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Adjusting for Social Risk Factors in Pediatric Quality Measures: Adding to the Evidence Base

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Abstract

Background: Outcome and utilization quality measures are adjusted for patient case-mix including demographic characteristics and comorbid conditions to allow for comparisons between hospitals and health plans. However, controversy exists around whether and how to adjust for social risk factors.

Objective: To assess an approach to incorporating social risk variables into a pediatric measure of utilization from the Pediatric Quality Measures Program (PQMP).

Methods: We used data from CA Medicaid claims (2015–16) and Massachusetts All Payer Claims Database (2014–2015) to calculate health plan performance using measure specifications from the Pediatric Asthma Emergency Department Use measure. Health plan performance categories were assessed using mixed effect negative binomial models with and without adjustment for social risk factors, with both models adjusting for age, gender and chronic condition category. Mixed effects linear models were then used to compare patient social risk for health plans that changed performance categories to patient social risk for health plans that did not.

Results: Of 133 health plans, serving 404,649 pediatric patients with asthma, 7–13% changed performance categories after social risk adjustment. Health plans that moved to higher performance categories cared for lower SES patients whereas those that moved to lower performance categories cared for higher SES patients.

Conclusions: Adjustment for social risk factors changed performance rankings on the PQMP Pediatric Asthma Emergency Department Use measure for a substantial number of health plans, with some health plans caring for higher risk patients with lower performance without social risk factor risk adjustment. In light of this, social risk factors are incorporated into the National Quality Forum-endorsed measure; whether to incorporate social risk factors into pediatric quality measures will differ depending on the use case.

Introduction

With the shift towards value-based care, quality measurement has become an essential component of American healthcare. Since 2011, over 160 quality measures have been developed through the Pediatric Quality Measures Program (PQMP) by the Centers of Excellence (COE), many of which have been endorsed by the National Quality Forum (NQF).[1,2] To facilitate unbiased performance comparisons, quality measures assessing outcomes (e.g., mortality, readmissions) and utilization commonly risk-adjust for patient demographic and clinical characteristics such as age, sex, comorbidities, and severity of underlying illness. Historically, measure developers have avoided including social risk factors in risk-adjustment approaches to avoid potentially setting lower quality standards for hospitals or providers that disproportionately care for poorer patients.[3] However, more recent studies have raised concerns that patients cared for by these hospitals may be more likely to have poorer outcomes due to social risk factors rather than poor quality healthcare. Hence, there has been an active public debate about whether, how, and when to adjust for social risk.

This debate has been most prominent surrounding the Medicare Hospital Readmission Reduction Program in adults.[4] Proponents of social risk adjustment have argued that financial penalties could lead to fewer resources allocated to hospitals that disproportionately treat patients with high social risk, thereby exacerbating existing disparities and discouraging providers from caring for these patients.[5–8] These concerns prompted legislative proposals to change Medicare pay-for-performance programs to include social risk factors in risk-adjustment models,[9] and in 2014, an NQF Expert Panel concluded that lack of adjustment for social risk factors might worsen health disparities.[10] Since then, the NQF has published a framework for determining when and how to adjust for social risk more broadly in quality measurement,[11] and several studies in adults have investigated how hospital or health plan performance change with social risk adjustment.[12–18]

Relatively fewer studies have studied the implications of social risk adjustment in pediatric quality measures.[19,20] Key differences between pediatric and adult patients are worthy of attention. Nearly 21% of children live in poverty,[21] leading to a high proportion of children insured by Medicaid/CHIP nationally. However, the percentage of Medicaid-insured children varies widely across states (15–61%),[22] in part due to federal regulations granting substantial discretion to states regarding enrollment criteria. State differences in pediatric Medicaid enrollment may lead to variable validity across states of measures that include social risk factor adjustment. In addition, because children have a social safety net in the form of their parents, parental protection and prioritization of their child's health may blunt the effects of social risk on health outcomes.

This paper explores the utility of incorporating social risk factors into risk adjustment for the Pediatric Asthma Emergency Department (ED) Use measure.[23,24] Asthma is the most common pediatric chronic disease, affecting 9% of school-aged children, and the third most common of pediatric hospitalizations in the U.S.[25,26] In addition, pediatric asthma exerts a tremendous burden on patients and their families in the form of days lost from school, interference with physical exercise, and time off of work to care for sick children. The

Pediatric Asthma ED Use measure was created to evaluate the quality of outpatient care for asthma patients at the health plan level.

In this paper we assess whether health plans change performance categories on the Pediatric Asthma ED Use measure with the addition of socioeconomic status (SES) into risk adjustment. Specifically, we evaluate the effects of social risk adjustment on health plan performance using two different sets of social risk factors for risk adjustment. We then compare social risk factors between patients served by health plans that changed performance categories to those that did not. We hypothesized that social risk factor inclusion would change health plan performance category, improving the measured performance of those health plans serving patients with higher social risk.

Methods

Rationale for including social risk factors in a pediatric asthma utilization measure

Children living below the federal poverty line are disproportionately affected by asthma, with a prevalence close to 12% and they are 40% more likely to be hospitalized annually than children from wealthier families.[27] Asthma self-management is complex, requiring health literacy, time for and transportation to preventive visits, and capacity to acquire and administer asthma controller medications. Patients and caregivers from lower SES groups may have less capacity for asthma management, leading to more uncontrolled disease and increased ED utilization.[28] Previous reports have shown that children insured by Medicaid are nearly 70% more likely to use the ED for asthma services than privately insured children, even after adjustment for frequency of primary care visits, asthma specialty care, symptomatology, and medication use.[27,28] Failure to account for social risk in asthma quality of care measures may lead to unfair comparisons across health plans.

Key social risk factors from the NQF report include education (related to health literacy and taking medication), employment, and income (both related to financial stability allowing for attending visits and acquiring medication). In addition, Andrist et al. found an increased association between high child poverty index and pediatric intensive care use.[29] Given that there is no standard set of social risk factors for quality measure risk adjustment, we explored the effects of including multiple social risk factors (education, employment, and income) on risk adjustment as well as a single risk factor (child poverty).

Data Sources:

We used data from the Massachusetts all-payer claims database (APCD) (2014–2015) and the California Medicaid claims database (2015–2016) to examine how health plan performance categories changed when social risk was included in the risk-adjustment models for asthma-related ED utilization. The MA APCD contains claims from most insurers (commercial, Medicaid, and Medicare) but does not include individuals covered by TRICARE, Veteran's Affairs, the Federal Employees Health Benefits Program, or some commercial self-pay insurance plans.[30] Data are submitted by health insurance payers to the MA Center for Health Information and Analysis and include patient demographics, service details, and inpatient and outpatient medical and pharmacy claims.

Study Population:

Consistent with the IMPLEMENT PQMP Pediatric Asthma ED Use measure denominator specifications,[23,24] we included patients aged 3–21 years-old in the measurement years (2014–2015 in MA and 2015–2016 in CA) with a diagnosis of identifiable asthma. Briefly, eligible patients had (1) at least 3 months of consecutive enrollment in the same insurance plan (the measurement month and the 2 months before), (2) evidence of claims with a primary or secondary diagnosis of asthma within the measurement month, and (3) prior documentation of asthma in the measurement year or year prior (2013 or 2014).[31] Prior documentation of asthma was defined as a prior hospitalization for asthma, one or more ambulatory visits with a diagnosis of asthma or bronchitis, and/or at least one asthma-related prescription. The numbers of ambulatory visits and asthma-related prescriptions required for inclusion varied by age (complete details have been described prior[31] and are in the publicly available technical specifications[23,24]). Patients with a diagnosis of cystic fibrosis or emphysema were excluded.

Social Risk Factor Variable Definitions:

Patient 5-digit zip codes from claims records were linked to zip code-level social risk factors in the U.S. American Community Survey (five-year file), as suggested in the NQF report.[11] Social risk factors included the percentage of adults with less than high school education, the percentage of unemployed males aged 25–60 years (MA) or percentage of unemployed adults aged ≥16 years (CA), the percentage of households below the federal poverty line, and median household income. These specific variables have been validated as measures of social risk in adults and found to be associated with increased healthcare utilization and readmissions in pediatrics.[32–35] In addition, following the approach from Andrist et al., we repeated the analyses using a single SES variable: zip code-level percentage of children aged <18 years living in poverty.[29]

Outcome Definition:

We defined the outcome, asthma-related ED visit rate (ED visits/100 child-years), using the definition from the PQMP Pediatric Asthma ED Use measure specifications.[23,24] ED visits were identified from claims records as having a primary or secondary diagnosis of asthma. The primary diagnosis was often a related symptom (e.g. fever or wheezing) or a known asthma trigger (e.g. upper respiratory tract illness). ED visits were excluded from the numerator if a hospitalization occurred within the same or the next calendar day to allow for ED visits that crossed midnight.

Statistical Analyses:

We used negative binomial regression with random effects for payer to estimate health plan performance on asthma-related ED visit rates. Negative binomial regression is a generalization of Poisson regression which allows for over-dispersion of the outcome variable when the conditional variance exceeds the mean. The predicted effects (ED visit rates per member-month) and standard errors for each plan were generated in a post-estimation “margins” command.[36] This command calculates a marginal (or average) ED visit rate by averaging predicted values for each predictor category, which can be interpreted

as the per member-month rate for each predictor category. We then calculated the rate per 100 child-years for each health plan by multiplying the marginal rates by 1200 (12 months in calendar year * 100 children). Standardized z-scores were used to identify high, medium, and low performers consistent with the Centers for Medicare & Medicaid Services (CMS) approach.[37] Plans with a Z-statistic>1.96 were considered poor performing outliers, those with <−1.96 were considered high performing outliers and those in between were considered no different from average.

The baseline risk-adjustment model included fixed effects for age, gender, and mutually exclusive Pediatric Medical Complexity Algorithm (PMCA) chronic condition indicators.[38] Z-statistics from this model were then compared to those of a second model that adjusted for the same variables plus the social risk factors specified above except child poverty level. Health plans that changed performance categories before and after risk adjustment for neighborhood social risk factors were identified. The distribution of social risk variables was compared across health plans by whether they changed rankings, using mixed effects linear models, clustered by health plan. As a secondary analysis, we repeated the same calculations using only child poverty level as a social risk factor in risk adjustment. All analyses were performed with SAS version 9.4 (SAS Institute, Inc., Cary, NC) and STATA 16 (STATA Corp, College Station, TX).

Results

The sample included 83,577 patients across 29 health plans in MA and 321,072 patients across 104 health plans in CA. The overall rate of asthma-related ED visits was 18.0/100 child-years (95% confidence interval (CI) 17.6–18.3) in MA and 26.1/100 child-years (95% CI 25.9–26.3) in CA (Table 1); however, there was significant variability in ED visit rates across plans (Table 2). Using the performance categories defined above, 5 (17%) health plans in MA and 27 (26%) health plans in CA were labeled as high-performing and 6 (21%) health plans in MA and 33 (32%) health plans in CA were labeled as low-performing.

In both MA and CA, performance varied with the addition of social risk variables to the baseline risk adjustment model. In MA, 2 (7%) health plans moved to a higher performance ranking and 27 (93%) did not move when the risk adjustment model included the social risk variables; no health plans moved to a lower performance ranking. In CA, 7 (7%) health plans moved to a higher performance category, 91 (88%) did not move, and 6 (6%) moved to a lower performance category after adjustment for social risk. Health plans in both states that moved to higher performance categories had more patients on average residing in higher social risk zip codes as evidenced by lower median incomes, higher percentage of limited education, higher percentage of poverty, and higher unemployment percentage. In contrast, health plans that moved to a lower performance category in CA had fewer patients residing in higher social risk zip codes than those that did not move performance categories (Table 3). These differences were statistically significant for poverty level and unemployment in CA. When only using child poverty rates for social risk factor assessment, findings for Massachusetts were the same (same number of health plans changing performance ranking and the same health plans moved); California findings were similar with both approaches, but with fewer health plans changing performance category (2 moved higher; 7 moved

lower) (Table 4) and differences in social risk factors by change in performance category were statistically significant in education and poverty measures.

Discussion

Using the Pediatric Asthma ED Use measure, we found that incorporation of social risk factors into risk-adjustment had a measurable effect on health plan performance rankings. In both MA and CA, 7–13% of health plans changed rankings after adjustment for social risk. Inclusion of neighborhood education, unemployment and income in the case-mix adjusted models appeared to improve performance for health plans caring for more patients from areas with higher social adversity but decreased performance for health plans caring for patients with lower adversity. These findings were similar across both approaches to social risk factor assessment and suggest that some of the variation in performance for lower-performing health plans was explained by higher percentages of patient with social risk.

Numerous studies have documented a strong relationship between asthma ED visit rates and social risk factors.[33,34,39,40] Factors such as obesity, healthcare literacy, access to preventive and specialist care, and ability to afford controller medications are believed to contribute to this relationship.[39] While some of these factors may be addressable with proper asthma management and education, others are more challenging to address. As such, even with excellent outpatient care, health plans that care for a disproportionate number of patients with high social risk may be unable to effectively improve their asthma ED utilization rates.

Our findings demonstrate that it is feasible to incorporate social risk into risk-adjustment models at the health plan level using all-payer claims data as well as payer-specific Medicaid claims; however, questions remain as to which social risk metrics to use. Social risk is a complex attribute that encompasses a host of factors with both neighborhood and individual factors interacting to influence health outcomes.[11,41,42] With the multitude of social risk variables available, there is no consensus on the best approach for incorporating social risk factors in risk adjustment.

Case-mix adjustment models using administrative claims data have gravitated towards neighborhood measures (zip code or census tract) of social risk because they are readily available, easily linked, and have been shown to be associated with health outcomes.[43] While appealing, these variables may not accurately reflect the socioeconomic composition of a health plan population if there is significant heterogeneity within a neighborhood. As such, neighborhood risk factors can be poor proxies for individual social risk and may not appropriately represent the socioeconomic composition of a health plan. However, there is also some evidence that neighborhood alone, independent of individual risk, is associated with health outcomes.[44,45] As noted in the NQF report, the choice of social risk metrics and their source is an evolving science, leading to the recommendation to assess the effects of social risk adjustments without dictating exact methods for doing so.[11] Research aimed at understanding the importance of various social risk metrics (education, income, occupation, health literacy, environmental factors) in risk-adjustment as well as the interaction between individual and neighborhood social risk is greatly needed.

The NQF report to Congress in 2020 published a framework for determining when and how to adjust for social risk in quality measurement.[11] They concluded that structure and process measures should never be adjusted for social risk or other case-mix variables, whereas other measures such as resource use measures should always be adjusted for social risk to ensure that socially at-risk patients receive adequate resources. For outcome, patient experience, and utilization measures, the decision whether to adjust for social risk was more challenging, and the NQF advised against a blanket social risk-adjustment policy.

In the case of the Pediatric Asthma ED utilization measure, disparities in asthma care and outcomes are well-documented and adjustment for social risk changed performance rankings for ~10% of health plans. Our findings suggest that though child poverty has validity as a stand-alone indicator of social risk, the inclusion of additional measures of education and employment status, per the conceptual model suggested by the NQF and others, capture social risk more completely.[29,43] Based on the findings in this study in the context of broader discussions, the PQMP measure includes the fuller set of social risk variables in the NQF-endorsed risk-adjustment model for the measure.[46] Although this approach has been adopted for the pediatric asthma measure, the decision whether to risk adjust for social risk will differ depending on the use case and other approaches to risk adjustment may be considered. For example, the Medicare Payment Advisory Commission ultimately concluded that adult 30-day hospital readmission measures should not be risk-adjusted for social risk but instead proposed stratifying performance comparisons to evaluate safety-net hospitals relative to one another rather than to the broader group.[47] While this approach has worked for hospital measures and led to fewer penalties levied on safety-net hospitals, there are no comparable safety-net designations for health plans or outpatient providers. The overarching goal of quality measurement is to optimize the care of pediatric patients, and the discussion about social risk highlights the opportunity in pediatrics to address social risk early, leveraging the current efforts towards social risk screening in pediatric primary care.[48,49]

There are a few notable limitations to this study. First, we adjusted for zip-code level social risk factors because we did not have access to census block data, though this can be a limitation also for those using quality measures. ZIP codes have more heterogeneity than census blocks or tracts, making census blocks potentially preferable for risk adjustment. Second, we used Medicaid data from MA and CA which historically have had lower income eligibility criteria than other states; thus, it is not clear how these analyses would generalize more broadly to other state Medicaid programs.

In summary, we found that adjusting for social risk changed performance rankings on the Pediatric Asthma ED Use measure for a substantial number of health plans. This example and others in the literature show that careful consideration should be given to each measure and its application when deciding whether to risk adjust for social risk. In particular, insight into the role for both individual and neighborhood level social risk as well as the intersection between these metrics is needed. Approaches to social risk adjustment should be guided by future research into which variables to include and the implications for risk adjustment on hospital or health plan performance.

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What's New:

Little is known about including social risk factors in case-mix adjustment models for pediatric quality measures. Using the Asthma Emergency Department Use measure as an example, we discuss the merits, feasibility, and challenges of incorporating these factors into pediatric quality assessment.

Table 1.

Eligible Patient Characteristics and Asthma-related ED Utilization rates

	Eligible Patients, N (%)	Asthma ED Rates (per 100 child-years, 95%CI)
Total	404,649 (100%)	24.5 (24.4–24.7)
Age group, years		
3–5	59,198 (14.6%)	39.5 (38.9–40.1)
6–11	177,795 (43.9)	21.9 (21.6–22.1)
12–17	118,886 (29.4)	19.8 (19.5–20.1)
18–21	48,770 (12.1)	29.7 (29.1–30.3)
Gender		
Male	226,726 (56.0%)	24.5 (24.3–24.8)
Female	177,923 (44.0)	24.6 (24.3–24.8)
Insurance type		
Medicaid managed care	340,616 (77.7%)	25.6 (25.4–25.8)
Medicaid FFS[c]	59,470 (13.6)	28.9 (28.2–29.6)
Commercial (MA ONLY)	30,941 (7.1)	8.8 (8.4–9.2)
Other (MA only)	7,617 (1.7)	10.9 (9.9–11.9)
PMCA[d]		
None (non-chronic)	253,138 (62.6%)	22.3 (22.1–22.6)
Chronic, non-complex	89,366 (22.1)	25.3 (24.9–25.7)
Complex chronic	62,145 (15.4)	32.2 (31.6–32.8)
Health Plans		
Number of Health Plans, N	133	--
Number of eligible patients per health plan, Mean (SD), Median (IQR)	Mean: 3161 (6357) Median: 922 (25%ile: 121, 75%ile: 3337)	--
State		
California	321,072	26.1 (25.9–26.3)
Massachusetts	83,577	18.0 (17.6–18.3)

Table 2.

Performance and performance categories for Massachusetts and California health plans, baseline risk adjusted without social risk factor adjustment

Measure	High performing*	No different than average	Low performing*
Massachusetts			
Health plan performance category baseline risk adjustment, n (%)+	5 (17.2%)	18 (62.1%)	6 (20.7%)
Rate Asthma ED Visits per 100 child-years**	8.9 (8.5–9.4)	10.9 (9.7–12.0)	23.9 (23.4–24.5)
California			
Health plan performance category baseline risk adjustment, n (%)+	27 (26.0%)	44 (42.3%)	33 (31.7%)
Rate Asthma ED Visits per 100 child-years**	17.6 (17.3–17.9)	23.1 (22.4–23.8)	30.4 (30.1–30.7)

* For asthma ED use, a lower quantity on the measure is considered higher performance.

Performance categories are from the baseline risk adjustment model (adjusting for age, gender, chronic condition indicator). Rates across the three groups before and after risk adjustment including SES factors were similar.

** Mean rates across patients in each performance group.

+ n is the number of health plans

Table 3.

Distribution of social risk measures for patients in health plans that changed performance ranking after social risk factor adjustment using income, education, employment measures

	Median household income in zip code, mean (95% CI)	% population with <high school education in zip code, mean (95%CI)	% households below federal poverty level in zip code, mean (95%CI)	% unemployed in zip code, mean (95%CI)**
Massachusetts				
Patients in health plans that did not change (n=77,304) *	$72696 ($69207-$76360)	5.2% (4.8%–5.5%)	10.3% (9.4%–11.1%)	7.6% (7.3%–7.9%)
Patients in health plans moved to **higher** performance ranking (n=6,273) *	$64888 ($55568-$75771)	5.6% (4.4%–6.8%)	11.1% (8.3%–13.8%)	8.1% (7.2%–8.9%)
California				
Patients in health plans that did not change (n= 276,938) *	$52362 ($50,200–54,618)	19.7% (17.9%–21.5%)	13.5% ** (12.4%–14.6%)	5.8% ** (5.5%–6.1%)
Patients in health plans that moved to **higher** performance ranking (n= 18,182) *	$45208 ($38,981–52,430)	22.3% (17.9%–21.5%)	19.5% ** (15.6%–23.4%)	7.3% ** (6.2%–8.3%)
Patients in health plans that moved to **lower** performance ranking (n= 25,952) *	$72181 ($61,489–84,734)	17.1% (10.2%–24.0%)	8.1% ** (4.0%–12.4%)	5.0% ** (3.9%–6.1%)

* Health plans that did not change: MA n=27; CA n=91. Health plans that improved: MA n=2; CA n=7. Health plans with lower performance: MA n= 0; CA n=6.

** p-value<0.01 for comparisons across patients in health plans according to health plan change in performance ranking. Otherwise, these p-values were >0.05.

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Table 4.

Distribution of social risk measures for patients in health plans that changed performance ranking after social risk factor adjustment only using percent of child poverty

	Median household income in zip code, mean (95% CI)	% population with <high school education in zip code, mean (95%CI)	% households below federal poverty level in zip code, mean (95%CI)	% unemployed in zip code, mean (95%CI)**
California				
Patients in health plans that did not change (n= 307,666)*	$52239 ($50,044–54,532)	20.0%** (18.4%–21.7%)	13.9%** (12.8%–14.9%)	5.9% (5.6%–6.2%)
Patients in health plans that moved to **higher** performance ranking (n= 3,388)*	$42511 ($31,838–56,762)	34.4%** (23.0%–45.6%)	22.7%** (15.5%–30.0%)	6.1% (4.1%–8.2%)
Patients in health plans that moved to **lower** performance ranking (n= 10,018)*	$65248 ($55,892–76,172)	12.2%** (6.1%–18.2%)	8.1%** (4.2%–12.0%)	5.0% (3.9%–6.1%)

*Health plans that did not change: CA n=95. Health plans that improved: CA n=2. Health plans with lower performance: CA n=7. Performance effects in Massachusetts health plans were the same as the model in Table 3.

**p-value<0.01 for comparisons across patients in health plans according to health plan change in performance ranking. Otherwise, these p-values were >0.05.