**Children’s Hospital Status and Value for Common Surgical Conditions**

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**ABSTRACT**

Background: Children’s hospitals (CH) provide a significant proportion of care to children in the United States. While CH have been shown to provide higher quality care than non-children’s hospitals (NCH) for highly specialized procedures, our purpose was to evaluate the value CH provide for common and routine procedures by assessing clinical outcomes and payments.

Methods: Retrospective cohort study that examined outcomes and payments following 11 commonly performed pediatric surgical procedures among patient with continue health plan enrollment from 2007 to 2014 using claims data from the Health Care Cost Institute. The primary exposure was CH or NCH status defined using self-reported pediatric services from the American Hospital Association annual survey, affiliation with pediatric focused programs, and final validation based on proportion of pediatric admissions. Value was defined using common clinical metrics such as surgical site infections and readmissions combined with cost data in the form of actual payments for services rendered.

Results:

Conclusions: For lower acuity, commonly performed surgical procedures in children clinical outcomes are equivalent at CH and NCH but are associated with higher payments and, thus, lower value care.

**INTRODUCTION**

Though children’s hospitals (CH) comprise less than 5% of all hospitals in the United States, CH account for 40% of pediatric inpatient days and 50% of costs for pediatric care.1 CH often provide high volume, specialized, and resource intensive care to children who require highly trained care providers and innovative technologies. One such example is surgery for congenital heart disease where mortality rates are lowest at high volume, specialized centers such as CH.2,3 For this type of highly specialized pediatric care, the value proposition of higher costs at CH is justified by demonstrable improved outcomes and quality.4 In 2009, 40 freestanding CH accounted for greater than $10 billion of annual U.S. healthcare expenditure, and the top 10 CH profited over $800 million.5 Contemporary pediatric care has also witnessed significant regionalization in the last decade, and there are currently several efforts underway to centralize the delivery of children’s surgical care to specialized centers.6-9 These trends represent a dramatic change in hospital market structure with regard to pediatric care.

Although CH have been shown to provide higher quality than NCH for highly specialized procedures, there are compelling data to suggest that the cost of common and routine procedures, not just highly specialized care, is greater at CH than at NCH.10,11 Despite surgical interventions representing a high risk and costly experiences in our healthcare system, very little attention has been directed at surgeons, surgical care, or surgical payment reform, transparency of surgical outcomes, and consumer/patient empowerment in choices surrounding surgical care.12,13 Of the 50 most prevalent and costly pediatric inpatient conditions, 32 are surgical conditions.14 The financial and clinical implications of trends and policies related to the surgical care of children have not been fully evaluated and may result in a significant rise in health care costs without demonstrable improvement in quality.6,15 We compared the quality and price of commonly performed surgeries at CH and NCH. We then explored the extent to which quality and price differences could be explained by patient and hospital characteristics versus other economic factors such as hospital and insurer market structure.

**METHODS**

**Study population**

We analyzed 2007 to 2014 data from the Health Care Cost Institute (HCCI). The HCCI provides de-identified administrative cost and utilization data for approximately 50 million beneficiaries in the United States covered by private insurance and is ideal for evaluating variation in hospital-level pricing and payment. These data consist of the population of claims submitted to HCCI by Aetna, Humana, Kaiser Permanente, and UnitedHealthcare.16 HCCI data are representative of the national population younger than 65 using population weights based on U. S. Census Bureau data. HCCI data have previously been used to evaluate variations in prices between states and Metropolitan Statistical Areas (MSA).17

From this population of privately insured beneficiaries, we selected a cohort of patients 18 years of age or less, who underwent commonly performed pediatric surgical procedures. We examined outcomes and costs following 11 common pediatric surgical procedures: anterior cruciate ligament (ACL) repair, appendectomy, humerus fracture repair, inguinal hernia, laparoscopic cholecystectomy, orchiopexy, posterior spinal fusion, strabismus surgery, tonsillectomy, tympanostomy, and umbilical hernia repair. Procedures were identified with Current Procedural Terminology (CPT) and International Classification of Diseases, Ninth Revision (ICD-9) procedure codes using both facility and professional claims (Supplemental Table 1). Patients who underwent multiple procedures at the same visit (e.g., both tonsillectomy and tympanostomy) were excluded due to higher complexity. We excluded patients who did not have continuous enrollment in the year before the procedure (with the exception of children younger than 1 year).

CH were distinguished from NCH using a previously described methodology.18 Hospitals were categorized using combination of self-reported pediatric services on the American Hospital Association (AHA) Survey followed by validation using publicly available data on hospital membership in various pediatric programs such as the Children’s Hospital Association, Children’s Oncology Group, and American College of Surgeons National Surgical Quality Improvement Program-Pediatric. Using this methodology, four tiers of hospitals were created. A final validation used Health Care Cost Institute claims data to determine the proportion of pediatric admissions at each hospital.

**Outcome measures**

Postoperative outcomes were identified using ICD-9 codes using both facility and professional claims for wound complications, surgical site infections, urinary tract infections, renal insufficiency, pneumonia, respiratory failure, sepsis, deep vein thromboses, pulmonary embolism, cardiac complications, intraoperative complications, and 30-day readmissions (Supplemental Table 2). Payment data was utilized using \*\*\*McCarthy to talk about payment data

**Statistical analyses**

Ian to help with this

A descriptive analysis was performed for the overall population and comparisons between hospital types were determined using either the chi squred test (for categorical variables), the Kruskal-Wallis test (for nonparametric continuous variables presented at median and interquartile range (IQR)), or the t-test (for parametric continuous varibles presented as mean and standard deivation (SD)). Bivariable Cox proporitional hazard models were used to determine the crude and adjusted association between hospital type and each outcome. Adjustment was peformed to account for patient demographics (age, sex, and race/ethnicity), procedure type, hospital features (???).

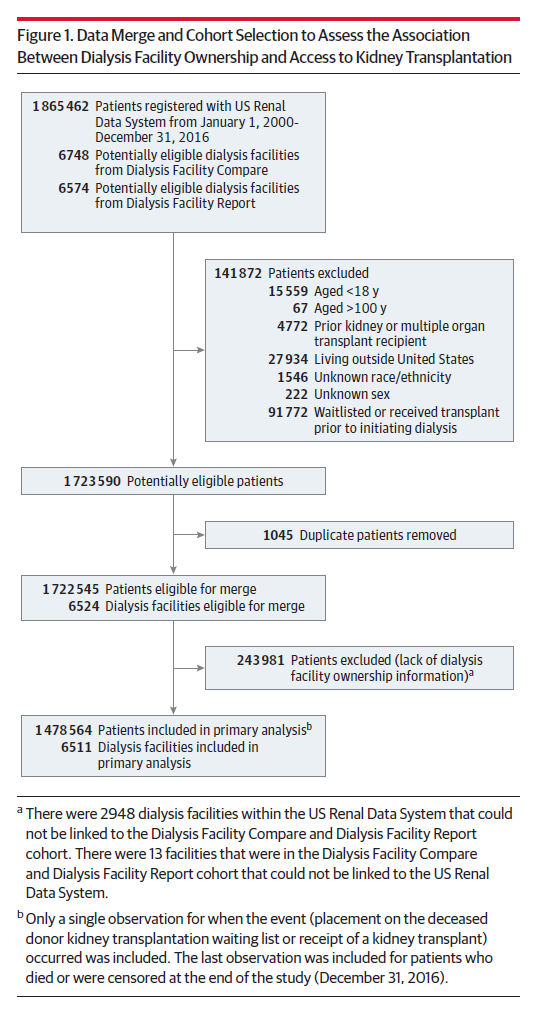
Sensitivity analyses…

Data management and statistical analyses were conducted using SAS version ? (SAS Institute Inc, Cary, NC). Two-sided *P* values were used for all analyses and *P* < 0.05 was considered statistically significant.

**RESULTS**

**Study population**

Of the XXXXX patients represented in HCCI data spanning from January 1, 2007 to December 31, 2014, XXXX (XXX%) were 18 years or less. Of these patients, xxxxx (xxxx%) were identified to have undergoing one of the index procedures of interest. Additional patients were excluded if XXXXXXXXXXXX (n=xxxxxxx), XXXXXXXXX (n=xxxxxxx), XXXXXXXX (n=xxxxxx). The remaining cohort of patients were assigned to CH or NCH excluding xxxxxx(XXXX%). The final cohrt of xxxxxxxxx included patients had a median follow up of X years (Figure 1).

*I would like to create a flow diagram of HCCI data selection that resembles this type of approach demonstrating our population starting with the overall HCCI universe and getting down to the cohort of patients we studied.* Example Figure 1

The median age was ? years (IQR, x-x years), with X% male and X% non-Hispanic black patietns (Table 1). *Did we do any imputation for missing data?*

Breakdown the procedures included in the study.

Table 1. Characteristics of patients undergoing surgery at children’s hospitals and non-children’s hospitals

|  |  |  |  |
| --- | --- | --- | --- |
|  | CH | CH | NCH |
| Characteristics | Tier A | Tier B | (combined Tier C/D?) |
| Hospitals | # | # | # |
| Patients | # | # | # |
| Patient level characteristics |  |  |  |
| Mean age (yr) |  |  |  |
| Female sex (%) |  |  |  |
| Race/ethnicity |  |  |  |
| Non-Hispanic white |  |  |  |
| Non-Hispanic black |  |  |  |
| Hispanic white |  |  |  |
| Hispanic black |  |  |  |
| Other |  |  |  |
| Insurance features |  |  |  |
| High deductible |  |  |  |
| Low deductible |  |  |  |
| Etc |  |  |  |
| Hospital level characteristics |  |  |  |
| Bed size |  |  |  |
| Nonprofit status |  |  |  |
| Teaching status |  |  |  |
| Location |  |  |  |
| Metro |  |  |  |
| Micro |  |  |  |
| Rural |  |  |  |
| Procedure |  |  |  |
| Tympanostomy tube placement |  |  |  |
| Tonsillectomy and adenoidectomy |  |  |  |
| Inguinal hernia repair, non-obstructive |  |  |  |
| Anti-reflux surgery |  |  |  |
| Circumcision |  |  |  |
| Appendectomy for acute appendicitis |  |  |  |
| Strabismus surgery |  |  |  |
| Orchiopexy for undescended testis |  |  |  |
| Repair of humerus fracture |  |  |  |
| Umbilical hernia repair |  |  |  |
| ACL/knee? |  |  |  |
| Posterior spinal fusion for scoliosis |  |  |  |
| Cholecystectomy |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

**Primary Analysis**

Of the XXXXX patients represented in HCCI data spanning from January 1, 2007 to December

**Table2.**

**Outcomes**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | CH  (n = x) | NCH  (n = x) | Stats (PV) adjusted OR or HR | Overall  (n = x) |
| Overall complication rate |  |  |  |  |
| Comp 1 |  |  |  |  |
| Comp 2 |  |  |  |  |
| Comp 3 |  |  |  |  |
| Comp 4 |  |  |  |  |
| Comp 5 |  |  |  |  |
| Surgical Site Infection rate |  |  |  |  |
| Readmission |  |  |  |  |
| Payment |  |  |  |  |
| Tympanostomy tube placement |  |  |  |  |
| Tonsillectomy and adenoidectomy |  |  |  |  |
| Inguinal hernia repair, non-obstructive |  |  |  |  |
| Anti-reflux surgery |  |  |  |  |
| Circumcision |  |  |  |  |
| Appendectomy for acute appendicitis |  |  |  |  |
| Strabismus surgery |  |  |  |  |
| Orchiopexy for undescended testis |  |  |  |  |
| Repair of humerus fracture |  |  |  |  |
| Umbilical hernia repair |  |  |  |  |
| ACL/knee? |  |  |  |  |
| Posterior spinal fusion for scoliosis |  |  |  |  |

**Table 3. Like table 2 but for each procedure?**

**Table 4.**

**Payment differential (adjusted at hospital level) adjust for hospital factors, competitiveness at the market level.**

**Trends over time – are the # of cases inc at CH and dec at NCH? Is this observed phenonmon getting worse**

**What if the market becomes more CH oriented.**

**DISCUSSION**

For commonly performed pediatric procedures, CH have comparable clinical outcomes, higher costs based on actual payment data, and, thus, lower value compared to NCH. To our knowledge, no studies have examined the value of CH for commonly performed procedures using payment data. The major limitation of prior studies attempting to assess value is that costs are estimated using hospital-level charges rather than actual payments.19,20 Hospital level charges are problematic because they are usually inflated at several times the actual costs and result in variable charge-to-reimbursement ratios that are hospital specific and are challenging to use for hospital comparison. In contrast, we utilized payments from private insurance carriers which are superior to charges and estimated costs as payments are a direct measure of prices paid for care and provide a better measure of the costs of care from a patient and societal perspective. To date, a barrier to this kind of work using payments is that valid payment information has been nearly impossible to obtain directly from the source as financial transparency is lacking. Using a novel approach made possible by access to the HCCI dataset of hospital payments, our proposed research is the first to examine actual payments across CH and NCH from four of the nation’s largest insurers.

There is an increasing desire on the part of consumers to understand the true value proposition for rising healthcare expenditures in terms of clinical outcomes and costs.13 ONE line here that references (What Is Value in Health Care? Michael E. Porter, Ph.D. N Engl J Med 2010; 363:2477-2481). Transparency for both of these endpoints is lacking (REF) for several reasons. First, there is not a single payor system to capture all these data. Half of kids are insured so HCCI is good in that regard. Publically insured patients either through CHIP or Mediciad are hareder to study as things are broken down states. Second, for common procedures outcomes are generally good with low complicdation/event rates. Our study found…. Detecting differences would require large sample sizes. Last, there are very few CH and the way that CH are defined is highly variable. We were able to partner w/HCCI and use a variety of techniques descdribed in 18 to define CH.

CH are growing in number and size. Increased from x to y. (REF). Increases in bed sizes and geography. Reginaliztion of care happeing. (REF = David C. Radley, Ph.D., M.P.H., and Cathy Schoen, M.S. Geographic Variation in Access to Care — The Relationship with Quality. N Engl J Med 2012; 367:3-6). Our study showed… Others have reported similar trends. This allows CH to negotiation high reimgursements from private payors. For an examination of the market power that providers have to negotiate higher prices, see Ginsburg PB . Wide variation in hospital and physician payment rates evidence of provider market power . *Res Brief* . 2010 ;( 16 ): 1 – 11 . [Medline](https://www-healthaffairs-org.turing.library.northwestern.edu/servlet/linkout?suffix=B3&dbid=8&doi=10.1377%2Fhlthaff.2015.1379&key=21117341) , [Google Scholar](http://scholar.google.com/scholar?hl=en&q=3++++++++++++For+an+examination+of+the+market+power+that+providers+have+to+negotiate+higher+prices%2C+see++++++++++++Ginsburg+PB++++++++++++.+++++++++++Wide+variation+in+hospital+and+physician+payment+rates+evidence+of+provider+market+power+++++++++++.+++++++++++Res+Brief+++++++++++.+++++++++++2010+++++++++++%3B%28+++++++++++16+++++++++++%29%3A+++++++++++1+++++++++++%E2%80%93+++++++++++11+++++++++++.+++++++++) Cutler D , McClellan M , Newhouse JP . How does managed care do it? *Rand J Econ* . 2000 ; *31* ( 3 ): 526 – 48 .[Crossref](https://www-healthaffairs-org.turing.library.northwestern.edu/servlet/linkout?suffix=B4&dbid=16&doi=10.1377%2Fhlthaff.2015.1379&key=10.2307%2F2600999" \t "_blank), [Medline](https://www-healthaffairs-org.turing.library.northwestern.edu/servlet/linkout?suffix=B4&dbid=8&doi=10.1377%2Fhlthaff.2015.1379&key=11503704) , [Google Scholar](http://scholar.google.com/scholar?hl=en&q=4+++Cutler+D+++++++++++++%2C+McClellan+M+++++++++++++%2C+Newhouse+JP++++++++++++.+++++++++++How+does+managed+care+do+it%3F+Rand+J+Econ+++++++++++.+++++++++++2000+++++++++++%3B+++++++++++31+++++++++++%28+++++++++++3+++++++++++%29%3A+++++++++++526+++++++++++%E2%80%93+++++++++++48+++++++++++.+++++++++)

**Limitations**

There are several limitations to note. Claims data proxy billing codes for clinical outcomes. Looking at privately insured patients only. Did not look at surgeon specialization at the hospitals.

**CONCLUSIONS**

For lower acuity, commonly performed surgical procedures in children clinical outcomes are equivalent at CH and NCH but are associated with higher payments and, thus, lower value care.

**REFERENCES**

1. All Children Need Children’s Hospıtals. National Association of Children's Hospitals and Related Institutions. 2nd edition. ed. Alexandria, VA2007.

2. Allen SW, Gauvreau K, Bloom BT, Jenkins KJ. Evidence-based referral results in significantly reduced mortality after congenital heart surgery. Pediatrics 2003;112:24-8.

3. Chang RK, Klitzner TS. Can regionalization decrease the number of deaths for children who undergo cardiac surgery? A theoretical analysis. Pediatrics 2002;109:173-81.

4. Porter ME. What is value in health care? N Engl J Med 2010;363:2477-81.

5. Gaul GM. Growing Size And Wealth Of Children’s Hospitals Fueling Questions About Spending. Kaiser Health News Available at <http://khnorg/news/childrens-hospitals-part-one/>. September 25, 2011 ed2011.

6. Lorch SA, Myers S, Carr B. The regionalization of pediatric health care. Pediatrics 2010;126:1182-90.

7. Goldin AB, Dasgupta R, Chen LE, et al. Optimizing resources for the surgical care of children: an American Pediatric Surgical Association Outcomes and Clinical Trials Committee consensus statement. J Pediatr Surg 2014;49:818-22.

8. Oldham KT. Optimal resources for children's surgical care. J Pediatr Surg 2014;49:667-77.

9. Salazar JH, Goldstein SD, Yang J, et al. Regionalization of Pediatric Surgery: Trends Already Underway. Ann Surg 2016;263:1062-6.

10. Raval MV, Cohen ME, Barsness KA, Bentrem DJ, Phillips JD, Reynolds M. Does hospital type affect pyloromyotomy outcomes? Analysis of the Kids' Inpatient Database. Surgery 2010;148:411-9.

11. Tian Y, Heiss KF, Wulkan ML, Raval MV. Assessment of variation in care and outcomes for pediatric appendicitis at children's and non-children's hospitals. J Pediatr Surg 2015.

12. Dupree JM, Patel K, Singer SJ, et al. Attention to surgeons and surgical care is largely missing from early medicare accountable care organizations. Health Aff (Millwood) 2014;33:972-9.

13. Huckman RS, Kelley MA. Public reporting, consumerism, and patient empowerment. N Engl J Med 2013;369:1875-7.

14. Keren R, Luan X, Localio R, et al. Prioritization of comparative effectiveness research topics in hospital pediatrics. Arch Pediatr Adolesc Med 2012;166:1155-64.

15. Kastenberg ZJ, Lee HC, Profit J, Gould JB, Sylvester KG. Effect of deregionalized care on mortality in very low-birth-weight infants with necrotizing enterocolitis. JAMA pediatrics 2015;169:26-32.

16. Health Care Cost Institute. Data. Available at: <https://www.healthcostinstitute.org/data>. Last accessed August 7, 2019.

17. Newman D, Parente ST, Barrette E, Kennedy K. Prices For Common Medical Services Vary Substantially Among The Commercially Insured. Health Aff (Millwood) 2016;35:923-7.

18. Piper KN, Baxter KJ, McCarthy I, Raval MV. Distinguishing Children's Hospitals From Non-Children's Hospitals in Large Claims Data. Hosp Pediatr 2020.

19. Lee VS, Kawamoto K, Hess R, et al. Implementation of a Value-Driven Outcomes Program to Identify High Variability in Clinical Costs and Outcomes and Association With Reduced Cost and Improved Quality. JAMA 2016;316:1061-72.

20. Mehrotra A, Schleifer D, Shefrin A, Ducas AM. Defining the Goals of Health Care Price Transparency: Not Just Shopping Around. NEJM Catalyst 2018;Available at: <https://catalyst.nejm.org/health-care-price-transparency-goals/>. Last accessed March 11, 2019.