Published in final edited form as:

Am Surg. 2016 January ; 82(1): E3–E5.

Cost of Hospitalization for Infantile Pyloric Stenosis

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There is a controversy whether infantile pyloric stenosis is best treated in children's referral center, either a freestanding specialty hospital or a general hospital with a designated pediatric service line ("children's hospital within a hospital"). A group of pediatric specialists in surgery and anesthesia have recommended that any infant under age one year be referred to a specialty facility for a surgical condition, and thus those with pyloric stenosis, citing a 2- to 6-fold higher rate of complications in treating the condition among nonspecialist surgeons and nondesignated children's hospitals.¹

Complications, however, occur in only 5 per cent of cases; 95 per cent of infants recover uneventfully. Moreover, the most significant complication, perforation of the duodenum or stomach, is most often recognized and corrected during the original operation and the usual result is a delay in discharge by a day or so. Nearly all such patients survive. Most recent series report no deaths among thousands of cases.²

Thus, pyloric stenosis may be an example of a condition where recovery is expected and quality is uniform for nearly all cases, such as appendicitis.³ In such cases, cost becomes the primary determinant of value in health care, the relationship defined by Porter and Teisberg in the equation, value equals quality divided by cost.⁴ Decreasing cost, the denominator in the ratio, thus increases value.

Optimal value in the treatment of pyloric stenosis thus involves cost. The Kids' Inpatient Database (KID) developed by the Agency for Healthcare Research and Quality as part of the Healthcare Cost and Utilization Project provides de-identified patient charges and weighted cost-to-charge ratios by hospital. The nationwide administrative database thus allows comparisons of average cost of care among hospitals for various conditions, identified by diagnosis-related group as defined by the Center for Medicare and Medicaid Services. Thus, we wanted to use KID to quantify differences in cost and define hospital characteristics that led to lower costs in the treatment of infantile pyloric stenosis.

KID hospital file data elements allowed the analysis of 3,407,146 patient records. Hospital characteristics included the following indices: location (rural or urban), region (Northeast, Midwest, South, or West), size of the hospital (small, medium, or large), type (children's general hospital, children's unit in a general hospital, or general hospital not identified as a

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Presented as a Poster Presentation at the Southeastern Surgical Congress Annual Meeting, Chattanooga, TN, February 2015.

children's hospital), total charges, and cost-to-charge ratios. Total hospital costs were determined using hospital-specific cost-to-charge ratios and were controlled for length of stay. Analyses were performed to determine the total costs associated with a pyloromyotomy, as the primary procedure. Statistical analyses were carried out using JMP/Pro visualization software V11 (SAS Institute Inc., Cary, NC). Analysis involved single and multiple factor analysis of variance where random nested factors were used where appropriate. A level of $P = 0.05$ was used to determine statistical significance.

There were 6693 hospitalizations analyzed. Average length of stay was 2.47 days and average cost was \$5351 per hospitalization. Average total hospital costs for pyloromyotomy as the sole operative procedure (Fig. 1) were significantly higher in urban compared with rural hospitals (\$5293 vs \$4729, respectively; $P < 0.0001$). Although an additional procedure increased costs for both (\$6510 vs \$5076), the increment for urban hospitals was higher than that observed for rural hospitals (\$1217 vs \$347). Although the overall costs were higher among urban hospitals, rural hospitals had a significantly higher average cost-to-charge ratio by 27 per cent ($P < 0.0001$).

Costs were highest in children's general hospitals (\$6799; children's unit in a general hospital, \$4792; nondesignated general hospital, \$4610; $P < 0.001$). Secondary procedures (laparoscopy, diagnostic ultrasound of the abdomen, and spinal tap) were performed with the highest frequency in children's units in general hospitals and lowest in children's general hospitals. Costs were highest in the West and lowest in the South. The largest hospitals by numbers of beds had the lowest costs; those with the fewest had the highest. There were no reported deaths associated with pyloromyotomy.

Our analysis is the first to use hospital-specific cost-to-charge ratios to arrive at final costs. Cost-to-charge adjustments are necessary because of wide variations in hospital prices by region and type of hospital. The system of cost-to-charge ratios allows the translation of total charges into actual costs using a validated conversion factor that provides an estimate of all-payer inpatient costs. This essential modification allows comparisons of average cost of care among hospitals.

In conditions where outcome is uniformly good, cost of care is the primary determinant of value in health care. Identifying the best surgeon and facility for the treatment of pediatric conditions defies a simple answer that is more complicated than the number of cases performed. The training and experience of the surgeons and the array of specialists and critical care areas in the facility are paramount in the treatment of complex heart disease and the correction of severe congenital anomalies. But in a condition like pyloric stenosis, where 95 per cent of infants do well, training, and quality reporting may address the issues of surgeon and facility competence.

A general surgeon who has had extensive experience in dealing with common pediatric surgical conditions may have acquired the training necessary to deal with infantile pyloric stenosis. An experienced nursing unit in a general hospital may have become accustomed to treating pyloric stenosis as part of a general pediatric service line that handled other commonplace pediatric conditions such as asthma and croup. Many pediatric surgeons

practice in community hospitals and provide specialty-level care. Rates of complications under these circumstances would be expected to approach those observed in children's facilities and surgeons' best results.

Quality reporting arises from a duty to improve clinical practice of surgery and a professional responsibility to the community. The activity involves a scrutiny of all cases that lie within the physician and facility's scope of practice to assure that patients received care appropriate to their conditions. Scrutiny is especially appropriate in pediatric surgical conditions, such as pyloric stenosis, where controversies exist.

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Fig. 1. Pyloromyotomy cost per hospitalization by hospital location, region, type, and number of beds.