unadjusted readmission rates calculated separately by Massachusetts fiscal year and includes unadjusted and risk-adjusted hospital readmission rates for the entire 6-year period. Each state fiscal year runs from July 1 to June 30, and this report includes fiscal years 2017 – 2022 (i.e., July 1, 2016 to June 30, 2022).

Data Source

While originally developed for analyses using inpatient claims, this report adapts the Pediatric All-Condition Readmission Measure by using data from the Massachusetts Acute Hospital Case Mix Databases. Specifically, this report uses data from the Massachusetts Hospital Inpatient Discharge Database (HIDD), which includes data on patient socio-demographics, diagnostic information, treatment and service information, and hospital charges. The data is submitted quarterly by all Massachusetts acute care hospitals and undergoes a cleaning and verification process at CHIA that includes the feedback of verification reports to hospitals for confirmation of their information. Once quarterly data has been processed and verified, CHIA produces and makes available annual files based on federal fiscal years (FFY, running from October 1 to September 30). All discharges, if included by a hospital in data submitted to CHIA may be included in the analysis. Additionally, to accommodate CHIA's hospital inpatient discharge data, CHIA removed logic excluding insurance enrollment requirements, as primary payer type data is reported by the hospital and not the payer.

Patient Identification

CHIA utilizes an enhanced patient identifier (EPI) to link patient records, instead of Social Security Number (SSN), for its readmissions analyses. The quality and completeness of SSN on patient records has deteriorated over time,

especially for pediatric patients. In FFY 2022, 96.9% of pediatric discharges had missing or invalid SSN, up from 89.8% in FFY 2016. The EPI was created by CHIA using Master Data Management (MDM) techniques by employing an industry-leading MDM software solution, IBM Initiate Master Data Service. It utilizes probabilistic matching on all available and valid patient demographic information to identify records belonging to the same patient. Patient demographic information was sourced from CHIA's Acute Hospital Case Mix Databases which include hospital inpatient discharge data, outpatient observation data, and emergency department data, and has records dating back to 2006, and member enrollment information from CHIA's All-Payer Claims Database and CMS's Medicare Fee-For-Service data from the Research Data Assistance Center (ResDAC).

Calculation Steps for the Readmission Measure

1. Identify hospitals eligible for inclusion in the measure
2. Define episodes of care
3. Define episodes of care eligible for inclusion in measure cohort
4. Identify index admissions and readmissions
5. Calculate observed readmissions rates
6. Calculate risk-adjusted readmission rates by hospital

Step 1: Identify hospitals eligible for inclusion in the measure

The Pediatric All-Condition Readmission Measure recommends exclusions at the hospital level for specialty and non-acute-care hospitals, as well as hospitals with less than 80% complete data. CHIA's Case Mix Databases includes data from acute care hospitals only, and the specialty acute care hospitals excluded from the analysis include Dana-Farber Cancer Institute, Massachusetts Eye and Ear, New England Baptist Hospital, Shriners Children's Boston and Shriners Children's Springfield. CHIA's classification of hospitals differs from classifications from the American Hospital Association (AHA) and the Centers for Medicare and Medicaid Services (CMS) and classifies Boston Children's Hospital as a specialty hospital. As the focus of the readmission measure is admissions to hospitals that provide general pediatric acute care services, Boston Children's Hospital is included in the measure. As CHIA's Case Mix Databases go through quarterly a quality assurance validation process to assure the completeness and quality of select fields sometimes requiring resubmission and updating of data, no hospitals were excluded for incomplete data.

Step 2: Define episodes of care

This step collapses potential instances of multiple observations for the same hospitalization into a single episode of care prior to applying exclusions and evaluating readmissions.

- Identifies duplicate visits and drops all but one visit
- Identifies and combines multiple valid records from the same hospital for the same hospitalization
- Identifies and combines multiple valid records for hospitalizations that include transfers
- Identifies and excludes invalid episodes of care

Step 3: Define episodes of care eligible for inclusion in measure cohort

This step drops episodes of care based on certain exclusion criteria, specifically:

- Visits missing a primary diagnosis code
- Visits with admission dates that occur after a discharge status of death during a prior episode of care
- Certain visits based on clinical criteria:
    - Visits for patients over 18 years of age and 29 days at the time of admission
        - This age exclusion was performed earlier in data processing to reduce data processing time
        - The extra 29 days allows for patients who were 17 years of age at the time of the index discharge and turned 18 before the readmission to be included in the analysis
    - Visits for birth of healthy newborns
        - This includes newborns born with a primary ICD-10 diagnosis for cesarean section and a length of stay under 5 days, and newborns born with a primary ICD-10 diagnosis code for vaginal delivery with a length of stay under 3 days
        - Additionally, CHIA included a small number of newborns with a diagnosis of being born outside of the hospital, and used a length of stay cutoff of 3 days as these newborns appeared clinically similar to those born by vaginal delivery
    - Visits with a primary diagnosis or principal procedure for labor and delivery
    - Visits with a mental health primary diagnosis
    - Visits with a CCI for "Complications of pregnancy, childbirth, and the puerperium" as defined using the AHRQ CCI tool

Step 4: Define index admissions and readmissions

These criteria exclude visits from the index admission definition:

- Visits for patients over the age of 18 years and 0 days at the time of discharge
    - Note: a patient can have been up to 18 years, 29 days of age for the readmission but not the index discharge
- Visits with a discharge disposition of death or leaving the hospital against medical advice (AMA)

These criteria exclude visits from the readmission definition:

- Visits with a principal ICD-10 code for a planned procedure as defined in the Pediatric All-Condition Readmission Measure specification
- Visits with a principal ICD-10 procedure code or a primary ICD-10 diagnosis code for chemotherapy

Note: Visits for a planned procedure or chemotherapy are allowed under the index admission definition, but not the readmission definition. Thus, a pediatric patient could have been in the hospital originally for chemotherapy and readmitted within 30 days, but to qualify as a readmission in this measure the readmission visits would have to be for a reason other than a planned procedure or chemotherapy.

Step 5: Calculate observed readmission rates

The observed readmission rate for a hospital, or for some other defined group of patients or visits, is simply the number of readmissions that occurred during the designated time period (plus 30 days thereafter), divided by the base number of index discharges within the period, and multiplied by 100 to produce a percentage. The report features readmission rates calculated for hospitals as well as by other patient-level and visit-level characteristics such as patient age, sex, payer type, and medical complexity. In this report, the average length of stay is calculated as the difference between the discharge date and the admission date on the index inpatient record.

Step 6: Calculate risk-adjusted readmission rates by hospital

The pediatric readmission measure utilizes a 2-level logistic regression model with fixed effect variables for patient case-mix at the first level and random intercept at the second level.

- **Patient demographics and clinical characteristics:** Includes age, sex, presence of chronic conditions in 17 different body systems as defined by the AHRQ CCI tool, and the number of body systems affected.
- **Hospital random effects:** Accounts for a hospital's systematic deviation from an average intercept across hospitals, which represent the greater or lesser adjusted probability of readmission not explained by patient-level fixed effects.

Weighting of Risk-Adjusted Readmission Rates for Analyses of Hospital Characteristics

In order to aggregate the risk-adjusted readmission rates (RARR) across hospitals to larger entities such as pediatric trauma center, we averaged the hospital-specific RARRs for each group and weighted each hospital's RARR by their discharge volume. This weighting scheme allows hospitals with higher volumes to contribute more to the aggregated rates than those with lower volumes. For grouping by hospital characteristics, hospitals with zero readmissions were matched with hospitals that were part of the same hospital system, had the same hospital cohort (teaching vs. community hospital), and had a similar share of gross patient service revenue coming from public payers. One hospital with zero readmissions matched with two hospitals based on these criteria and was ultimately grouped with the hospital serving the same geographic area based on the Hospital Service Area.

Hospital Characteristics

Hospital characteristics are assessed at the end of each hospital fiscal year, which varies from hospital to hospital. Acute care hospitals and their corresponding hospital characteristics are provided in Appendix A.

Data Categorization and Grouping

All Payer Refined – Diagnosis Related Groups (APR-DRGs)

The All Patient Refined – Diagnosis Related Groups (APR-DRGs, 3M) are a severity and risk-adjusted classification system that provides a more effective means of adjusting for patient differences. The 3M APR-DRGs expand the basic DRG structure by adding four subclasses to each illness and risk of mortality. CHIA utilized version 34.0 of the APR-DRG, which was used to group inpatient discharges over the study period of SFY 2017-2022. The 3M APR-DRG grouper was used to analyze readmissions by top discharge diagnoses for this report.

Pediatric Medical Complexity

The Pediatric Medical Complexity Algorithm (PMCA) was used to categorize patients based on the presence of chronic conditions and whether the patient's medical conditions were complex, meaning that the conditions were malignant or progressive, or if multiple body systems were involved, based on the provided primary and secondary diagnoses for each visit. Since this analysis utilizes data from SFY 2017 to 2022, only ICD-10-CM codes were used in this report. The three medical complexity groups include:

- **Complex Chronic**
  - More than one body system is involved, or
  - One or more conditions are progressive, or
  - One more or conditions are malignant
- **Non-Complex Chronic**
  - Only one body system is involved, and
  - The condition is not progressive or malignant
- **Non-Chronic**
  - No body system indicators are present, and
  - The condition is not progressive or malignant

The PMCA recommends using up to 3 years of data to examine a patient's medical history and complexity. For this report, patients' medical complexity was calculated for each SFY in order to account for potential variation in medical complexity across the 6-year study period. Sensitivity analyses demonstrated only minor impacts on running PMCA by year compared to over the 6-year study period and at the visit level.

Additionally, the PMCA recommends using a less conservative approach when utilizing non-claims data sources, including hospital-level data like the Case Mix Database. The more conservative version requires that for the complex chronic group, conditions that affect body systems appear on more than one claim or visit. As inpatient admissions are relatively uncommon among the pediatric population compared to adults and this analysis does not link to claims or outpatient databases for emergency room and observation visits, the less conservative approach was used for this analysis.

Expected Primary Payer Type

For the reporting of readmission rates by payer type, payer type categories were created by grouping payer source codes from CHIA's hospital inpatient discharge data. Payer type categories were grouped as follows:

- **Medicaid:** Expected primary payer source is MassHealth, including Medicaid managed care, or Commonwealth Care
- **Commercial:** Blue Cross and Blue Cross Managed Care, Commercial Insurance and Commercial Managed Care, HMO, PPO/Other managed care plans not elsewhere classified, point-of-service plans, exclusive provider organizations, and other non-managed care plans

- **Other:** Includes Medicare, Other payer (including Worker's Compensation, Other Government Payment, Auto Insurance, and Dental Plans), and Self-pay (including Self-pay, Free Care and Health Safety Net)

During the study period from SFY 2017 to 2022, there were 140 patients with missing payer information.

Age

Patient age in years was calculated from the date of the inpatient admission and the patient's date of birth.

Sex

During the study period from SFY 2017 to 2022, there were 12 patients with missing sex. These patients were not included in the section looking at readmission rates by patient sex and were also not included in the hospital-specific readmission rates as sex is a required field in the risk-adjustment model. These patients are accounted for in other parts of the report.

Patient Region of Residence

Patient region was derived from the patient's ZIP code listed on the visit-level record. The ZIP code used was derived from both the listed permanent and temporary patient ZIP code, with the permanent ZIP code being used first followed by the temporary ZIP code if the permanent ZIP code was missing or invalid.

The report uses the Massachusetts Health Policy Commission (HPC)'s regions which aggregate ZIP codes in Massachusetts into 15 different regions. These regions were defined by multiple criteria including the Dartmouth Atlas Hospital Service Area (HSA). Visits that were defined as being from Massachusetts but did not have a valid ZIP code or were from out-of-state were grouped as Other United States, and all other visits with missing or invalid ZIP code were grouped into Unknown/Other.

Appendix A

HOSPITAL NAME	PEDIATRIC TRAUMA CENTER	HOSPITAL COHORT	HIGH PUBLIC PAYER STATUS	HOSPITAL SYSTEM
Anna Jaques Hospital		Community Hospital	Not HPP	Beth Israel Lahey Health
Athol Memorial Hospital		Community High Public Payer Hospital	HPP	Heywood Healthcare
Baystate Medical Center	Level 2	Teaching Hospital	HPP	Baystate Health
Baystate Franklin Medical Center		Community High Public Payer Hospital	HPP	Baystate Health
Fairview Hospital		Community High Public Payer Hospital	HPP	Berkshire Health Systems
Brigham and Women's Hospital		Academic Medical Center	Not HPP	Mass General Brigham
Signature Healthcare Brockton Hospital		Community High Public Payer Hospital	HPP	Independent Health System
Cape Cod Hospital		Community High Public Payer Hospital	HPP	Cape Cod Healthcare
Falmouth Hospital		Community High Public Payer Hospital	HPP	Cape Cod Healthcare
Steward Norwood Hospital*		Community High Public Payer Hospital	HPP	Steward Health Care
Steward Carney Hospital		Teaching Hospital	HPP	Steward Health Care
Boston Children's Hospital*	Level 1	Specialty Hospital	Not HPP	Independent Health System
Cooley Dickinson Hospital		Community Hospital	Not HPP	Mass General Brigham

HOSPITAL NAME	PEDIATRIC TRAUMA CENTER	HOSPITAL COHORT	HIGH PUBLIC PAYER STATUS	HOSPITAL SYSTEM
Beth Israel Deaconess Hospital - Needham		Community Hospital	Not HPP	Beth Israel Lahey Health
Emerson Hospital		Community Hospital	Not HPP	Independent Health System
Brigham and Women's Faulkner Hospital		Community Hospital	Not HPP	Mass General Brigham
Harrington Memorial Hospital		Community High Public Payer Hospital	HPP	Independent Health System
Heywood Hospital		Community High Public Payer Hospital	HPP	Heywood Healthcare
Steward Holy Family Hospital		Community High Public Payer Hospital	HPP	Steward Health Care
Holyoke Medical Center		Community High Public Payer Hospital	HPP	Independent Health System
Beth Israel Deaconess Hospital - Plymouth		Community High Public Payer Hospital	HPP	Beth Israel Lahey Health
Lawrence General Hospital		Community High Public Payer Hospital	HPP	Independent Health System
Lowell General Hospital		Community High Public Payer Hospital	HPP	Wellforce
Martha's Vineyard Hospital		Community Hospital	Not HPP	Mass General Brigham
Massachusetts General Hospital	Level 1	Academic Medical Center	Not HPP	Mass General Brigham
Milford Regional Medical Center		Community Hospital	Not HPP	Independent Health System

HOSPITAL NAME	PEDIATRIC TRAUMA CENTER	HOSPITAL COHORT	HIGH PUBLIC PAYER STATUS	HOSPITAL SYSTEM
Beth Israel Deaconess Hospital - Milton		Community Hospital	Not HPP	Beth Israel Lahey Health
Morton Hospital		Community High Public Payer Hospital	HPP	Steward Health Care
Mount Auburn Hospital		Teaching Hospital	Not HPP	Beth Israel Lahey Health
Nantucket Cottage Hospital		Community Hospital	Not HPP	Mass General Brigham
Tufts Medical Center**	Level 1	Academic Medical Center	HPP	Wellforce
Newton-Wellesley Hospital		Community Hospital	Not HPP	Mass General Brigham
Baystate Noble Hospital		Community High Public Payer Hospital	HPP	Baystate Health
Steward Saint Anne's Hospital		Community High Public Payer Hospital	HPP	Steward Health Care
South Shore Hospital		Community Hospital	Not HPP	Independent Health System
Steward St. Elizabeth's Medical Center		Teaching Hospital	HPP	Steward Health Care
Saint Vincent Hospital		Teaching Hospital	HPP	Tenet Healthcare
Sturdy Memorial Hospital		Community High Public Payer Hospital	HPP	Independent Health System
Marlborough Hospital		Community High Public Payer Hospital	HPP	UMass Memorial Health Care
Winchester Hospital		Community Hospital	Not HPP	Beth Israel Lahey Health

HOSPITAL NAME	PEDIATRIC TRAUMA CENTER	HOSPITAL COHORT	HIGH PUBLIC PAYER STATUS	HOSPITAL SYSTEM
North Shore Medical Center		Community High Public Payer Hospital	HPP	Mass General Brigham
Boston Medical Center	Level 2	Academic Medical Center	HPP	Independent Health System
Cambridge Health Alliance		Teaching Hospital	HPP	Independent Health System
MetroWest Medical Center		Community High Public Payer Hospital	HPP	Tenet Healthcare
Melrose-Wakefield Healthcare		Community High Public Payer Hospital	HPP	Wellforce
Northeast Hospital		Community High Public Payer Hospital	HPP	Beth Israel Lahey Health
Southcoast Hospitals Group		Community High Public Payer Hospital	HPP	Independent Health System
UMass Memorial Medical Center	Level 1	Academic Medical Center	HPP	UMass Memorial Health Care
Berkshire Medical Center		Community High Public Payer Hospital	HPP	Berkshire Health Systems
Lahey Hospital & Medical Center		Teaching Hospital	Not HPP	Beth Israel Lahey Health
Mercy Medical Center		Community High Public Payer Hospital	HPP	Independent Health System
Steward Good Samaritan Medical Center		Community High Public Payer Hospital	HPP	Steward Health Care
Beth Israel Deaconess Medical Center		Academic Medical Center	Not HPP	Beth Israel Lahey Health
Nashoba Valley Medical Center		Community High Public Payer Hospital	HPP	Steward Health Care

HOSPITAL NAME	PEDIATRIC TRAUMA CENTER	HOSPITAL COHORT	HIGH PUBLIC PAYER STATUS	HOSPITAL SYSTEM
Baystate Wing Hospital		Community High Public Payer Hospital	HPP	Baystate Health
HealthAlliance-Clinton Hospital		Community High Public Payer Hospital	HPP	UMass Memorial Health Care

Note: Pediatric visits from specialty hospitals including Shriner's Children Boston, Shriner's Children Springfield, Dana Farber Cancer Hospital, New England Baptist Hospital, and Massachusetts Eye and Ear are not included in this report.

*CHIA's hospital cohort definition of specialty hospital includes Boston Children's Hospital but is also considered a teaching hospital.
**Steward Norwood closed in Summer 2020 due to flooding, data for this hospital is included in this report through its closure.
***In Summer 2022, Tufts Medical Center Closed its Pediatric Hospital, thus data for this hospital and for cuts for pediatric trauma center are included through this change. As this report covers data through SFY 2023, any changes in the readmission rate for Tufts and Level 1 trauma centers would not be reflected until SFY 2023.