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## Resource utilization patterns of pediatric esophageal foreign bodies



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## ABSTRACT

**Background:** Ingested foreign bodies are a frequent presentation in pediatric emergency departments. Although some pass spontaneously through the gastrointestinal tract, the majority of esophageal-ingested foreign bodies (EFB) require removal.

**Materials and Methods:** Kids' Inpatient Database (1997–2009) was used to identify children (aged <20 y) with EFB (International Classification of Diseases, Ninth Revision, Clinical Modification code 935.1). Multivariate logistic regression analyses were constructed to identify predictors of resource utilization.

**Results:** Overall, 14,767 EFB cases were identified. Most patients were <5 y of age (72%), boys (57%), and non-Caucasian (55%), with a median (interquartile range) length of stay (LOS) of 1 (1) d, and total charges of \$11,003 (8503). A total of 11,180 procedures were performed, most commonly esophagoscopy (77%), followed by bronchoscopy (20%), gastroscopy (2%), and rarely surgery (0.8%). By multivariate logistic regression, increased total charges were associated with a diagnosis of esophageal ulceration (odds ratio [OR] = 1.57), esophagoscopy (OR = 1.42), and bronchoscopy (OR = 1.62), all  $P < 0.001$ . Total charges also increased with admission to urban nonteaching hospitals (OR = 1.51) versus urban teaching hospitals,  $P < 0.001$ . Prolonged LOS ( $\geq 1$  d) was associated with admission to a hospital in the Midwest (OR = 3.18) and with esophageal ulceration (OR = 2.11) and esophagoscopy (OR = 1.13),  $P < 0.03$ . Boys had higher odds of longer hospitalization (OR = 1.21),  $P < 0.001$ . Overall hospital mortality was 0.1% ( $n = 16$ ). **Conclusions:** Most EFB occur in children <5 y of age. Esophageal ulceration, esophagoscopy, and bronchoscopy are associated with increased total charges. Esophageal ulceration, esophagoscopy, and boys are associated with an increased LOS. Surgery and hospital mortality are both extremely rare in children with EFB.

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## 1. Background

Ingested foreign bodies are a frequent presentation in pediatric emergency departments. [1] In 1999 alone, the American

Association of Poison Control Centers documented over 180,000 cases of ingested foreign bodies in children aged <20 y [2].

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Esophageal-ingested foreign bodies (EFB) require urgent evaluation and treatment [3]. Although some will pass spontaneously through the gastrointestinal tract, the majority of foreign bodies that become fixed in the esophagus require an intervention for removal [4–6]. EFB can result in serious complications including caustic injury, bleeding, ulceration, esophageal perforation, and aortoesophageal fistula formation [7–10]. Owing to the risk of complications secondary to EFB, significant rates of endoscopic (63%–76%) or surgical intervention (12%–16%) have been reported [4,11,12].

In the current economic state of health care in the United States, cost analysis and resource utilization studies are important [13]. Resource utilization for admissions after EFB has been studied in the adult population at single institutions, demonstrating that the majority of patients required a therapeutic procedure because medical interventions were ineffective [3].

Presentation, complications, and management of EFB in the pediatric population are well documented in the literature, but few studies directly address hospital charge and resource utilization directly [3,13]. Therefore, we analyzed hospital admissions for pediatric EFB to identify significant predictors of increased resource utilization in the United States.

## 2. Materials and methods

The Kids' Inpatient Database (KID) is a nationally representative sample of pediatric hospital discharges, maintained by the Healthcare Cost and Utilization Project and sponsored by the US Agency for Healthcare Research and Quality. Data sets with demographic, clinical, hospital, and charge information are released on a triennial basis and are available between 1997 and 2009. Admissions of children (<20 y of age) with EFB were identified using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code 935.1. Cases of other gastrointestinal-ingested foreign bodies (935.2, 936, 937, and 938) were excluded from this cohort. Information regarding related diagnoses and procedures were analyzed using their respective ICD-9-CM codes.

Continuous variables with nonparametric distributions are presented as median and interquartile range. Binary and ordinal logistic regression modeling was used to perform risk-adjusted analyses of resource utilization to identify independent predictors of increased hospital length of stay (LOS) and total charges, respectively. Overall model performance is presented as an area under the receiver operator curve or Nagelkerke pseudo- $R^2$  value for each of these models. Risk adjustment for regression modeling was performed using a standard set of 31 Elixhauser comorbidities, as well as demographic (age, gender, and race), socioeconomic (primary payer and income status), clinical factors (year of admission, admission source, and associated diagnoses or procedures), and hospital (region, type, location, and/or teaching status) characteristics, which has been validated in previous clinical outcomes studies [14–16]. The multivariate analyses used associated diagnosis codes for psychiatric and/or cognitive disorder and self-inflicted injury; esophageal obstruction, ulceration, and perforation; and caustic injury. Associated procedure codes used were for

endoscopy (esophagus, stomach, and colon), surgical procedure (esophagus, stomach, and colon), and bronchoscopy. Although procedure dates during the admission are available within the KID database, diagnoses dates are not. Thus, any diagnoses with the potential for presence at admission were included in the multivariate analyses. Total charges information from the study period was adjusted to 2009 US standard currency. All cases were weighted to project nationally representative estimates.

The Institutional Review Board at the University of Miami Miller School of Medicine exempted this retrospective analysis from full review.

## 3. Results

Overall, 14,767 EFB cases were identified. Most patients were <5 y of age (72%), boys (57%), and non-Caucasian (55%). Median (interquartile range) LOS was 1 d (1) with total charges of \$11,003 (8503). Case incidence was stable throughout the study period. Cases presented most frequently to large (56%), urban teaching (78%), or children's (64%) hospitals. Overall hospital mortality was 0.1% ( $n = 16$ ). For full descriptive demographics of the cohort, see Table 1.

Esophageal ulceration (5%) and psychiatric and/or cognitive disorders (4%) were the most common diagnoses, although caustic injury or esophageal perforation occurred infrequently (0.5% and 0.4%, respectively). A total of 11,180 procedures were performed, most commonly esophagoscopy (77%), followed by bronchoscopy (20%), gastroscopy (2%), and rarely surgery (0.8%). A total of 5826 patients (39% of the cohort) did not have an endoscopic procedure and were not transferred. Additional details regarding associated diagnoses and procedures are detailed in Table 2.

The Figure shows a graphical representation of the primary determinants of increased LOS and increased total charges found via multivariate logistic regression. Prolonged LOS ( $\geq 1$  d) was associated with admission to a hospital in the Midwest (OR, 3.18 [2.52–4.01]) versus that in the West,  $P < 0.001$ , along with esophageal ulceration (2.11 [1.56–2.87]) and esophagoscopy (1.13 [1.02–1.26]),  $P < 0.03$ . Boys had higher odds of longer hospitalization (1.21 [1.10–1.34]) versus girls,  $P < 0.001$ . Admission in 1997 (1.78 [1.41–2.25]) or 2000 (1.37 [1.09–1.71]) had longer LOS versus that in 2009,  $P < 0.01$ . Meanwhile, admission to facilities in the Western United States tended to decrease admission LOS,  $P < 0.001$ . Transfer in from another facility was not a significant predictor of prolonged LOS.

Increased total charges were associated with a diagnosis of esophageal ulceration (1.57 [1.29–1.90]), esophagoscopy (1.42 [1.30–1.54]), and bronchoscopy (1.62 [1.45–1.80]), all  $P < 0.001$ . Total charges also increased with a diagnosis with psychiatric and/or cognitive disorders (1.28 [1.04–1.58]),  $P = 0.019$ . Total charges also increased with admission to urban nonteaching hospitals (1.51 [1.34–1.71]) versus urban teaching hospitals,  $P < 0.001$ . Large bedsize hospitals and facilities located in the Western United States had the highest total charges versus all others,  $P < 0.03$ . Transfer in from another facility was not a significant predictor of higher total charges.

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