



# Adding Social Determinant Data Changes Children's Hospitals' Readmissions Performance

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**Objectives** To determine whether social determinants of health (SDH) risk adjustment changes hospital-level performance on the 30-day Pediatric All-Condition Readmission (PACR) measure and improves fit and accuracy of discharge-level models.

**Study design** We performed a retrospective cohort study of all hospital discharges meeting criteria for the PACR from 47 hospitals in the Pediatric Health Information database from January to December 2014. We built four nested regression models by sequentially adding risk adjustment factors as follows: chronic condition indicators (CCIs); PACR patient factors (age and sex); electronic health record-derived SDH (race, ethnicity, payer), and zip code-linked SDH (families below poverty level, vacant housing units, adults without a high school diploma, single-parent households, median household income, unemployment rate). For each model, we measured the change in hospitals' readmission decile-rank and assessed model fit and accuracy.

**Results** For the 458 686 discharges meeting PACR inclusion criteria, in multivariable models, factors associated with higher discharge-level PACR measure included age <1 year, female sex, 1 of 17 CCIs, higher CCI count, Medicaid insurance, higher median household income, and higher percentage of single-parent households. Adjustment for SDH made small but significant improvements in fit and accuracy of discharge-level PACR models, with larger effect at the hospital level, changing decile-rank for 17 of 47 hospitals.

**Conclusions** We found that risk adjustment for SDH changed hospitals' readmissions rate rank order. Hospital-level changes in relative readmissions performance can have considerable financial implications; thus, for pay for performance measures calculated at the hospital level, and for research associated therewith, our findings support the inclusion of SDH variables in risk adjustment. (*J Pediatr* 2017;186:150-7).

In the US, hospital readmissions are common and costly and, thus, are a focus of both performance measurement (including public reporting and financial penalties) and efforts to identify high-risk patients for discharge-related interventions. In national estimates (2013), 10.6% of discharges for children age 1-17 years and 14.0% of discharges for adults resulted in readmission within 30 days, at a cost of \$2.1 billion for children and \$50.2 billion for adults.<sup>1</sup> For adults, the Centers for Medicare and Medicaid Services has implemented readmission penalties nationwide.<sup>2</sup> For children, many state Medicaid agencies have imposed penalties on hospitals with excess readmissions.<sup>3-10</sup>

The use of readmission rates as the basis for financial penalties is controversial, particularly regarding the construct validity of readmission performance penalty thresholds as a measure of inpatient care quality<sup>11-16</sup> (Figure 1; available at [www.jpeds.com](http://www.jpeds.com)). One concern about construct validity is that most readmission penalty measures do not include adjustment for social determinants of health (SDH)—factors such as race, ethnicity, and income—despite evidence that SDH have a greater impact on overall health than healthcare received.<sup>13,17</sup> Because the quality of healthcare received that is relevant to readmission risk, especially across

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CCIs	Chronic condition indicators
EHR	Electronic health record
NQF	National Quality Forum
PACR	Pediatric All-Condition Readmission
PHIS	Pediatric Health Information
SDH	Social determinants of health
Zip-linked	Zip code-linked

conditions, is complex and thus often unmeasured, we know of no pediatric studies that have assessed the relative contribution of SDH and inpatient care quality on readmissions, although several have demonstrated that SDH are important risk factors for all-condition readmissions among children.<sup>16,18-20</sup>

The unit of analysis in most studies of SDH and readmission risk is the discharge (or hospitalization), as discharge-level analyses are most relevant to the stakeholders seeking to identify risk factors to guide targeted intervention, namely researchers and clinical providers. Readmission penalties are calculated on the hospital level, where the hospital is the unit of analysis. Thus, the more policy-relevant outcome (the outcome more relevant to pay-for-performance stakeholders such as hospitals and federal and state agencies) for assessing the impact of SDH adjustment is at the hospital level rather than the discharge level<sup>20</sup> (**Figure 1**).

Although each state Medicaid readmission penalty calculation adjusts for varied combinations of nonhospital factors such as severity of illness, age, medical comorbidities, and mental health comorbidities, none of the policies currently adjusts for SDH.<sup>3-10</sup> Risk adjustment for SDH in readmission penalty calculations is part of an active policy debate: proponents argue that SDH are strongly correlated with readmission risk and thus SDH adjustment protects hospitals serving disproportionately high numbers of disadvantaged patients, whereas opponents argue that SDH adjustment obscures disparities in quality of care for underserved populations.<sup>21,22</sup> Others caution that SDHs are difficult to measure, as most are not routinely collected in electronic health record (EHR) systems.<sup>23,24</sup>

The National Quality Forum (NQF) initiated a national discussion about its current policy to permit SDH risk adjustment for performance measures. During a trial period, measure developers performed analyses using empirical data to examine associations between SDH variables and measure outcomes.<sup>25</sup> The pediatric readmission analyses submitted to NQF, including discharge-level analyses of the Pediatric All-Condition Readmission (PACR) measure, found minimal improvement in model performance with SDH adjustment.<sup>26</sup> Although the NQF analyses studied discharge-level performance, as noted above, it is also important to consider the more policy-relevant outcome for assessing the impact of SDH adjustment, namely hospital-level performance.<sup>20</sup> In this study, to better understand the implications of SDH adjustment on hospital performance measures, we directly compare how SDH adjustment differentially impacts hospital- vs discharge-level readmission models.

## Methods

We performed a multicenter retrospective cohort study of children with inpatient hospitalizations using data from 47 hospitals in the Children's Hospital Association's Pediatric Health Information (PHIS) database, for the calendar year 2014. We excluded observation stays as they are not used in most readmission penalty assessments.<sup>3-10</sup> To be included, hospitals had to be acute-care, general (ie, nonspecialty) US hospitals that

provide inpatient care for children (including free-standing children's hospitals and children's hospitals within a healthcare system).

The study hospitals provide patient demographic data; patient home zip code; up to 41 *International Classification of Diseases, 9th Revision, Clinical Modification* diagnosis; and up to 41 procedure codes. Data are deidentified before inclusion in the database, but unique identifiers allow for longitudinal analyses across visits. Data quality and reliability are assured jointly by the Children's Hospital Association (Overland Park, Kansas), participating hospitals and Truven Health Analytics (New York, New York).<sup>27</sup> In accordance with the Common Rule (45 CFR 46.102[f]) and the policies of Cincinnati Children's Institutional Review Board, this study using a deidentified dataset was not considered human subjects research.

We analyzed all inpatient stays that met criteria for inclusion in the PACR measure, a measure developed to calculate case-mix-adjusted readmission rates among children discharged from general acute care hospitals.<sup>28</sup> We chose the NQF-endorsed PACR measure for this study because its cohort definition and risk adjustment measure specifications are publicly available, in contrast to 3M's (Maplewood, Minnesota) proprietary Potentially Preventable Readmissions measure, and include only data commonly available in administrative databases. Full specifications for the PACR measures are available online from the measure developer.<sup>28</sup> Briefly, these criteria include hospitalizations at general acute care hospitals for patients under 18 years old and exclude hospitalizations of newborns or for primary diagnoses related to obstetrics and psychiatry, as well as hospitalizations with a primary procedure code for a planned procedure.<sup>28</sup>

Our primary outcome was the rank-decile for hospital-level readmission rate. Our secondary outcome was the discriminative ability of each risk adjustment model to predict discharge-level readmission (**Figure 1**). Although our primary outcome was hospital-level performance, as discharge-level readmissions inform hospital-level readmission calculations, we present our discharge-level methods and findings first.

We built nested sequential models by adding nonhospital risk adjustment variables to identify an optimal model for predicting readmissions within 30 days of the index stay (**Table 1**; available at [www.jpeds.com](http://www.jpeds.com) and **Figure 1**). Our sequence of models permitted us to examine the separate contribution of chronic condition indicator (CCI) only (model 1) and the limited SDH adjustment variables that are included in the PACR specifications (age and sex) in model 2, and to examine the effects of additional SDH adjustment in models 3 and 4.

### Baseline: Unadjusted Readmissions

We used the cohort specification criteria for the PACR measure to define the number of discharges included in the analysis of readmissions (ie, the denominator of our analysis). We included all 30-day readmissions specified in the PACR specifications in the numerator without the risk adjustment variables (chronic conditions, age, and sex).<sup>28</sup>

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