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Emergency pediatric surgery: Comparing the economic burden in specialized versus nonspecialized children's centers☆

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ABSTRACT

Background: The American College of Surgeons has developed a verification program for children's surgery centers. Highly specialized hospitals may be verified as Level I, while those with fewer dedicated resources as Level II or Level III, respectively. We hypothesized that more specialized children's centers would utilize more resources.
Study design: We performed a retrospective study of the Maryland Health Services Cost Review Commission (HSCRC) database from 2009 to 2013. We assessed total charge, length of stay (LOS), and charge per day for all inpatients with an emergency pediatric surgery diagnosis, controlling for severity of illness (SOI). Using published resources, we assigned theoretical level designations to each hospital.
Results: Two hospitals would qualify as Level 1 hospitals, with 4593 total emergency pediatric surgery admissions (38.5%) over the five-year study period. Charges were significantly higher for children treated at Level I hospitals (all $P < 0.0001$). Across all SOI, children at Level I hospitals had significantly longer LOS (all $P < 0.0001$).
Conclusion: Hospitals defined as Level II and Level III provided the majority of care and were able to do so with shorter hospitalizations and lower charges, regardless of SOI. As care shifts towards specialized centers, this charge differential may have significant impact on future health care costs.
Level of Evidence: Level III Cost Effectiveness Study.

Pediatric surgical care is increasingly concentrated in major specialized centers [1,2]. Such centers include dedicated pediatric emergency, anesthesiology and intensive care services. Specialized centers can provide appropriate multidisciplinary and critical care to sick children. However, many children will present with pediatric surgical emergencies that will be managed at hospitals with fewer dedicated resources.

The American College of Surgeons (ACS) and Children's Hospital Association have formed a Task Force for Children's Surgical Care in an attempt to optimize delivery of pediatric surgical care. As with adult and pediatric trauma care, children's surgical hospitals will be verified into Level I–III centers, with Level I hospitals offering the most comprehensive care [3]. Trauma and emergency systems development in adult patients has resulted in more optimized resource utilization and a significant improvement in survival probability (as high as 25%) [4].

The standards ascribed by the different levels are important for triage of complex cases, so as to ensure appropriate levels of care. However, many pediatric surgical conditions present without advance notice, through emergency departments. With elective pediatric surgery, physicians often have the time and capacity to refer patients with complicated disease processes to more specialized centers. Pediatric trauma is often triaged in the field, with responders able to assess disability and determine where patients should be treated. In contrast, many children with emergent surgical conditions are brought by family members to the closest hospital. Given this, it is important to understand the state of current emergency pediatric surgery.

The potential financial ramifications of the new children's surgical hospital verification have not been studied. With the Affordable Care Act and health care expenditures priorities shifting to the forefront, there will be increasing focus on resource utilization. Specialized children's centers have shown shorter length of stay and lower charges, with lower mortality, for similarly severe traumatic injuries, as compared to less specialized centers [5,6].

We set out to assess resource utilization in the different hospital levels providing emergency pediatric care across the state of Maryland, assigning presumed future level designation based on publicly available information. We sought to assess charge differentials between hospital

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types for the emergency pediatric surgery population. We further examined whether patient or hospital factors were the greatest drivers of hospital charges. Among children undergoing emergent appendectomy, we sought to assess components of total hospital charges across hospital types.

Our previous work in an adult emergency general surgery population showed that specialized hospitals were more resource intensive [7]. We hypothesized that care would be more resource intensive at Level 1 hospitals, even among otherwise healthy children.

1. Methods

We performed a retrospective study of the Maryland Health Services Cost Review Commission (HSCRC) database, as previously described by our group [8]. The Maryland HSCRC was created in the 1970s following a waiver from the federal government, exempting the state from national Medicare and Medicaid reimbursement principles. The HSCRC was created and mandated to review and approve reasonable hospital rates, and publicly disclose this information [9]. Since its inception in 1971, all payers pay Maryland hospitals on the basis of rates established by the HSCRC [10]. The HSCRC Inpatient Data Set contains discharge medical record abstract and billing data on each of the state's approximately 100,000 inpatient pediatric births and admissions annually.

1.1. Patient and outcome definitions

The Maryland Health Services Cost Review Commission database was queried from 2009 to 2013. We defined the emergency population as all patients age 0–17, either admitted through the emergency department as urgent / emergent admissions. We defined the emergency surgery group as patients admitted via the emergency department with an emergency surgical diagnosis and at least one procedure code. The American Association for the Surgery for Trauma Emergency General Surgery ICD-9 codes [11] were updated to include congenital pyloric stenosis (Appendix 1). We excluded infants born during the index hospitalization. We also excluded any patient transferred to a different hospital at the end of hospitalization.

The All Patient Refined Severity of Illness (APR-SOI) is defined by the extent of physiologic decompensation or organ system loss of function [12]. The HSCRC database uses this definition to stratify patients into 4 levels of increasing severity: minor, moderate, major, and extreme [13]. Demographic characteristics, specialized pediatric center designation, severity of illness, and hospital charge data were collected. As per HSCRC data use guidelines, results with less than 11 children were censored for privacy.

Other data collected included length of stay (both total and in ICU), gender, race, and payer status. Notably, the HSCRC database lists ages by year only, so we are unable to differentiate between neonates and

Table 1
Baseline characteristics of children admitted with an Emergency Pediatric Surgery diagnosis.

Variable	All patients[a] N = 11,942	Level III N = 2626	Level II N = 4723	Level I N = 4593	*P* value
Age	10 (2–15)	13 (7–16)	11 (3–15)	5 (1–12)	<0.0001
Age category					
0 (newborn, infant)	1810 (15.2)	146 (8.1)	630 (34.8)	1034 (57.1)	<0.0001
1 (toddler)	1023 (8.6)	185 (18.1)	366 (35.8)	472 (46.1)	
2 to 5 (preschool)	1489 (12.5)	205 (13.8)	460 (30.9)	824 (55.3)	
6 to 11 (child)	2679 (22.4)	567 (21.2)	1092 (40.8)	1020 (38.1)	
12 to 17 (adolescent)	4941 (41.4)	1523 (30.8)	2175 (44.0)	1243 (25.2)	
Gender					
Female	5196 (43.5)	1181 (45.0)	2064 (43.7)	1951 (42.5)	0.11
Male	6746 (56.5)	1445 (55.0)	2659 (56.3)	2642 (57.5)	
Race					
Caucasian	6646 (55.7)	1819 (27.4)	2793 (42.0)	2034 (30.6)	<0.0001
African American	3620 (30.3)	511 (14.1)	1147 (31.7)	1962 (54.2)	
Other	1676 (14.0)	296 (17.7)	783 (46.7)	597 (35.6)	
Payer status					
Medicaid	5684 (47.6)	1087 (19.1)	1911 (33.6)	2686 (47.3)	<0.0001
Blue Cross, Commercial & HMO	5685 (47.6)	1333 (23.5)	2599 (45.7)	1753 (30.8)	
Others	573 (4.8)	206 (36.0)	213 (37.2)	154 (26.9)	
APR-SOI					
Minor	4523 (37.9)	1171 (25.9)	2266 (50.1)	1086 (24.0)	<0.0001
Moderate	4547 (38.1)	1254 (27.6)	1948 (42.8)	1345 (29.6)	
Major	1744 (14.6)	164 (9.4)	375 (21.5)	1205 (69.1)	
Extreme	1128 (9.5)	37 ()3.3	134 (11.9)	957 (84.8)	
Year					
2009	2687 (22.5)	688 (25.6)	1176 (43.8)	823 (30.6)	<0.0001
2010	2510 (21.0)	598 (23.8)	1063 (42.4)	849 (33.8)	
2011	2351 (19.7)	543 (23.1)	900 (38.3)	908 (38.6)	
2012	2269 (19.0)	449 (19.8)	850 (37.5)	970 (42.8)	
2013	2125 (17.8)	348 (16.4)	734 (34.5)	1043 (49.1)	
Disposition					
Home	11,292 (96.2)	2553 (22.6)	4612 (40.8)	4127 (36.6)	<0.0001
Home health	352 (3.0)	57 (16.2)	72 (20.5)	223 (63.5)	
Died	77 (0.66)	≤0.2%[b]	≤0.2%[b]	63 (81.8)	
Any ICU stay					
No	11,864 (99.4)	2596 (21.9)	4690 (39.5)	4578 (38.6)	0.0002
Yes	78 (0.7)	30 (38.5)	33 (42.3)	15 (19.2)	

[a] Median (IQR), Wilcoxon rank-sum test.
[b] < 11 patients, in accordance with HSCRC policy censored for privacy protection.