Racial Disparities in Failure-to-Rescue among Children Undergoing Congenital Heart Surgery

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Objective To determine if racial/ethnic disparities exist among children undergoing congenital heart surgery, using failure-to-rescue (FTR) as a measure of hospital-based quality.

Study design This is a retrospective, repeated cross-sectional analysis using admissions from the 2003, 2006, and 2009 Kids' Inpatient Database. All pediatric admissions (≤18 years) with a Risk Adjustment for Congenital Heart Surgery procedure were included. Logistic regression models examining complications, FTR, and overall mortality were constructed.

Results Hispanic ethnicity (OR 1.13, 95% CI 1.01-1.26) was associated with increased odds of experiencing a complication when compared with white race. However, black race (OR 1.66, 95% CI 1.33-2.07) and other race/ethnicity (OR 1.40, 95% CI 1.10-1.79) were risk factors for FTR. Although Hispanic ethnicity was associated with increased odds of experiencing a complication, it was not associated with FTR. In hospital fixed-effects models, black race and other race/ethnicity remained as "within hospital" risk factors for FTR.

Conclusions Black children and children of other race/ethnicity had higher rates of mortality after experiencing a complication. This suggests that racial disparities may exist in hospital-based cardiac care or response to care. *(J Pediatr 2015;166:812-8)*.

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Racial disparities have been documented in both adult myocardial infarct care and pediatric cardiac surgery. Specifically, non-white patients are more likely to suffer delays in receiving care, be referred to high mortality hospitals, and die than their white counterparts.[1-5] Some studies of adult care have demonstrated that, while some disparities may be attributed to referral patterns, disparities in treatment allocation, such as usage of revascularization therapies, remain evident.[2,4,6,7] However, a similar phenomenon of disparities in treatment allocation has not been documented in pediatric cardiac care.

Unlike adult myocardial infarct care, there are few evidence-based practices in congenital cardiac care that are useful measures of treatment disparities. Failure-to-rescue (FTR), which is defined as mortality after experiencing a hospital complication, has been utilized as a measure of quality for hospitals.[8,9] Because this measure examines mortality after a complication, it minimizes the impact of prehospital factors and may be a more sensitive marker of hospital-based disparities than hospital mortality alone. This study investigates the relationship between race, insurance type, and FTR as a measure of hospital-based disparities in children undergoing congenital heart surgery using 3 sequential iterations of a national inpatient dataset.

Methods

We utilized the 2003, 2006, and 2009 Kids' Inpatient Database (KID), produced every 3 years by the Healthcare Cost and Utilization Project (HCUP). Each iteration of the KID contains approximately 3 million deidentified pediatric discharge abstracts from between 36 (2003) and 44 (2009) states. Each KID database includes discharges from a random sampling of 10% of uncomplicated hospital births and 80% of complicated births and pediatric admissions with variables for patient-level demographics, diagnostic and procedure codes, indicators of comorbidities, and hospital level characteristics, such as teaching status and bed size. From 2003 onwards, the KID includes *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) E-codes, which provide environmental details of injury, including the mechanism and

FTR	Failure-to-rescue
HCUP	Healthcare Cost and Utilization Project
ICD-9-CM	*International Classification of Diseases, Ninth Revision, Clinical Modification*
KID	Kids' Inpatient Database
RACHS	Risk Adjustment for Congenital Heart Surgery-1
WMIPP	Wisconsin Medical Injuries Prevention Program

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place where the event occurred. Developed for injury prevention research and including designations for medical injuries, E-codes are instrumental in identifying healthcare complications. This study was exempted from human subjects research guidelines by the Institutional Review Board.

We examined all pediatric admissions (≤18 years old) that included 1 or more congenital cardiac surgeries, determined by qualifying ICD-9-CM codes in each KID hospitalization record. Using qualifying diagnostic and procedural ICD-9-CM codes, the Risk Adjustment for Congenital Heart Surgery-1 (RACHS) was used to stratify and adjust for the complexity of surgical procedures.[10] The RACHS was chosen as a risk adjustment tool as it has previously been utilized in administrative datasets that contain ICD-9-CM codes. Increasing RACHS categories (range 1-6) correspond with increasing complexity of surgical procedures and increasing risk of hospital mortality and morbidity. Only admissions associated with a RACHS surgical procedure were included in the analysis, and the highest RACHS category was assigned for patients who underwent multiple procedures during that admission. Complications were identified through matching ICD-9-CM diagnosis codes using 2 methods. First, in order to examine disparities in basic inpatient care, the Wisconsin Medical Injuries Prevention Program (WMIPP) complications[11] were utilized to identify complications, such as medication administration errors, that are applicable to all hospitalizations, irrespective of disease process (**Appendix I**; available at www.jpeds.com). Although broad-based, the WMIPP complications have been associated with increased mortality in children undergoing congenital heart surgery.[12] In addition, even though adult administrative dataset methodologies have shown very low sensitivity in detecting complications when compared with clinical datasets,[13,14] the WMIPP has a sensitivity of 60% and specificity of 97% when compared with medical chart review.[15] Second, the Society of Thoracic Surgeons Database complication list[16] was used as a basis to identify cardiac surgery specific complications that were not captured by the WMIPP complication set. Cardiac complications that could be identified by ICD-9-CM codes and had not been captured by the WMIPP algorithm, such as cardiac arrest, complete heart block requiring pacing, and pericardial effusion requiring drainage, were included (**Appendix II**; available at www.jpeds.com).

Because the KID does not track patients after hospital discharge, all outcomes are constrained to their respective hospital admission. The primary dependent variable of interest was FTR, defined as inpatient mortality in all patients experiencing either a WMIPP or cardiac complication. We empirically assumed that all patients who died would have suffered a complication (some of which may be undocumented in the administrative record) prior to their death.[17] Thus, patients who died without a WMIPP or cardiac complication were also included as FTR (**Figure 1**; available at www.jpeds.com). We also examined complication rates and overall mortality (mortality among all patients, with the denominator including all patients who died with and without a complication and all patients who survived with and without a complication). Overall mortality was examined separately as the at-risk denominator population for overall mortality and FTR are different (**Figure 1**). Thus, odds of FTR and overall mortality for a specific group (be it hospital or race) can differ, depending upon the proportion of patients who survive despite having a complication and the proportion that survive without a complication. The independent variables of interest were race/ethnicity and insurance type. The KID categorizes race and ethnicity into mutually exclusive categories: non-Hispanic White (hereafter referred to as "white"), non-Hispanic Black ("black"), Hispanic ethnicity, Asian/Pacific Islander, Native American, and other (including multirace). Because of very small numbers, Native American and other categories were grouped together as "other" race/ethnicity in the analysis. Insurance type was classified based upon the designated expected primary payer for each separate admission and divided into 3 categories: (1) private insurance including both fee-for-service and managed care; (2) Medicaid including both fee-for-service and Medicaid managed care; and (3) other forms of payment, including Medicare and self-pay.

The analysis adjusted for major, noncardiac structural anomalies, prematurity, and age at admission, consistent with previously published multivariable RACHS models.[10] The presence of a major, noncardiac structural defect and prematurity (gestational age <37 weeks) were denoted with dichotomous variables. Age at admission was divided into 3 groups: <30 days, 1 month to 1 year, and >1 year. The KID includes a quartile classification of the median household income for each patient's zip code. Residing in a zip code in the lowest quartile was classified as living in a low income neighborhood. Urgent or emergent admission, as classified by HCUP, was also examined, as nonelective admission for cardiac surgery may be a marker of severity of illness.

Designations for pediatric vs general hospitals and teaching vs nonteaching institutions were taken from the KID (based on data from the American Hospital Association Annual Survey of Hospitals and the Children's Hospital Association). In addition, because higher hospital volume is associated with lower odds of mortality and FTR, hospital volume (total RACHS procedures per year) was computed as a continuous variable.

Statistical Analyses

A univariate analysis examining baseline characteristics across 3 possible outcomes (survived without complication, survived with complication, FTR) was performed. A χ^2 test was performed for all dichotomous or categorical variables, and a Kruskal-Wallis ANOVA was performed for all nonnormally distributed continuous data and ordinal data. A P value of <.05 in the univariate analysis was considered statistically significant and was used as the criterion for consideration in each multivariate model. Logistic regression models examining complications, FTR, and overall mortality at the patient-level were constructed separately, adjusting for sex, age, surgical complexity, race/ethnicity, insurance type,