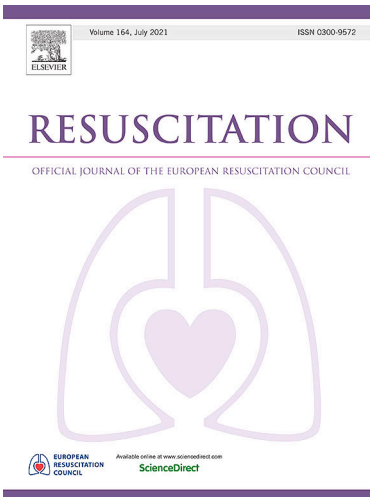
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Original paper

Trends in United States Pediatric In-Hospital Cardiac Arrest Incidence and Mortality in a Nationally Representative Sample, 2009–2022

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Trends in United States Pediatric In-Hospital Cardiac Arrest Incidence and Mortality in a Nationally Representative Sample, 2009–2022

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Abstract

Aim:

National estimates of pediatric in-hospital cardiac arrest (IHCA) incidence in the United States rely on a voluntary registry that may underrepresent smaller and critical access hospitals. Administrative datasets offer a nationally representative alternative. We estimated nationally representative pediatric IHCA incidence and mortality trends from 2009 through 2022.

Methods:

Serial cross-sectional analysis of five triennial editions of the Kids' Inpatient Database (2009–2022), identifying IHCA in children <18 years by ICD-9 (99.60, 99.63) and ICD-10 (5A12012) cardiopulmonary resuscitation procedure codes. Two hospitals with implausible CPR rates were excluded. Survey-weighted incidence per 1,000 hospitalizations and in-hospital mortality among resuscitated children were estimated overall and by neonatal status, complex chronic condition (CCC) status, ZIP-code income quartile, and US Census region. Trends were tested with survey-weighted quasi-Poisson regression across the full period and, as exploratory analyses, within the ICD-10 era (2016–2022).

Results:

Observed IHCA incidence was 1.11/1,000 in 2009 and 1.22/1,000 in 2012, decreased to 1.11/1,000 at the ICD-10 transition and increased to 1.35/1,000 by 2022. IHCA incidence in children hospitalized with a CCC rose from 3.26 to 6.60/1,000 (6.2%/year, $p<0.001$), while incidence without CCC remained low. Incidence varied by socioeconomic status (lowest vs highest income quartile 1.78 vs 1.04/1,000 in 2022). In-hospital mortality ranged from 34.1% (2012) to 40.4% (2019), whereas IHCA deaths per 1,000 hospitalizations increased 1.7%/year ($p<0.001$), concentrated among children with a CCC.

Conclusion:

The incidence of pediatric IHCA increased among hospitalizations involving children with CCC and was higher among children who live in lower income areas. In-hospital mortality after CPR was largely stable, whereas arrest-related deaths per 1,000 hospitalizations increased among children with CCC. A single hospital's coding practices can materially distort national administrative estimates.

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What is already known

Pediatric in-hospital cardiac arrest affects approximately 15,200 children annually in the United States, with this national estimate derived primarily from a voluntary registry that may underrepresent smaller and critical access hospitals. Administrative databases offer nationally representative coverage but rely on procedure codes that are susceptible to misclassification.

What this study adds

In this nationally representative administrative database sample spanning 2009–2022, this study demonstrated that: 1) the incidence of IHCA among children with complex chronic conditions (CCC) rose steadily and accounted for the substantial majority of events, 2) the overall IHCA incidence was higher among children who live in lower income areas with the gradient worsening over the period evaluated, and 3) in-hospital mortality after CPR increased only slightly (34–40%), whereas arrest-related deaths per 1,000 hospitalizations increased more, driven mainly by rising incidence among children with CCC, and 4) CPR coding at a single hospital can substantially distort national administrative estimates.

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Introduction

Pediatric in-hospital cardiac arrest (IHCA) affects approximately 15,200 children annually in the United States and causes substantial morbidity and mortality.[1–3] National estimates derive primarily from the American Heart Association's Get With The Guidelines–Resuscitation (GWTG-R) registry, a voluntary, prospective registry that has defined contemporary pediatric resuscitation epidemiology.[1,3–6] Because participating hospitals self-select, GWTG-R hospitals may differ from non-participating hospitals in resources, case-mix, and demographics, introducing potential ascertainment bias.[7–9] Small and critical access hospitals are underrepresented.[10,11]

The Healthcare Cost and Utilization Project (HCUP) Kids' Inpatient Database (KID) provides a nationally representative alternative with weighted samples of pediatric hospitalizations, but relies on procedure code capture of cardiopulmonary resuscitation (CPR) to identify hospitalizations with documented IHCA care,[12,13] which are subject to misclassification.[14,15]

Increases in survival of children with complex chronic conditions (CCCs)[16] have produced a hospitalized pediatric population with growing medical complexity.[17–19] Although prior work has characterized racial and ethnic disparities in pediatric IHCA outcomes using KID,[20] the corresponding national trends in IHCA incidence among children hospitalized with a CCC, and across socioeconomic and geographic strata, have not been quantified.

Our objective was to describe trends in IHCA incidence and post-arrest in-hospital mortality among hospitalized children in the US from 2009 through 2022, overall and by CCC status, neonatal status, ZIP-code income quartile, and US Census region.

Methods

Study design and data source

We performed a serial cross-sectional analysis of pediatric IHCA using the 2009, 2012, 2016, 2019, and 2022 KID editions. KID is a nationally representative triennial weighted sample of US pediatric hospital discharges. The Children's Hospital of Philadelphia Institutional Review Board determined this investigation did not constitute human subjects research.

Population

We included all pediatric (<18 years) hospitalizations recorded in each KID edition. Records that lacked the standard discharge weight variable were excluded. Because KID is a discharge-level file without patient identifiers, estimates describe hospitalizations rather than unique individuals: a subject may contribute more than one hospitalization, and a hospitalization may include more than one CPR event, but only one will be coded. The remaining hospitalizations comprised the analytic denominator for incidence estimates.

Exposure and outcomes

IHCA hospitalizations were identified by the presence of a procedure code for CPR: ICD-9 codes 99.60 (cardiopulmonary resuscitation, not otherwise specified) and 99.63 (closed chest cardiac massage) in 2009 and 2012, and ICD-10 code 5A12012 (performance of cardiac output, single, manual) in 2016, 2019, and 2022[12,13,21]. Procedure rather than diagnosis codes were used because CPR procedure codes more specifically identify resuscitation occurring during hospitalization, whereas cardiac arrest diagnosis codes may not reliably distinguish IHCA from cardiac arrest occurring before hospital admission[12,22].

These CPR procedure codes have not been validated against medical records in US children. They capture CPR performed anywhere during the hospital stay, including the delivery room, emergency department of the admitting hospital and the operating room, and do not distinguish pulseless arrest from CPR for bradycardia with poor perfusion. The primary incidence outcome was determined as the presence of qualifying CPR code per 1,000 eligible hospitalizations, henceforth referred to as IHCA per 1,000 hospitalizations[22,23]. The primary mortality outcome was in-hospital mortality among children who received CPR. Population-based IHCA mortality was calculated as in-hospital deaths among CPR-coded hospitalizations per 1,000 hospitalizations.

Subgroups

Subgroup analyses were conducted within neonates (KID-derived AGE_NEONATE variable (2012-2022 versions) defined as admission in first 28 days after birth) and between children with and without CCC status (one or more CCC vs. none, based on the Feudtner CCC classification system determined from diagnosis codes)[16,24], ZIP code median household income quartile (an area-level measure assigned by HCUP from the median household income of the patient's residential ZIP code), and US Census region (Northeast, Midwest, South, West). We performed additional sensitivity analyses utilizing additional exclusion criteria. First, we excluded birth hospitalizations in the 2016, 2019, and 2022 KID editions as identified by the variable I10_HOSPBRTH. Second, for mortality estimates, patients with discharge disposition of transfer to a short-term acute care hospitalization were both excluded and treated as all deceased.

Statistical analysis

All analyses incorporated the KID complex survey design using hospital identifiers as primary sampling units and KID-provided strata as stratification variables, each made unique to KID edition because HCUP assigns these identifiers independently in each edition, and the discharge weight (DISCWT) as the sampling weight, with sampling units nested within strata[25]. Survey-weighted proportions and 95% confidence intervals were estimated using Taylor series linearization.

For each KID edition, we calculated unweighted and survey-weighted IHCA counts and survey-weighted incidence per 1,000 hospitalizations. Trends were tested using survey-weighted quasi-Poisson regression with calendar year as a continuous variable and discharge-level binary outcomes (CPR-code presence for incidence; death among CPR-coded hospitalizations for mortality). Results are reported as annual incidence rate ratios (IRRs) with 95% confidence intervals. Within each edition, the income gradient was estimated by entering HCUP derived income quartile as an ordinal term (1, highest; 4, lowest) in the same model, assuming a log-linear association; the modeled lowest- versus highest-quartile ratio was calculated as IRR^3.

Because IHCA incidence appeared discontinuous at the ICD-9 to ICD-10 transition, we conducted two complementary analyses: 1) an exploratory trend analysis restricted to 2016–2022; and 2) a piecewise model including calendar year and a post-ICD-10 indicator (a common slope with a level shift at 2016), with a separate post-ICD-10 slope added as a sensitivity analysis. The same common-slope model was applied to mortality outcomes. Subgroup trend tests were exploratory without multiplicity correction. Neonatal trends were repeated using 2012–2022 only. Because the 2009 and 2012 estimates had wide confidence intervals, we examined hospital-level CPR coding rates and decomposed the linearized variance of each edition's incidence estimate into contributions from individual hospitals. We then defined a single exclusion rule, applied uniformly to all editions: hospitals with at least 100 sampled discharges and more than 100 CPR-coded hospitalizations per 1,000 sampled discharges were excluded. Results including all hospitals are presented as a sensitivity analysis. Analyses were performed in R version 4.4.0.

Results

Sample characteristics

After excluding one hospital in each of 2009 and 2012 that met exclusion criteria,24,358 unweighted pediatric hospitalizations across five KID editions included a CPR procedure code. Of these, 56% involved male patients and 76% involved children with a CCC; 66% occurred at large hospitals, 84% at urban teaching hospitals, and 38% in the South. Medicaid was the primary payer in approximately half (Table 1). Characteristics of excluded hospitals can be found in Supplemental Table 1.

Incidence of in-hospital cardiac arrest

IHCA incidence was 1.11/1,000 hospitalizations (95% CI 1.02–1.19) in 2009 and 1.35/1,000 (95% CI 1.25--1.45) in 2022 (Figure1A, Table 2). Across the full study period, observed incidence increased modestly (IRR per year 1.009, 95% CI 1.002–1.017; 0.9%/year, p=0.012) (Table 3). Excluding birth hospitalizations, increased incidence (1.40/1,000 [95% CI 1.26–1.54] in 2016 and 1.91/1,000 [1.72–2.09] in 2022), and the ICD-10-era increase persisted (5.2% per year; IRR 1.052, 95% CI 1.028–1.077, p<0.001) (Supplemental Tables 2-3). Incidence and mortality when all hospitals were included can be found in Supplementary Table 4 and 5.

Trends in IHCA among children with complex chronic conditions

Among children with one or more CCC, IHCA incidence approximately doubled, from 3.26/1,000 (3.02–3.51) in 2009 to 6.60/1,000 (6.11–7.09) in 2022 (Table 2), corresponding to a 6.2% increase per year across the full study period (IRR=1.062, 95%CI 1.054, 1.069; p<0.001) (Figure 2B, Table 3) and a 2.5% per-year increase within the ICD-10 era alone (IRR=1.025, 95%CI 1.007, 1.043; p=0.007). In contrast, IHCA incidence among children without CCC increased slightly from 2009 to 2022 (0.31 to 0.42/1,000; trend p=0.003), but not significantly in the ICD-10 era (trend p=0.39).

Trends in neonatal IHCA

Neonatal IHCA incidence was 1.08/1,000 in 2012 and 1.25/1,000 in 2022 (1.1% per year, p=0.033; Table 2-3).

Income quartile and regional trends in IHCA incidence

Across all editions, IHCA incidence was highest in the lowest-income and lowest in the highest-income ZIP quartiles (Figure 2C). In 2022, IHCA incidence among children living in the lowest-income quartile was 1.78/1,000 (1.60–1.95) compared with 1.04/1,000 (0.94–1.15) among those living in the highest-income quartile. (Table 2 - 3) Each step toward a lower-income quartile was associated with higher incidence (IRR range, 1.05–1.20; all p<0.05; Table 4), and the gradient steepened over time (quartile-by-year interaction p<0.001), with the modeled lowest- versus highest-quartile ratio increasing from 1.16 in 2009 to 1.71 in 2022.

The South and West demonstrated the steepest within-ICD-10-era increases in IHCA incidence (4.9% per year, p<0.01 and 4.1% per year, p=0.01, respectively; Figure 2D), with the South reaching 1.49/1,000 (1.30–1.68) and the West 1.30/1,000 (1.14–1.46) by 2022. The Northeast remained comparatively stable across the ICD-10 era (1.8% per year, p=0.37).

Mortality following in-hospital cardiac arrest

Overall mortality was 38.4% (95% CI 36.4–40.3%) in 2009 and 34.1% (32.3–35.8%) in 2012, increasing to 37.8% (35.9–39.8%) in 2016 and 39.8% (37.4–42.1%) in 2022 (Figure 1B and Table 2). Across the full study period, mortality increased slightly (0.7% per year; IRR=1.007, 95% CI 1.002–1.013, p=0.007) (Table 3), with no significant trend within the ICD-10 era (IRR 1.008, p=0.23) and no significant level change at the ICD-10 transition (piecewise level-shift IRR 1.101, 95% CI 0.995–1.218, p=0.06).. Sensitivity analysis excluding patients with a discharge disposition of transferred to a short-term hospital for inpatient care resulted in a mortality rate of 47.8% (44.8–50.7%) in 2022 (Supplemental Table 6). Mortality trends differed substantially by CCC status (Figure 2F). Among children with one or more CCC, mortality rose 1.5% per year (IRR=1.015, 95%CI 1.011, 1.020; p<0.001), reflecting a step between 2012 (37.0%) and 2016 (46.7%) with no change within the ICD-10 era (IRR 1.000, p=0.98), while mortality among children without CCCs decreased 2.3% per year (IRR=0.977, 95%CI 0.962, 0.992; p=0.003). Neonatal mortality after IHCA increased from 32.9% in 2012 to 36.7% in 2022 (Figure 2E, Table 2). On a population level, IHCA deaths per 1,000 hospitalizations increased from 0.43 in 2009 to 0.54 in 2022 (1.7% per year; IRR=1.017, 95%CI 1.008–1.026, p<0.001) (Table 2, Table 3). This increase was confined to children with a CCC (7.8% per year; IRR=1.078, 95%CI 1.069–1.087, p<0.001); IHCA deaths per 1,000 hospitalizations did not change among children without a CCC (IRR=0.994, 95%CI 0.980–1.008, p=0.40) (Table 3). The relative increase in IHCA deaths per 1,000 hospitalizations therefore exceeded that in mortality among CPR-coded hospitalizations, both overall (1.7% vs 0.7% per year) and among children with a CCC (7.8% vs 1.5% per year).

Incidence changes across ICD-9 to ICD-10 conversion

With the transition to ICD-10 in 2016, overall incidence decreased from 1.22/1,000 (1.13–1.30) in 2012 to 1.11/1,000 (1.04–1.18), then increased to 1.35/1,000 by 2022, exceeding the ICD-9 era estimates. In the piecewise model with a common slope, observed incidence increased 3.3% per year (IRR 1.033, 95% CI 1.018–1.049) with a 22% decrease at the ICD-10 transition (level-shift IRR 0.78, 95% CI 0.68–0.90, p<0.001); allowing separate slopes before and after the transition gave a similar level shift (IRR 0.79, 95% CI 0.65–0.96, p=0.02) (Supplemental Table 7). Within the ICD-10 era alone, however, observed incidence increased significantly by an estimated 3.4% per year (p<0.001) (Table 3).

Discussion

In a nationally representative analysis of pediatric IHCA in the US spanning 2009 to 2022, we identified five principal findings. First, IHCA incidence was substantially higher among hospitalizations in which one or more CCCs were documented, and incidence within this group rose substantially over the study period. Second, Second, a socioeconomic gradient in IHCA incidence was present in every KID edition and widened over time, and regional increases were concentrated in the South and West. Third, the in-hospital mortality rate in patients with IHCA was lower than that reported in most studies and increased only slightly, coinciding with the ICD-10 transition, whereas IHCA deaths per 1,000 hospitalizations increased more substantially, driven by rising incidence among hospitalizations involving children with a CCC. Fourth, observed IHCA incidence decreased across the transition from ICD-9 to ICD-10 procedure coding in 2016, then increased progressively across the ICD-10 era, exceeding the ICD-9 era estimates by 2022. Fifth, CPR coding at a single hospital in each ICD-9 edition materially distorted national incidence and mortality estimates.

Observed IHCA incidence among hospitalizations involving children with a documented CCC approximately doubled between 2009 and 2022. However, because CCC status was determined from all-listed discharge diagnoses without present-on-admission or timing information, we cannot determine whether a CCC preceded admission, was first recognized during the hospitalization, or resulted from

IHCA and severe illness. Several non-mutually exclusive processes could consequently produce the observed trend. First, the incidence of IHCA may truly be increasing among children admitted with established CCCs. Second, improved survival of children with congenital heart disease, severe prematurity, neuromuscular disease, and other serious conditions has expanded the population of medically complex children hospitalized.[18,26,27] The lower incidence among children with a CCC after excluding birth hospitalizations suggests that CCCs identified in neonates resuscitated during the birth hospitalization contribute to the high incidence in this group, although the ICD-10-era increase persisted after their exclusion. Increasing complexity and comorbidities may translate into higher baseline arrest risk.[17,26] We additionally hypothesize that aggressive resuscitation may be more frequently initiated for children with CCC, owing to expanded eligibility for extracorporeal cardiopulmonary resuscitation, increasing use of cardiac surgery and tracheostomy in medically complex children, and shifting care practices that previously discouraged intervention in children with multiple comorbidities or serious genetic syndromes.[27–30] Third, more children may survive an acute illness long enough to receive a new diagnosis or develop a serious condition expected to persist for at least 12 months, with the CCC and IHCA consequently documented during the same hospitalization. The rise in mortality after CPR among children with a CCC at the ICD-10 transition (37.0% to 46.7%), while mortality fell among children without a CCC, is consistent with, but does not establish, a shift toward resuscitation of a more medically complex population. Regardless of mechanism, IHCA is increasingly concentrated in hospitalizations involving children with serious long-duration conditions.

The area-level socioeconomic gradient in IHCA incidence was present in every KID edition and widened over the study period. Modeled incidence in the lowest- versus highest-income quartile was approximately 16% higher in 2009 and 71% higher by 2022, and a formal test of the quartile-by-year interaction supported a steepening gradient. Because ZIP-code median household income is an ecological rather than an individual-level measure, this gradient may reflect correlated differences in hospital case-mix, geography, payer, race and ethnicity, or chronic disease burden rather than household income per se and should be regarded as hypothesis-generating for future individual-level investigation.[20]

The ICD-9 to ICD-10 transition produced an observed discontinuity in IHCA incidence between 2012 and 2016, and within the ICD-10 era observed incidence has progressively risen beyond ICD-9 era estimates by 2022. The discontinuity observed at the ICD-10 transition, followed by a progressive rise, could reflect a true increase in pediatric IHCA or, more plausibly, a change in capture as institutions and coders adapted to ICD-10 procedural coding.[31] A GWTG-R analysis of 2008-2017 data did not identify significant changes in incidence of either pulseless or non-pulseless CPR events during this period. Direct comparisons of incidence between KID and GWTG-R should be interpreted cautiously: KID captures hospitalizations with CPR procedure codes, whereas GWTG-R captures adjudicated cardiac arrest events with prospective case finding and Utstein-style definitions.[1,4]

Overall mortality rates in children with IHCA and the modest increase in observed mortality after IHCA at the ICD-10 transition warrants similar caution as the corresponding decrease in observed incidence. The KID-derived 38.4% in-hospital mortality rate estimate in 2009 coincided with a GWTG-R absolute in-hospital mortality rate of 53.6% from the same year. While mortality rates increased in KID from 2012 to 2016 and remained elevated, GWTG-R analyses have demonstrated improving survival after pediatric IHCA, with survival to hospital discharge rising from 37% to 53% over the prior two decades.[2,4,32] This suggests that these data sources have captured different patients. Population-based IHCA mortality, which shares a denominator with incidence and is therefore not affected by changes in the composition of CPR-coded hospitalizations, increased more than mortality among CPR-coded hospitalizations. Among children with a CCC, this increase predominantly reflects more arrest-related deaths arising from rising incidence, with a smaller contribution from higher mortality after CPR; in the overall cohort, the two contributed similarly. The small increase in mortality after CPR occurred as a step at the ICD-10 transition rather than as a gradual trend. If the patients identified by CPR procedure code with the ICD-10

change shifted toward a sicker subset or a more selective group of CPR events that met stricter criteria for billing (e.g., excluding brief CPR events), the modest mortality increase at the transition would reflect ascertainment of a selected case-mix rather than worsening of resuscitation outcomes.

Our findings also illustrate how the coding practices of a single institution can distort national administrative estimates. In each ICD-9-era edition, one hospital coded CPR in more than 40% of its sampled discharges (967 of 2,039 in 2009 and 920 of 2,181 in 2012), with near-universal survival (≤10 deaths among the CPR-coded hospitalizations at each hospital) and a complex chronic condition documented in 98–99%. These two hospitals accounted for approximately 95% of the variance in those editions' incidence estimates, and no other hospital with at least 100 sampled discharges exceeded 57 CPR-coded hospitalizations per 1,000 in any edition. Their inclusion produced an apparent decline in incidence across the study period and an apparent rise in post-arrest mortality from 31.5% to 39.8%, and widened the confidence intervals for the ICD-9 editions. CPR in nearly half of all admissions with almost no deaths is not clinically plausible and most likely reflects hospital-specific coding or data-submission issues rather than resuscitation events. Because KID discharge weights extrapolate sampled discharges to national totals within strata, an idiosyncrasy at one hospital propagates directly into national estimates. Hospital-level influence diagnostics, including facility-specific coding rates and contributions to variance, should be a routine part of administrative data studies estimating national resuscitation incidence.

These findings collectively highlight challenges in current pediatric IHCA surveillance in the United States. Voluntary registries such as GWTG-R provide rigorous case ascertainment but are limited by hospital self-selection, whereas administrative datasets such as KID provide all-hospital coverage but are susceptible to code misclassification This discordance supports a more inclusive approach, such as a federally supported surveillance system with mandatory or near-mandatory reporting across all hospital types.

This study has several limitations. Identification of IHCA relies on procedure codes for CPR, which precludes distinguishing pulseless cardiac arrest from CPR delivered for bradycardia with poor perfusion, recurrent CPR events within a hospitalization, perioperative CPR, or coding artifacts. Procedures performed in the emergency department of the admitting hospital are included in the inpatient record, so some out-of-hospital arrests with ongoing CPR at the hospital who survive to admission may be captured. CPR performed as part of neonatal resuscitation that was coded with ICD procedural code for CPR cannot be distinguished from other forms of IHCA in our methodology. In sensitivity analyses excluding birth hospitalizations in the 2016, 2019, and 2022 KID editions, incidence and mortality where higher, but temporal trends were similar to the main analysis. KID is discharge-based without patient identifiers; estimates represent the proportion of hospitalizations with a CPR procedure code and may overestimate unique individuals affected. The triennial structure of KID precludes more granular yearly analyses, and ICD-10-era trend tests rest on only three time points and should be interpreted as exploratory rather than confirmatory. We excluded two hospitals with implausible CPR coding using a threshold defined after hospital-level diagnostics; although the rule was applied uniformly to all editions and the threshold lies far above the rate at any other hospital, less extreme hospital-level coding idiosyncrasies may remain, and estimates including these hospitals are presented in Supplemental Tables 4-5. The number of states contributing to KID increased across editions, and KID lacks state identifiers, precluding restriction to consistently participating states. KID also lacks pre-arrest physiologic measures of illness severity. Transfers to other acute care hospitals were counted as survivors in the primary mortality analysis, unlike some prior work;[34] mortality was higher when transfers were excluded or assumed to have died, but the pattern across editions was similar (Supplemental Table 6).

Conclusion

In this nationally representative sample of pediatric hospitalizations in the US from 2009–2022, we observed that IHCA incidence increased substantially among hospitalizations involving children with a documented CCC and was higher among children living in lower-income areas. In-hospital mortality following IHCA was increased minimally, whereas arrest-related deaths per 1,000 hospitalizations increased more substantially, driven largely by rising incidence among CCC-coded hospitalizations. Mortality estimates may partly reflect changes in case ascertainment and coding across the ICD-10 transition, and the coding practices of individual hospitals can materially influence national administrative estimates. Because KID cannot establish whether CCCs preceded admission or arrest, these trends may reflect increasing arrest risk among children with established CCCs, but should not be interpreted exclusively as this mechanism. Regardless of mechanism, children with serious chronic conditions now account for the substantial majority of pediatric IHCA events and should be central to contemporary prevention, resuscitation research, education, and quality-improvement efforts.

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AI Use: During the preparation of this work, the author(s) used Anthropic Claude Opus and Sonnet large language models for statistical code revision and manuscript drafting and revisions. The author(s) reviewed and edited the output as needed and take full responsibility for the content of the published article.

Declaration of Interests: Dr. Topjian is a member of the Editorial Board for *Resuscitation*

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Tables

Table 1. Characteristics of pediatric hospitalizations with in-hospital cardiac arrest, KID 2009–2022.

Values are unweighted counts (column percentages) for categorical variables and median (interquartile range) for age.

Table 2. Survey-weighted incidence (per 1,000 hospitalizations) and post-arrest in-hospital mortality by Year and Subgroup

All estimates incorporate KID complex survey design (hospital-level clustering, KID-provided strata, discharge weights). Mortality is among children receiving CPR. IHCA deaths per 1,000 hospitalizations use all hospitalizations as the denominator. Income quartile is the HCUP-assigned quartile of median household income for the patient's residential ZIP code, an area-level measure. CCC = complex chronic condition. CI = confidence interval.

Table 3: Incidence and Survey-Weighted Poisson Mortality Tests of Trend

IRR = incidence rate ratio per calendar year, with calendar year entered as a continuous term; % change/year = (IRR − 1) × 100. ICD-10 era = 2016–2022. Neonatal estimates are restricted to 2012–2022. Population mortality = in-hospital deaths among CPR-coded hospitalizations per 1,000 hospitalizations.

Table 4: Survey-weighted test for a monotone area-level income gradient in pediatric IHCA incidence, by KID edition.

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Figure Legends

Figure 1. Survey-weighted national estimates of pediatric in-hospital cardiac arrest (IHCA) incidence and post-arrest in-hospital mortality, KID 2009–2022. **(A)** Overall IHCA incidence per 1,000 pediatric hospitalizations. **(B)** Overall in-hospital mortality (%) among children receiving cardiopulmonary resuscitation. Error bars represent 95% confidence intervals.

Figure 2. Survey-weighted national estimates of pediatric IHCA incidence (top row) and post-arrest in-hospital mortality (bottom row) by subgroup, KID 2009–2022. **(A)** Incidence among neonates (2012-2022). **(B)** Incidence by complex chronic condition (CCC) status. **(C)** Incidence by ZIP-code median household income quartile. **(D)** Incidence by US Census region. (**E)** Mortality among neonates. **(F)** Mortality by CCC status. **(G)** Mortality by income quartile. **(H)** Mortality by US Census region.

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Author Contributions

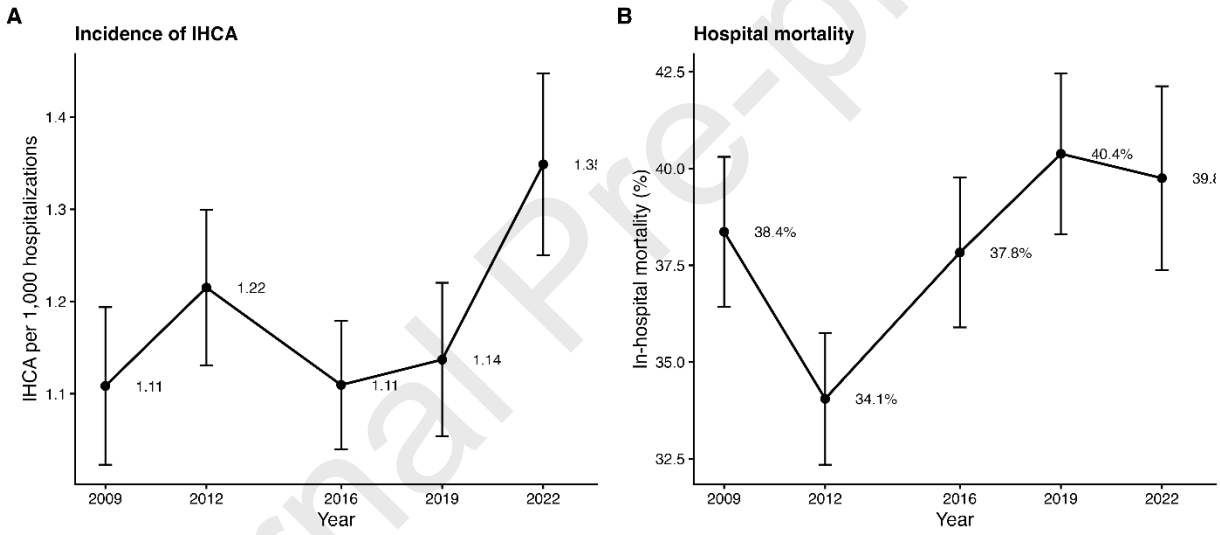
All authors contributed to study conception and design. GK performed the analyses and drafted the manuscript. AO, MFK, AAT, RAB, RMS, NY, and RWM provided critical intellectual content and revisions. RWM provided senior oversight. All authors approved the final manuscript and agree to be accountable for the content.

Conflict of Interest

Drs. Keim and Yehya utilize a medical device loaned to the Children's Hospital of Philadelphia by Timpel Medical for research work unrelated to this manuscript. The authors otherwise declare no relevant conflicts of interest.

Data Availability

Data are available from the Healthcare Cost and Utilization Project (HCUP) Kids' Inpatient Database. Analytic code can be made available upon reasonable request to the corresponding author.



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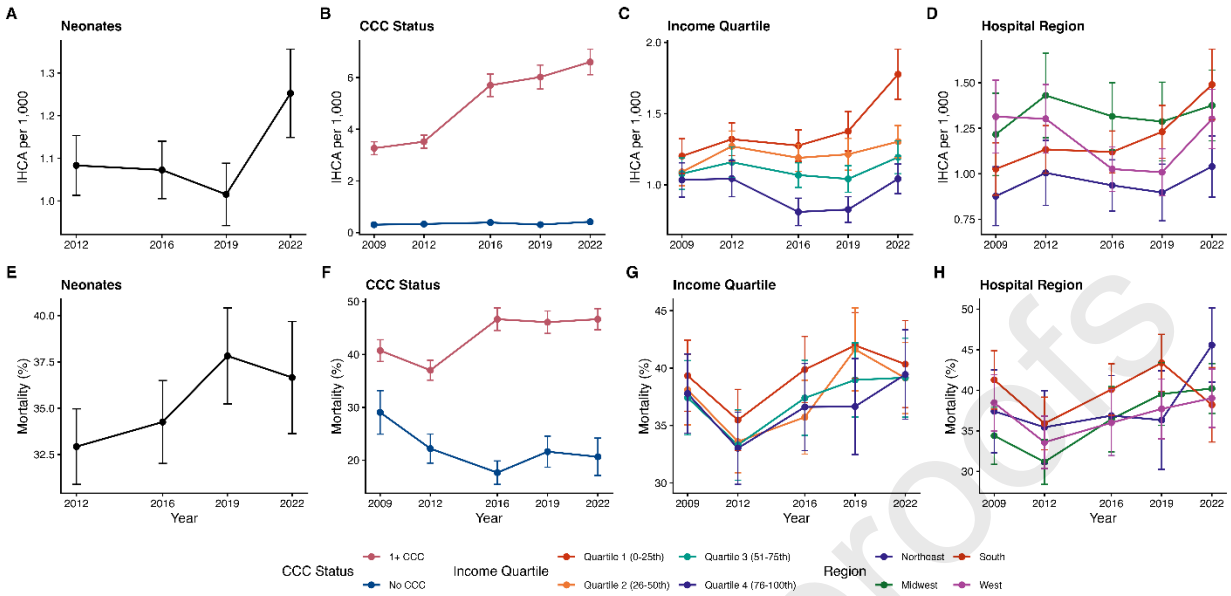


Table 1. Characteristics of Pediatric Hospitalizations with In-Hospital Cardiac Arrest (KID 2009-2022)

Characteristic	Overall N = 24,358[1]	2009 N = 4,854[1]	2012 N = 5,196[1]	2016 N = 4,599[1]	2019 N = 4,563[1]	2022 N = 5,146[1]
Age[2], years — median (IQR)	0 (0, 0)	0 (0, 1)	0 (0, 1)	0 (0, 0)	0 (0, 0)	0 (0, 0)
Age[2] excluding neonates, years — median (IQR)	8 (2, 14)	10 (3, 15)	8 (2, 15)	7 (2, 14)	7 (2, 13)	7 (2, 14)
Sex						
Female	10,698 (44%)	2,125 (44%)	2,298 (44%)	2,023 (44%)	2,000 (44%)	2,252 (44%)
Male	13,635 (56%)	2,723 (56%)	2,896 (56%)	2,571 (56%)	2,558 (56%)	2,887 (56%)
Missing	25	6	2	5	5	7
Race/Ethnicity						
White	9,566 (44%)	1,873 (45%)	2,126 (46%)	1,860 (46%)	1,790 (43%)	1,917 (42%)
Black	5,093 (24%)	841 (20%)	1,010 (22%)	991 (24%)	1,062 (26%)	1,189 (26%)
Hispanic	4,161 (19%)	930 (22%)	920 (20%)	721 (18%)	723 (18%)	867 (19%)
Other	2,784 (13%)	532 (13%)	613 (13%)	486 (12%)	542 (13%)	611 (13%)
Missing	2,754	678	527	541	446	562
Complex Chronic Condition						
1+ CCC	18,569 (76%)	3,892 (80%)	4,155 (80%)	3,214 (70%)	3,502 (77%)	3,806 (74%)
No CCC	5,789 (24%)	962 (20%)	1,041 (20%)	1,385 (30%)	1,061 (23%)	1,340 (26%)
Hospital Region						
Northeast	3,368 (14%)	705 (15%)	752 (14%)	653 (14%)	592 (13%)	666 (13%)
Midwest	6,020 (25%)	1,157 (24%)	1,379 (27%)	1,200 (26%)	1,140 (25%)	1,144 (22%)
South	9,255 (38%)	1,604 (33%)	1,743 (34%)	1,751 (38%)	1,908 (42%)	2,249 (44%)
West	5,715 (23%)	1,388 (29%)	1,322 (25%)	995 (22%)	923 (20%)	1,087 (21%)
Primary Payer						
Medicare	63 (0.3%)	12 (0.2%)	19 (0.4%)	13 (0.3%)	9 (0.2%)	10 (0.2%)
Medicaid	13,158 (54%)	2,509 (52%)	2,806 (54%)	2,534 (55%)	2,519 (55%)	2,790 (54%)
Private insurance	8,824 (36%)	1,893 (39%)	1,877 (36%)	1,621 (35%)	1,618 (35%)	1,815 (35%)

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Characteristic	Overall N = 24,358[1]	2009 N = 4,854[1]	2012 N = 5,196[1]	2016 N = 4,599[1]	2019 N = 4,563[1]	2022 N = 5,146[1]
Self-pay	1,089 (4.5%)	189 (3.9%)	190 (3.7%)	220 (4.8%)	212 (4.6%)	278 (5.4%)
No charge	32 (0.1%)	14 (0.3%)	4 (<0.1%)	3 (<0.1%)	6 (0.1%)	5 (<0.1%)
Other	1,156 (4.7%)	234 (4.8%)	291 (5.6%)	199 (4.3%)	187 (4.1%)	245 (4.8%)
Unknown/ Not submitted	36 (0.1%)	3 (<0.1%)	9 (0.2%)	9 (0.2%)	12 (0.3%)	3 (<0.1%)
Median Household Income Quartile						
Quartile 1 (0-25th)	8,111 (33%)	1,504 (31%)	1,631 (31%)	1,550 (34%)	1,588 (35%)	1,838 (36%)
Quartile 2 (26-50th)	6,153 (25%)	1,231 (25%)	1,315 (25%)	1,179 (26%)	1,185 (26%)	1,243 (24%)
Quartile 3 (51-75th)	5,535 (23%)	1,116 (23%)	1,174 (23%)	1,077 (23%)	1,039 (23%)	1,129 (22%)
Quartile 4 (76-100th)	4,172 (17%)	904 (19%)	953 (18%)	719 (16%)	698 (15%)	898 (17%)
Missing	387 (2%)	99 (2%)	123 (2%)	74 (2%)	53 (1%)	38 (1%)
Hospital Location/Teaching Status						
Rural	1,644 (7.3%)	301 (6.7%)	323 (6.2%)	396 (10%)	298 (7.1%)	326 (6.9%)
Urban non-teaching	2,055 (9.1%)	1,058 (23%)	997 (19%)	0 (0%)	0 (0%)	0 (0%)
Urban teaching	18,834 (84%)	3,147 (70%)	3,876 (75%)	3,496 (90%)	3,898 (93%)	4,417 (93%)
Missing	1,825	348	0	707	367	403
Hospital Bed Size						
Small	2,719 (11%)	483 (11%)	489 (9.4%)	553 (12%)	557 (12%)	637 (12%)
Medium	5,437 (23%)	1,037 (23%)	1,234 (24%)	1,097 (24%)	898 (20%)	1,171 (23%)
Large	15,854 (66%)	2,986 (66%)	3,473 (67%)	2,949 (64%)	3,108 (68%)	3,338 (65%)
Missing	348	348	0	0	0	0

[1]Median (Q1, Q3); n (%)

[2]Age is reported as completed years (truncated, not rounded)

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Table 2. Survey-Weighted IHCA Incidence (per 1,000 Hospitalizations) and Post-Arrest In-Hospital Mortality by Year and Subgroup

Group	Subgroup	Year	Incidence Rate per 1,000 Hospitalizations (95% CI)	In-Hospital Mortality Rate amongst subjects' experiencing IHCA (95% CI)	Deaths for subjects with IHCA per 1,000 Hospitalizations (95% CI)
Overall		2009	1.11 (1.02, 1.19)	38.4% (36.4%, 40.3%)	0.425 (0.386–0.464)
Overall		2012	1.22 (1.13, 1.30)	34.1% (32.3%, 35.8%)	0.414 (0.377–0.451)
Overall		2016	1.11 (1.04, 1.18)	37.8% (35.9%, 39.8%)	0.419 (0.382–0.457)
Overall		2019	1.14 (1.05, 1.22)	40.4% (38.3%, 42.5%)	0.459 (0.417–0.501)
Overall		2022	1.35 (1.25, 1.45)	39.8% (37.4%, 42.1%)	0.536 (0.492–0.580)
Age	Neonates	2009	NA	NA	NA
Age	Neonates	2012	1.08 (1.01, 1.15)	32.9% (30.9%, 35.0%)	0.357 (0.323–0.390)
Age	Neonates	2016	1.07 (1.01, 1.14)	34.3% (32.0%, 36.5%)	0.367 (0.332–0.402)
Age	Neonates	2019	1.02 (0.94, 1.09)	37.8% (35.2%, 40.4%)	0.384 (0.349–0.419)
Age	Neonates	2022	1.25 (1.15, 1.36)	36.7% (33.6%, 39.7%)	0.459 (0.421–0.497)
Complex Chronic Condition (CCC) Status	1+ CCC	2009	3.26 (3.02, 3.51)	40.7% (38.7%, 42.8%)	1.330 (1.206–1.453)
Complex Chronic Condition (CCC) Status	1+ CCC	2012	3.52 (3.26, 3.77)	37.0% (35.1%, 38.9%)	1.302 (1.185–1.419)
Complex Chronic Condition (CCC) Status	1+ CCC	2016	5.70 (5.26, 6.14)	46.7% (44.5%, 48.8%)	2.657 (2.407–2.908)
Complex Chronic Condition (CCC) Status	1+ CCC	2019	6.02 (5.56, 6.48)	46.1% (44.0%, 48.2%)	2.773 (2.512–3.034)
Complex Chronic Condition (CCC) Status	1+ CCC	2022	6.60 (6.11, 7.09)	46.7% (44.7%, 48.7%)	3.079 (2.809–3.349)

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Group	Subgroup	Year	Incidence Rate per 1,000 Hospitalizations (95% CI)	In-Hospital Mortality Rate amongst subjects' experiencing IHCA (95% CI)	Deaths for subjects with IHCA per 1,000 Hospitalizations (95% CI)
Complex Chronic Condition (CCC) Status	No CCC	2009	0.31 (0.27, 0.34)	29.0% (24.9%, 33.2%)	0.089 (0.077–0.102)
Complex Chronic Condition (CCC) Status	No CCC	2012	0.34 (0.31, 0.36)	22.2% (19.5%, 24.9%)	0.075 (0.065–0.085)
Complex Chronic Condition (CCC) Status	No CCC	2016	0.39 (0.36, 0.42)	17.7% (15.4%, 19.9%)	0.069 (0.060–0.078)
Complex Chronic Condition (CCC) Status	No CCC	2019	0.31 (0.28, 0.34)	21.6% (18.7%, 24.6%)	0.067 (0.057–0.077)
Complex Chronic Condition (CCC) Status	No CCC	2022	0.42 (0.36, 0.48)	20.7% (17.1%, 24.2%)	0.087 (0.075–0.099)
Median Household Income Quartile by Zip Code	Quartile 1 (0-25th)	2009	1.20 (1.08, 1.32)	39.3% (36.2%, 42.4%)	0.472 (0.416–0.529)
Median Household Income Quartile by Zip Code	Quartile 1 (0-25th)	2012	1.32 (1.21, 1.43)	35.5% (32.8%, 38.1%)	0.468 (0.414–0.522)
Median Household Income Quartile by Zip Code	Quartile 1 (0-25th)	2016	1.28 (1.17, 1.39)	39.9% (37.0%, 42.8%)	0.509 (0.448–0.569)
Median Household Income Quartile by Zip Code	Quartile 1 (0-25th)	2019	1.38 (1.24, 1.51)	42.0% (39.1%, 44.8%)	0.578 (0.505–0.651)

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Group	Subgroup	Year	Incidence Rate per 1,000 Hospitalizations (95% CI)	In-Hospital Mortality Rate amongst subjects' experiencing IHCA (95% CI)	Deaths for subjects with IHCA per 1,000 Hospitalizations (95% CI)
Median Household Income Quartile by Zip Code	Quartile 1 (0-25th)	2022	1.78 (1.60, 1.95)	40.3% (36.6%, 44.1%)	0.717 (0.631–0.802)
Median Household Income Quartile by Zip Code	Quartile 2 (26-50th)	2009	1.09 (0.99, 1.19)	38.1% (35.0%, 41.2%)	0.415 (0.363–0.467)
Median Household Income Quartile by Zip Code	Quartile 2 (26-50th)	2012	1.27 (1.16, 1.38)	33.6% (30.9%, 36.3%)	0.427 (0.375–0.478)
Median Household Income Quartile by Zip Code	Quartile 2 (26-50th)	2016	1.19 (1.09, 1.28)	35.7% (32.5%, 38.9%)	0.424 (0.372–0.476)
Median Household Income Quartile by Zip Code	Quartile 2 (26-50th)	2019	1.21 (1.10, 1.33)	41.6% (38.0%, 45.2%)	0.505 (0.440–0.570)
Median Household Income Quartile by Zip Code	Quartile 2 (26-50th)	2022	1.30 (1.19, 1.42)	39.1% (36.0%, 42.2%)	0.509 (0.449–0.570)
Median Household Income Quartile by Zip Code	Quartile 3 (51-75th)	2009	1.08 (0.97, 1.19)	37.4% (34.2%, 40.7%)	0.403 (0.350–0.456)
Median Household Income Quartile by Zip Code	Quartile 3 (51-75th)	2012	1.16 (1.05, 1.27)	33.3% (30.2%, 36.4%)	0.386 (0.334–0.438)
Median Household Income Quartile by Zip Code	Quartile 3 (51-75th)	2016	1.07 (0.98, 1.15)	37.4% (34.1%, 40.7%)	0.399 (0.351–0.448)

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Group	Subgroup	Year	Incidence Rate per 1,000 Hospitalizations (95% CI)	In-Hospital Mortality Rate amongst subjects' experiencing IHCA (95% CI)	Deaths for subjects with IHCA per 1,000 Hospitalizations (95% CI)
Median Household Income Quartile by Zip Code	Quartile 3 (51-75th)	2019	1.04 (0.95, 1.13)	39.0% (35.7%, 42.2%)	0.406 (0.355–0.456)
Median Household Income Quartile by Zip Code	Quartile 3 (51-75th)	2022	1.19 (1.08, 1.31)	39.2% (35.7%, 42.6%)	0.467 (0.415–0.520)
Median Household Income Quartile by Zip Code	Quartile 4 (76-100th)	2009	1.03 (0.91, 1.15)	37.8% (34.3%, 41.2%)	0.391 (0.336–0.445)
Median Household Income Quartile by Zip Code	Quartile 4 (76-100th)	2012	1.04 (0.92, 1.17)	33.0% (29.9%, 36.2%)	0.345 (0.291–0.398)
Median Household Income Quartile by Zip Code	Quartile 4 (76-100th)	2016	0.81 (0.71, 0.91)	36.6% (32.8%, 40.4%)	0.295 (0.247–0.344)
Median Household Income Quartile by Zip Code	Quartile 4 (76-100th)	2019	0.83 (0.74, 0.92)	36.7% (32.5%, 40.8%)	0.303 (0.260–0.346)
Median Household Income Quartile by Zip Code	Quartile 4 (76-100th)	2022	1.04 (0.94, 1.15)	39.4% (35.5%, 43.3%)	0.411 (0.352–0.470)
Hospital Region	Midwest	2009	1.22 (0.99, 1.44)	34.4% (30.9%, 37.9%)	0.418 (0.323–0.513)
Hospital Region	Midwest	2012	1.43 (1.20, 1.66)	31.2% (28.4%, 33.9%)	0.446 (0.357–0.535)
Hospital Region	Midwest	2016	1.32 (1.13, 1.50)	36.4% (32.4%, 40.4%)	0.479 (0.377–0.581)
Hospital Region	Midwest	2019	1.29 (1.07, 1.50)	39.5% (35.7%, 43.4%)	0.509 (0.398–0.619)

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Group	Subgroup	Year	Incidence Rate per 1,000 Hospitalizations (95% CI)	In-Hospital Mortality Rate amongst subjects' experiencing IHCA (95% CI)	Deaths for subjects with IHCA per 1,000 Hospitalizations (95% CI)
Hospital Region	Midwest	2022	1.38 (1.18, 1.57)	40.2% (37.2%, 43.3%)	0.553 (0.455–0.650)
Hospital Region	Northeast	2009	0.88 (0.71, 1.04)	37.4% (32.3%, 42.5%)	0.328 (0.263–0.393)
Hospital Region	Northeast	2012	1.00 (0.83, 1.18)	35.4% (30.9%, 39.9%)	0.356 (0.282–0.430)
Hospital Region	Northeast	2016	0.94 (0.80, 1.08)	36.9% (31.9%, 41.8%)	0.344 (0.271–0.417)
Hospital Region	Northeast	2019	0.90 (0.74, 1.05)	36.3% (30.2%, 42.4%)	0.325 (0.270–0.380)
Hospital Region	Northeast	2022	1.04 (0.87, 1.21)	45.6% (41.0%, 50.1%)	0.474 (0.383–0.565)
Hospital Region	South	2009	1.03 (0.88, 1.17)	41.3% (37.7%, 44.9%)	0.424 (0.356–0.491)
Hospital Region	South	2012	1.13 (1.00, 1.26)	35.9% (32.7%, 39.2%)	0.407 (0.342–0.472)
Hospital Region	South	2016	1.12 (1.00, 1.23)	40.1% (36.9%, 43.3%)	0.449 (0.386–0.511)
Hospital Region	South	2019	1.23 (1.09, 1.38)	43.4% (39.9%, 46.9%)	0.534 (0.458–0.610)
Hospital Region	South	2022	1.49 (1.30, 1.68)	38.2% (33.6%, 42.8%)	0.569 (0.490–0.648)
Hospital Region	West	2009	1.31 (1.11, 1.51)	38.4% (35.0%, 41.9%)	0.505 (0.417–0.593)
Hospital Region	West	2012	1.30 (1.11, 1.49)	33.6% (30.4%, 36.8%)	0.437 (0.362–0.512)
Hospital Region	West	2016	1.03 (0.90, 1.15)	36.0% (31.9%, 40.1%)	0.369 (0.303–0.434)
Hospital Region	West	2019	1.01 (0.88, 1.14)	37.7% (34.0%, 41.4%)	0.380 (0.316–0.444)
Hospital Region	West	2022	1.30 (1.14, 1.46)	39.0% (35.4%, 42.6%)	0.508 (0.426–0.590)

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Table 3: Incidence and Survey-Weighted Poisson Mortality Tests of Trend

Metric	Subgroup	IRR (95% CI)	% Change/Year	p-value
Incidence (2009-2022)	Overall	1.009 (1.002–1.017)	0.9%	0.012
Incidence (ICD-10 era)	Overall	1.034 (1.017–1.051)	3.4%	<0.001
CPR Recipients Mortality (2009-2022)	Overall	1.007 (1.002–1.013)	0.7%	0.007
Population mortality (2009-2022)[1]	Overall	1.017 (1.008–1.026)	1.7%	<0.001
Incidence (2012-2022)	Neonates	1.011 (1.001–1.022)	1.1%	0.033
Incidence (ICD-10 era)	Neonates	1.027 (1.008–1.045)	2.7%	0.004
Mortality (2012-2022)	Neonates	1.013 (1.003–1.022)	1.3%	0.013
Population mortality (2012-2022) [1]	Neonates	1.025 (1.012–1.038)	2.5%	<0.001
Incidence (2009-2022)	1+ CCC	1.062 (1.054–1.069)	6.2%	<0.001
Incidence (ICD-10 era)	1+ CCC	1.025 (1.007–1.043)	2.5%	0.007
Mortality (2009-2022)	1+ CCC	1.015 (1.011–1.020)	1.5%	<0.001
Population mortality (2009-2022) [1]	1+ CCC	1.078 (1.069–1.087)	7.8%	<0.001
Incidence (2009-2022)	No CCC	1.017 (1.006–1.029)	1.7%	0.003
Incidence (ICD-10 era)	No CCC	1.012 (0.985–1.041)	1.2%	0.389
Mortality (2009-2022)	No CCC	0.977 (0.962–0.992)	-2.3%	0.003
Population mortality (2009-2022) [1]	No CCC	0.994 (0.980–1.008)	-0.6%	0.399
Incidence (2009-2022)	Quartile 1 (0-25th)	1.025 (1.015–1.035)	2.5%	<0.001
Incidence (ICD-10 era)	Quartile 1 (0-25th)	1.058 (1.034–1.082)	5.8%	<0.001
Mortality (2009-2022)	Quartile 1 (0-25th)	1.007 (0.999–1.015)	0.7%	0.107
Population mortality (2009-2022) [1]	Quartile 1 (0-25th)	1.032 (1.020–1.045)	3.2%	<0.001
Incidence (2009-2022)	Quartile 2 (26-50th)	1.009 (1.001–1.018)	0.9%	0.029
Incidence (ICD-10 era)	Quartile 2 (26-50th)	1.015 (0.995–1.036)	1.5%	0.131
Mortality (2009-2022)	Quartile 2 (26-50th)	1.008 (1.000–1.016)	0.8%	0.048

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Metric	Subgroup	IRR (95% CI)	% Change/Year	p-value
Population mortality (2009-2022) [1]	Quartile 2 (26-50th)	1.017 (1.005–1.030)	1.7%	0.005
Incidence (2009-2022)	Quartile 3 (51-75th)	1.003 (0.993–1.012)	0.3%	0.607
Incidence (ICD-10 era)	Quartile 3 (51-75th)	1.019 (0.997–1.041)	1.9%	0.091
Mortality (2009-2022)	Quartile 3 (51-75th)	1.008 (0.999–1.016)	0.8%	0.081
Population mortality (2009-2022) [1]	Quartile 3 (51-75th)	1.010 (0.998–1.023)	1.0%	0.105
Incidence (2009-2022)	Quartile 4 (76-100th)	0.992 (0.981–1.004)	-0.8%	0.180
Incidence (ICD-10 era)	Quartile 4 (76-100th)	1.044 (1.017–1.073)	4.4%	0.001
Mortality (2009-2022)	Quartile 4 (76-100th)	1.006 (0.996–1.016)	0.6%	0.229
Population mortality (2009-2022) [1]	Quartile 4 (76-100th)	0.998 (0.984–1.014)	-0.2%	0.843
Incidence (2009-2022)	Northeast	1.007 (0.990–1.024)	0.7%	0.443
Incidence (ICD-10 era)	Northeast	1.018 (0.980–1.057)	1.8%	0.365
Mortality (2009-2022)	Northeast	1.014 (1.001–1.026)	1.4%	0.034
Population mortality (2009-2022) [1]	Northeast	1.020 (1.000–1.041)	2.0%	0.049
Incidence (2009-2022)	Midwest	1.004 (0.988–1.020)	0.4%	0.619
Incidence (ICD-10 era)	Midwest	1.007 (0.974–1.042)	0.7%	0.675
Mortality (2009-2022)	Midwest	1.017 (1.008–1.026)	1.7%	<0.001
Population mortality (2009-2022) [1]	Midwest	1.021 (1.001–1.041)	2.1%	0.038
Incidence (2009-2022)	South	1.025 (1.012–1.039)	2.5%	<0.001
Incidence (ICD-10 era)	South	1.049 (1.020–1.080)	4.9%	<0.001
Mortality (2009-2022)	South	1.001 (0.991–1.011)	0.1%	0.847
Population mortality (2009-2022) [1]	South	1.026 (1.011–1.042)	2.6%	<0.001
Incidence (2009-2022)	West	0.990 (0.976–1.004)	-1.0%	0.166
Incidence (ICD-10 era)	West	1.041 (1.010–1.074)	4.1%	0.009

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Metric	Subgroup	IRR (95% CI)	% Change/Year	p-value
Mortality (2009-2022)	West	1.004 (0.995–1.013)	0.4%	0.428
Population mortality (2009-2022) [1]	West	0.994 (0.976–1.012)	-0.6%	0.498

Survey-weighted quasi-Poisson tests of trend for IHCA incidence, mortality among CPR-coded hospitalizations, and population-based IHCA mortality

[1]Deaths for subjects with IHCA per 1,000 Hospitalizations

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Table 4. Survey-weighted test for a monotone area-level income gradient in pediatric IHCA incidence, by KID edition.

Year	IRR per quartile step toward lower income (95% CI)	Modeled Q1 vs Q4 incidence ratio	p-value
2009	1.05 (1.01, 1.09)	1.16	0.024
2012	1.08 (1.04, 1.13)	1.26	<0.001
2016	1.15 (1.10, 1.19)	1.50	<0.001
2019	1.18 (1.13, 1.22)	1.63	<0.001
2022	1.20 (1.15, 1.24)	1.71	<0.001

Conflict of Interest

Drs. Keim and Yehya utilize a medical device loaned to the Children's Hospital of Philadelphia by Timpel Medical for research work unrelated to this manuscript. The authors otherwise declare no relevant conflicts of interest.

Declaration of interests

☐ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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