

Imaging Utilization for the Management of Intussusception in Stand-Alone Children's Hospitals in the United States: Trends, Outcomes and Costs

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Purpose

To describe the trends on imaging utilization, outcomes, and costs in the management of intussusception in children between 2010 and 2017 in pediatric hospitals in the United States

Methods

All pediatric patients with a primary discharge diagnosis of intussusception in the United States (U.S.) Between 2010 and 2017 were identified in a large administrative database

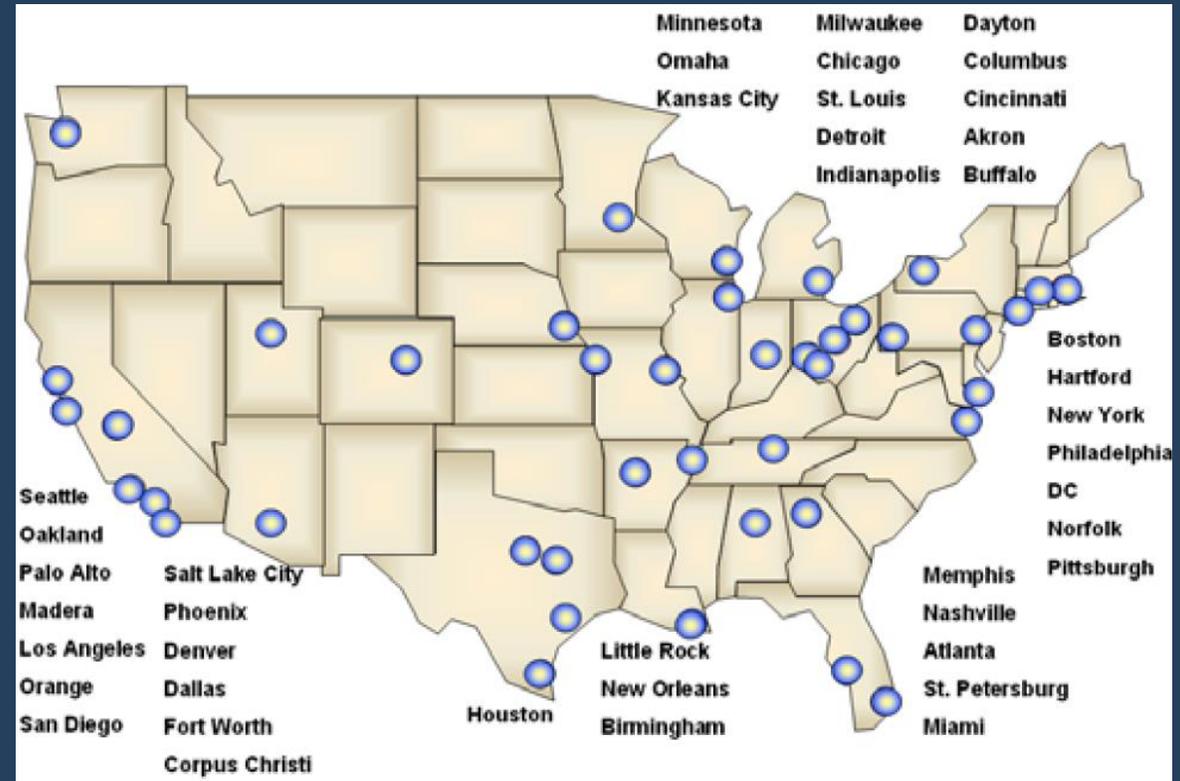
Demographics, imaging utilization, and costs were described

Methods: Database

Large claims-based administrative database of pediatric hospitals in the US:
Pediatric Health Information System

Includes clinical and resource utilization data for inpatients of over 45 children's hospitals

Participating hospitals voluntarily provide their claims data to the database



Methods: Analysis

1. Descriptive analysis of demographics; outcomes; imaging, and costs:
 - Means, standard deviations, medians and interquartile ranges (IRQ) for continuous variables
 - Percentages (%) are displayed for categorical variables
2. Correlation analysis:
 - T-tests for continuous variables
 - Chi-square for categorical variables
 - Pearson correlation (tests if imaging utilization was associated with costs and LOS)
3. Univariate and multivariate logistic regression:
 - Assess association between covariates and probability of surgery
4. We used a threshold of $p < 0.05$ to indicate statistical significance.

Methods: Assumptions/Definitions

- Transfers from outside hospital/facility:
 - Patients without ED charges
 - Patients that had surgery but no imaging
- Small-bowel-to-small-bowel or spontaneous reduction:
 - Patients not undergoing fluoroscopy nor surgery
- Primary surgical group:
 - Patients undergoing surgery without fluoroscopy
- Fluoroscopy success rate:
 - The percentage of patients undergoing fluoroscopy but no surgery
- Failed fluoroscopic reduction group:
 - Patients undergoing fluoroscopy and subsequently surgery

Results: Demographics

Cases	n= 20,655
Individual patients	n= 17,032
Mean Age	3.19 years
	88.5% <5 years
Gender	
Male	63.3%
Female	36.7%
Race/Ethnicity	
Non-Hispanic White	48.3%
Non-Hispanic Black	14.1%
Hispanic	24.0%
Other/Multiple	13.7%
Source of Payment	
Government	54.8%
Commercial	42.4%
Other/Self-Pay	7.5%

Comorbidities	15.4%
Tech Dependent	3.6%
Cardiac	1.9%
Malignancy	1.7%
Metabolic	1.4%
Others	6.8%
Residency	
Urban	87.0%
Rural	10.6%
Unknown	2.4%
Patient type	
ED visit	24.4%
Observation unit	31.2%
Ambulatory Surgery	1.5%
Inpatient	42.9%

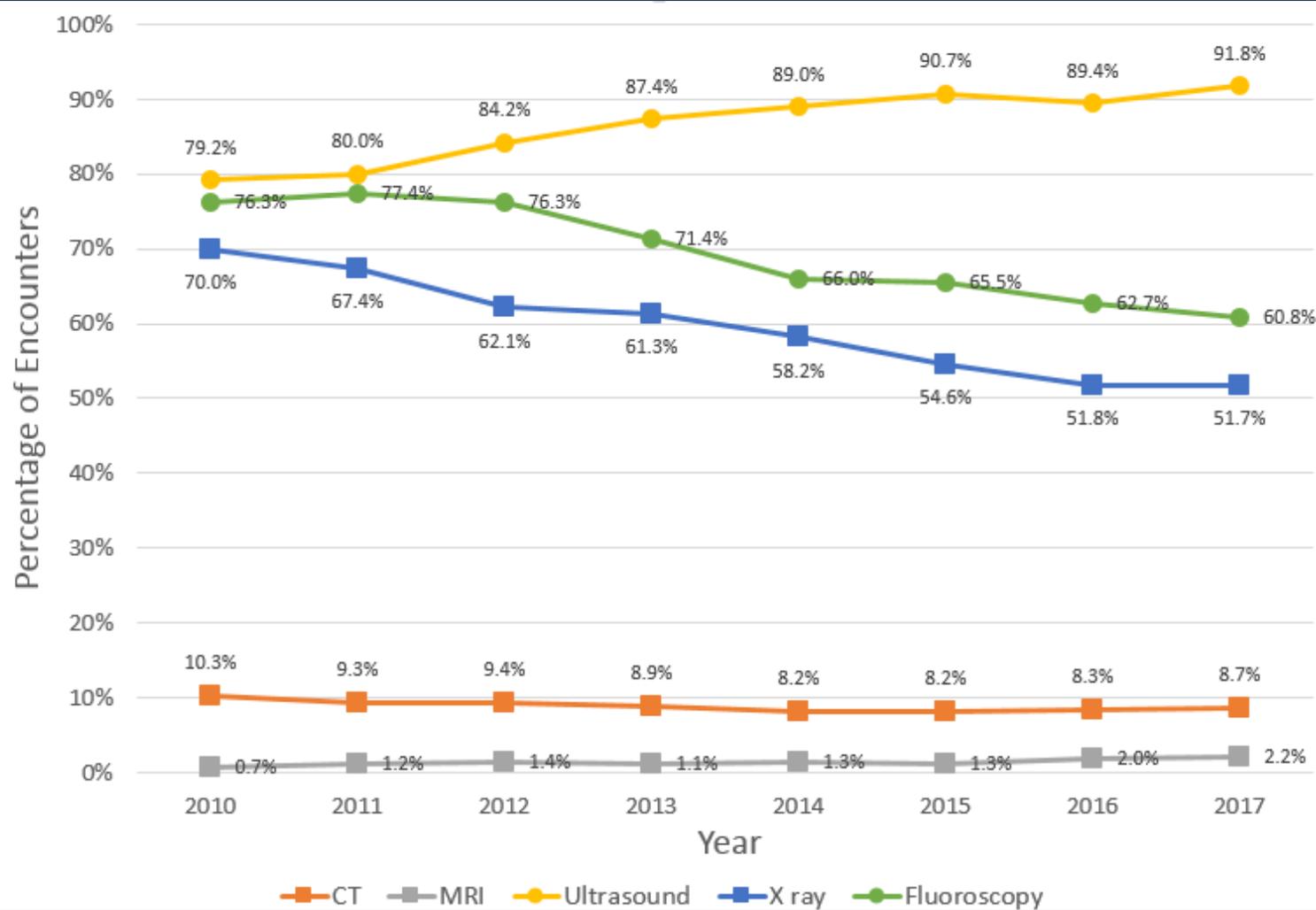
Results: Outcomes

	Frequency (%)
Median Length of Stay (IQR)	1 (1-2)
Encounter type	
Inpatient	8,865 (42.9%)
Observation unit	6,438 (31.2%)
Emergency dept	5,342 (25.9%)
Discharged Home	19,663 (95.2%)
Mortality	38 (0.2%)
ICU admissions	769 (3.7%)
Complications	
Medical	31 (0.2%)
Surgical	642 (3.1%)
Readmissions (90-day)	2,160 (10.5%)
Surgery	4,052 (19.6%)

Results: Imaging

- 93.5% (n=19,320) of patients underwent imaging
 - 57% had imaging the same day of surgery
 - 39% had imaging before surgery
 - 3% had postsurgical imaging studies
- The remaining 6.5% likely represent transfers from other institutions (which cannot be directly identified in the database)

Results: Imaging Utilization Trends



- Ultrasound: 93.1% (n=19,234)
- Radiographs: 75.9% (n=14,661)
- Fluoroscopy: 72.4% (n=13,993)
- CT abd & pelvis: 12.2% (n=2,359)

Results: Costs

Imaging costs represented ~ 1/3 third of **Total Costs**

	Mean (SD)	Median	IQR
Clinical	\$2,185 (\$18,587)	\$249	\$988-\$2,842
Imaging	\$2,768 (\$6,349)	\$1,807	\$988-\$2,842
Others	\$14,524 (\$59,749)	\$4,609	\$1,998-\$9,383
Total	\$9,010 (\$46,937)	\$2,675	\$1,637-\$5,465

Results: Analysis

- Assumed spontaneous reduction 25.3% (n=5233)

*patients who did not go to surgery nor fluoroscopy

- The intussusception reduction success rate for fluoroscopy was 77.9%
- Higher per patient mean costs were associated with:
 - Longer length of stay (<3 days: \$2,785 versus >3 days: \$35,694)
 - Use of CT (\$45,829 versus \$5,717 in patients without a CT)
 - Undergoing surgery (\$29,138 versus \$4,098 in those without surgery).

Results: Analysis

- Patients from rural areas had higher rate of surgery (26.8% versus 18% for those living in urban areas ($p < 0.001$))
- Patients undergoing surgery were more likely to undergo CT (19% versus 6% in those without surgery, $p < 0.001$) but had lower overall imaging utilization rates (91.3% versus 94.1% imaging in patients without surgery, $p < 0.001$)

Discussion

From the total number of children with a diagnosis of intussusception:

- Image-guided non-operative reduction rate (i.e.; raw fraction of children successfully managed with fluoroscopy and not requiring surgery): 50%
- Rate of spontaneous reduction plus small-bowel-to-small-bowel intussusception (i.e.; patients did not required fluorosocopy nor surgery): 25%
- Surgical rate: 20%
 - Directly went to surgery without fluoroscopy: 5.4%
 - Failed image-guided reduction attempts: 14.2%

Discussion

- In our sample, outcomes were excellent with a mortality rate of 0.2%, and only 3.5% of children requiring ICU admission. Better than mortality rates reported in the 1980s, when image-guided reduction became the preferred approach¹
- 6.5% of patients did not received any imaging tests, likely a combination of those patients transferred after initial diagnostic work-up at a different hospital, which we calculated at 4.75%, or those in whom intussusception was recognized during surgery.



Discussion

- The surgical rate in patients with intussusception in our sample (17%) was in the lower end of previously reported numbers that ranged from 19% to 43%
- The primary surgical reduction approach (without attempted fluoroscopy) rate of 4% is much lower than previously reported 19%
- Primary surgery should be reserved for patients with peritoneal signs, with evidence of non-viable bowel and when a lead point is present



Limitations

1. ICD code does not differentiate ileocolic from other types of intussusception
2. Our database only includes stand-alone pediatric hospitals, which might have different practice guidelines and be more responsive to changes in diagnosis and treatment than community or mainly adult-focus facilities
3. The data does not allow to identify and differentiate between hospitals that have 24/7 pediatric radiology and fluoroscopy coverage from others
4. This study assumes that all input into the administrative database and its coding are correct, ignoring human or system wide coding errors
5. We used ratios of charges and cost estimates, which even if specific for each hospital and reported by year, are prone to variability and do not directly relate to reimbursement

Conclusion

- Despite fluoroscopy having a high success rate in reducing intussusception, surgery and spontaneously-reduced intussusception account for 50% of cases
- Expanding evidence and knowledge of favorable outcomes and lower costs associated with image-guided intussusception reduction may decrease the number of cases undergoing surgery as a primary option and those in which CT or radiographs are used

Thank you!



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