Adherence to "Choosing Wisely" Recommendations in Pediatric Emergency Medicine

Tara F. Corcoran, MD*; Sriram Ramgopal, MD; Jennifer A. Hoffmann, MD, MS; Kenneth A. Michelson, MD, MPH

*Corresponding Author. E-mail: funktarac@gmail.com.

Study objective: In 2022, Choosing Wisely released recommendations to decrease the frequency of low-value testing in pediatric emergency medicine. The extent to which low-value testing occurs in US emergency departments (EDs) may vary by ED experience. We compared the frequency of low-value testing with ED volume.

Methods: We conducted a cross-sectional study using data from the Healthcare Cost and Utilization Project in all EDs in 8 states from January 1, 2014 to December 31, 2020. We included children aged below 18 years with one of the addressed diagnoses: respiratory tract illness, mental or behavioral health condition, seizure, constipation, or respiratory viral illness. ED volume was defined using National Pediatric Readiness Program categories of pediatric visits per year: less than 1,800 (low); 1,800 to 4,999 (low-medium); 5,000 to 9,999 (medium); or ≥10,000 (high) with an outcome of low-value testing, determined using procedure codes. We evaluated the adjusted association of volume with low-value testing using logistic regression with clustering by site.

Results: We analyzed 5.6 million visits. Low-value tests were obtained in 19.3% of encounters. Low-value tests were obtained in 12.2% of visits to low-volume EDs, 20.5% for low-medium-volume EDs, 23.1% for medium-volume EDs, and 18.7% for high-volume EDs. Low-volume sites had the lowest rates of testing for mental or behavioral health conditions, constipation, and respiratory viral illness. High-volume sites had the lowest rates of testing for respiratory tract illness and seizure.

Conclusions: Low-value testing occurred in one fifth of ED visits for children with a study condition. The relationship of ED volume to low-value testing was inconsistent across conditions. [Ann Emerg Med. 2025;86:28-35.]

Please see page 29 for the Editor's Capsule Summary of this article.

Keywords: Low-value care, Low-value testing, Pediatric emergency medicine, Choosing Wisely.

Readers: click on the link to go directly to a survey in which you can provide **feedback** to *Annals* on this particular article.
A **podcast** for this article is available at www.annemergmed.com.

0196-0644/$-see front matter

https://doi.org/10.1016/j.annemergmed.2025.02.004

INTRODUCTION

Background

Stewardship over health care resources has become increasingly important as health care costs rise across the United States.[1,2] Between 20% and 30% of tests and procedures performed in North America are deemed wasteful, defined as unnecessary costs added without improving patient outcomes.[3-5] In addition to generating wasteful expense, unnecessary tests may lead to incidental findings or false positive results.[6-9] Unnecessary tests may also cause both direct and indirect harms such as anxiety, pain, radiation, and missed school or work.[10]

Reducing the use of unnecessary tests can reduce waste and improve value, defined as outcomes per cost.[1,11] The American Board of Internal Medicine created the Choosing Wisely campaign to reduce unnecessary testing and procedures.[12] Through raising awareness, providing education, and prompting discussion about health care utilization, Choosing Wisely has led to practice improvements.[13,14] In 2022, Choosing Wisely recommendations were developed for pediatric emergency medicine to decrease the frequency of low-value tests in the emergency department (ED) setting.[15] The recommendations call for avoiding 5 common, low-value tests: (1) radiographs for respiratory tract illnesses, including bronchiolitis, croup, asthma, or first-time wheezing; (2) screening laboratory tests for psychiatric medical clearance; (3) laboratory testing or a head computed tomography scan for unprovoked, generalized seizure or a simple febrile seizure with return to baseline mental status; (4) abdominal radiographs for suspected constipation; and (5) comprehensive viral panel testing for suspected respiratory viral illnesses.[15]

Editor's Capsule Summary

What is already known on this topic

The 2022 Choosing Wisely campaign identified low-value testing for 5 common pediatric emergency department (ED) conditions.

What question this study addressed

Did the baseline frequency of low-value testing vary by annual pediatric ED volume?

What this study adds to our knowledge

Using 5.6 million pediatric ED encounters for the 5 selected conditions, 1 in 5 had a low-value test without a consistent association with pediatric volume.

How this is relevant to clinical practice

Further efforts to reduce low-value testing are needed.

Importance

The extent to which low-value testing occurs in US EDs is unclear but may vary between EDs. Most children are evaluated in general EDs (ie, those that treat both adults and children) with lower pediatric volumes, whereas a smaller proportion of children are evaluated and treated at referral centers with higher volumes.[16] Lower pediatric volume EDs often lack pediatric admission capabilities and have fewer supports such as quality improvement coordinators, care coordinators, and pediatric-specific processes and procedures.[17,18] Resources and experience vary between these settings, which may lead to differences in the use of low-value tests.

Goals of This Investigation

Understanding which facility types are most likely to obtain low-value testing can inform targeted education and quality improvement efforts.[4] Our objectives were therefore to (1) compare the frequency of low-value testing by ED volume, and (2) examine trends in low-value testing. We hypothesized that higher ED volume would be associated with decreased low-value testing.

METHODS

Study Design, Data Source, and Setting

We conducted a cross-sectional study testing the association of pediatric volume and low-value testing. We used 2014 to 2020 Healthcare Cost and Utilization Project (HCUP) data from the State Emergency Department and Inpatient Databases of Arkansas, Florida, Georgia, Iowa, Maryland, Nebraska, New York, and Wisconsin.[19] HCUP data include all EDs in these states. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline for cross-sectional studies.[20] This study was considered exempt by the Ann & Robert H. Lurie Children's Hospital of Chicago Institutional Review Board.

Selection of Participants

We included children aged below 18 years with one of the diagnoses addressed by the 2022 Choosing Wisely guidelines: respiratory tract illness, mental or behavioral health condition, seizure, constipation, or respiratory viral illness (Table 1).[21] Diagnoses were aligned with the Choosing Wisely framework.

The included conditions were identified using International Classification of Diseases, 9th and 10th Revision, Clinical Modification codes (Table E1, available at http://www.annemergmed.com). We excluded patients whose age, disposition, or concomitant diagnoses suggested that more testing could be indicated (Table 1).[22,23] For all conditions, we excluded patients with a codiagnosis of a complex chronic condition (using a commonly established definition for these based off of encounter-level diagnosis or procedure codes) for whom the value of diagnostic testing generally differs.[24]

Measurements

Our exposure was ED volume of children, defined using National Pediatric Readiness Program categories: less than 1,800 (low); 1,800 to 4,999 (low-medium); 5,000 to 9,999 (medium); or more than or equal to 10,000 (high) pediatric patients per year.[25]

Outcome

Our outcome was low-value testing, per Choosing Wisely guidelines. Low-value tests were determined by International Classification of Diseases and Current Procedural Terminology codes as follows: respiratory tract illness—chest radiography; mental or behavioral health condition—laboratory testing (complete blood count or metabolic panel); seizure—head imaging or laboratory testing (complete blood count or metabolic panel); constipation—abdominal radiography; respiratory viral illness—comprehensive viral testing for more than or equal to 3 targets. We considered the following covariates: age, sex, race, and ethnicity (as directly reported by the data source), payor, and weekend versus weekday arrival. Race

Table 1. Inclusion criteria for each studied condition.

Condition	Diagnoses	Disposition From ED	Exclusions
Respiratory tract illness	Bronchiolitis, croup, asthma, or wheeze	Discharged	<90 d
Mental or behavioral health condition	Depressive disorders; suicide or self-injury; disruptive, impulse control and conduct disorders; anxiety disorders, trauma and stressor-related disorders; substance-related and addictive disorders; and attention-deficit/hyperactivity disorder	Admitted inpatient, to a medicine or psychiatric bed, or transferred to a psychiatric facility	<6 y, schizophrenia spectrum and other psychotic disorders and patients with concomitant ingestion, trauma, or injury diagnosis
Seizure	Generalized seizure, unspecified convulsions, or simple febrile seizure	Discharged	<180 d, patients with a concomitant trauma or injury diagnosis
Constipation	Constipation	Discharged	<90 d
Respiratory viral illness	Acute upper respiratory tract infection, nasopharyngitis, bronchiolitis, croup	Discharged	<90 d

and ethnicity were interpreted as social constructs because of documented disparities in access to primary care.[26]

Analysis

We summarized demographic information by condition. We calculated the frequency of low-value tests overall and stratified by condition. We reported low-value test proportions by condition and volume, testing associations, with chi-square tests. To address potential confounding with visit characteristics, we evaluated the adjusted association of volume with low-value testing using logistic regression with clustering by site, adjusting for all covariates.

To evaluate whether clinician practices were changing prior to the release of the Choosing Wisely guidelines, we evaluated trends in low-value tests. We used logistic regression with the outcome of low-value testing, with the following variables: year, condition, and all covariates.

We calculated an Achievable Benchmark of Care (ABC), representing the highest-performing hospitals.[27] To do so, we first dropped hospitals with fewer than 28 patients with a given diagnosis, because the 95% confidence interval (CI) of their testing rate could be more than 20% from the estimate. Next, we kept the lowest-testing hospitals representing 10% of the cohort. From this sample, the ABC was calculated as the number of patients tested divided by the number of patients.

Sensitivity Analyses

We performed 3 sensitivity analyses. First, because some patients have multiple conditions, some of which could necessitate testing, we reran the analysis using only children with no secondary diagnosis codes. Second, to eliminate pandemic effects on respiratory virus evaluations for public health reasons, we reran the respiratory tract illness and respiratory viral illness analyses without 2020 data. Third, some admissions by children with mental and behavioral health conditions could have necessitated laboratory testing because of cooccurring medical conditions, so we reperformed our analysis only including those transferred directly from the ED to a psychiatric facility.

RESULTS

Characteristics of Study Subjects

There were 6,778,026 visits for a study condition. We excluded 617,232 (9.1%) visits for age less than 90 days in respiratory tract illness, constipation, and respiratory viral illnesses; 5,788 (0.1%) visits for age less than 180 days in seizure; 405,462 (6.0%) visits for a complex chronic condition; 97,612 (1.4%) visits for an excluded diagnosis or excluded codiagnosis; 21,5050 (0.3%) visits where ED volume was missing; and 2,151 (less than 0.0%) visits for age less than 6 years with a mental or behavioral health condition. Thus, we analyzed 5,628,276 (83%) visits (Figure 1). Except for mental or behavioral health conditions, most children visited high-volume EDs (Table 2) and demographics varied by condition.

Main Results

Low-value tests were obtained in 1,088,845 (19.3%) encounters overall: respiratory tract illness (31.3%), mental or behavioral health condition (17.0%), seizure (42.9%),

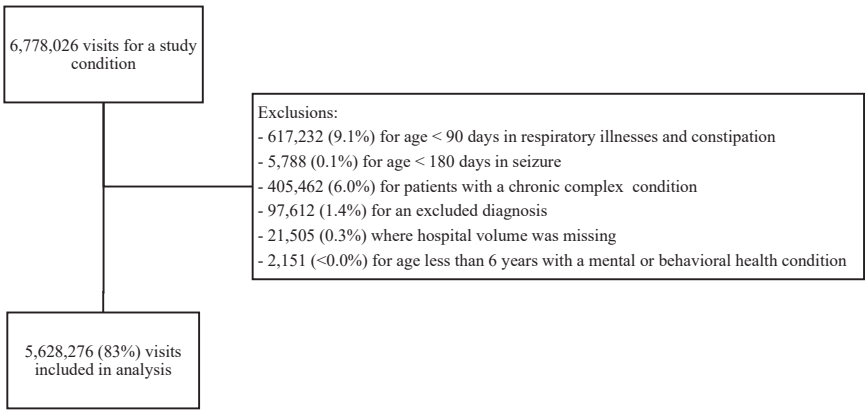

Figure 1. Inclusion diagram.

constipation (66.1%), and respiratory viral illness (3.2%). Low-value tests were obtained in 12.2% of visits to low-volume EDs, 20.5% for low-medium-volume EDs, 23.1% for medium-volume EDs, and 18.7% for high-volume EDs.

The relationship of volume and testing differed by condition. Significant volume associations existed for all condition-test combinations except for obtaining head imaging for seizure (Table 3). Low-volume sites had the lowest rates of testing for mental or behavioral health

Table 2. ED volume and demographic data by study condition.

Characteristics	Respiratory Tract Illness	Mental or Behavioral Health Condition	Seizure	Constipation	Respiratory Viral Illness
ED volume of pediatric patients					
<1,800	62,543 (3.7)	136,112 (37.9)	6,503 (3.6)	18,430 (3.7)	125,896 (4.3)
1,800-4,999	183,837 (10.8)	70,896 (19.7)	18,555 (10.3)	52,344 (10.6)	373,401 (12.9)
5,000-9,999	296,351 (17.4)	48,588 (13.5)	31,734 (17.6)	79,846 (16.2)	585,427 (20.2)
≥10,000	1,156,507 (68.1)	103,895 (28.9)	123,511 (68.5)	342,523 (69.5)	1,811,377 (62.5)
Age (y)	4.0 (1.7, 8.0)	14.0 (12.0, 16.0)	2.7 (1.4, 7.2)	7.2 (3.6, 11.0)	2.5 (1.0, 5.5)
Sex					
Female	662,110 (39.0)	210,223 (58.5)	77,364 (42.9)	263,847 (53.5)	1,327,741 (45.8)
Male	1,037,096 (61.0)	149,235 (41.5)	102,931 (57.1)	229,281 (46.5)	1,568,271 (54.2)
Race and ethnicity					
White	528,294 (33.7)	194,964 (58.0)	73,581 (44.5)	168,748 (36.5)	941,192 (35.0)
Black	539,095 (34.4)	74,515 (22.2)	44,229 (26.7)	121,160 (26.2)	836,420 (31.1)
Hispanic	356,924 (22.7)	45,507 (13.5)	28,668 (17.3)	126,054 (27.3)	658,242 (24.4)
Asian/Pacific Islander	28,955 (1.8)	3,860 (1.1)	6,034 (3.6)	11,290 (2.4)	54,398 (2.0)
Native American	5,706 (0.4)	1,518 (0.5)	729 (0.4)	1,743 (0.4)	11,082 (0.4)
Other	109,995 (7.0)	15,609 (4.6)	12,188 (7.4)	32,830 (7.1)	191,303 (7.1)
Payor					
Medicaid	1,116,172 (65.8)	194,340 (54.2)	101,210 (56.2)	320,480 (65.0)	2,078,938 (71.9)
Private	428,084 (25.2)	135,663 (37.8)	61,865 (34.4)	128,432 (26.1)	538,052 (18.6)
Other	51,354 (3.0)	15,510 (4.3)	5840 (3.2)	15,337 (3.1)	82,545 (2.9)
Uninsured	101,875 (6.0)	13,159 (3.7)	11,160 (6.2)	28,420 (5.8)	193,453 (6.7)
Arrival day					
Weekday	1,178,376 (69.3)	300,443 (83.6)	130,858 (72.6)	362,961 (73.6)	2,013,240 (69.5)
Weekend	520,852 (30.7)	59,048 (16.4)	49,443 (27.4)	130,181 (26.4)	882,836 (30.5)

Data are reported as median (interquartile range) or n (%).
ED, Emergency deparment.

Table 3. Low-value testing by condition, test, and pediatric volume.

				ED Volume of Pediatric Patients			
Cohort	**Low-Value Test**	**Overall Rate (%)**	**ABC (%)**	**<1,800 (%)**	**1,800-4,999 (%)**	**5,000-9,999 (%)**	**≥10,000 (%)**
Respiratory tract illness	Chest radiograph	31.3	3.6	34.2	41.6	45.8	25.9
Mental or behavioral health condition	Blood tests	17.0	0.0	2.3	17.6	36.3	27.0
Seizure	Blood tests and/or head imaging	42.9	8.0	61.3	55.1	54.8	37.1
	Blood tests only			43.3	35.4	36.0	26.3
	Head imaging only			1.2	1.2	1.1	1.3
	Blood tests and head imaging			16.7	18.5	17.7	9.5
Constipation	Abdominal radiograph	66.1	16.3	60.7	64.4	67.1	66.5
Viral respiratory illness	Comprehensive viral testing	3.2	0.0	2.4	2.8	2.9	3.4

ABC, Achievable benchmark of care; *ED*, emergency department.

conditions, constipation, and respiratory viral illness. High-volume sites had the lowest rates of testing for respiratory tract illness and seizure. Compared with EDs with more than 10,000 pediatric visits per year, the adjusted odds ratios of having a low-value test by ED volume were 0.53 (99% CI 0.41 to 0.67) for less than 1,800 visits per year, 1.24 (99% CI 1.00 to 1.54) for 1,800 to 4,999 visits per year, and 1.60 (99% CI 1.31 to 1.97) for 5,000 to 9,999 visits per year. There was no consistent ordinal trend between conditions by volume category (Figure 2).

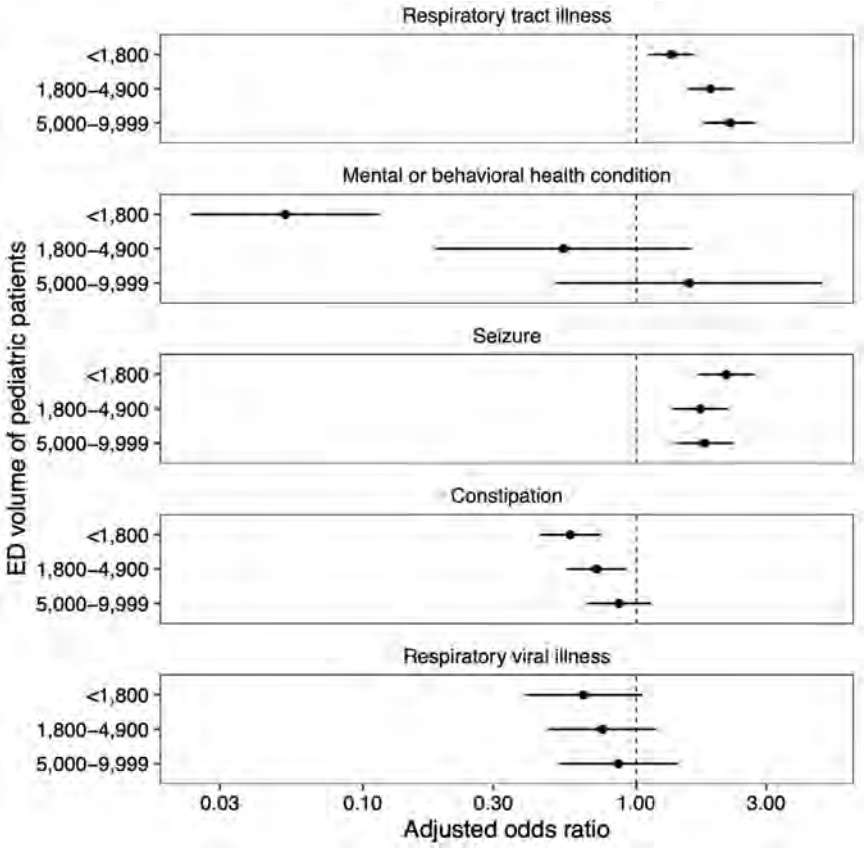

Figure 2. Subgroup plot demonstrating adjusted odds of low-value test being obtained when compared to an ED volume of pediatric patients of more than or equal to 10,000.

Time Trends

Low-value testing increased 5.8% per year (99% CI 3.4 to 8.3). This increase was driven by increased comprehensive viral testing in respiratory viral illnesses (Figure 3).

ABC

The ABC for constipation was 16.3%, for respiratory tract illness 3.6%, for seizure 8.0%, and for both psychiatric and respiratory viral infection 0% (Table 3).

Sensitivity Analyses

When limiting to patients with only one diagnosis, the proportion of low-volume tests was 18.2%. In this subsample, low-value testing by condition was respiratory tract illness (26.9%), mental or behavioral health condition (33.0%), seizure (42.4%), constipation (63.4%), and respiratory viral illness (2.6%). In the sensitivity analysis excluding 2020 data, we found overall similar results to the main analysis, with the frequency of chest radiography for respiratory tract illness at 31.3% and comprehensive viral swab at 2.8% for respiratory viral illness. To further evaluate patients with a mental or behavioral health condition, we evaluated only those who were transferred out to a psychiatric facility and found 19.7% of patients had laboratory studies performed.

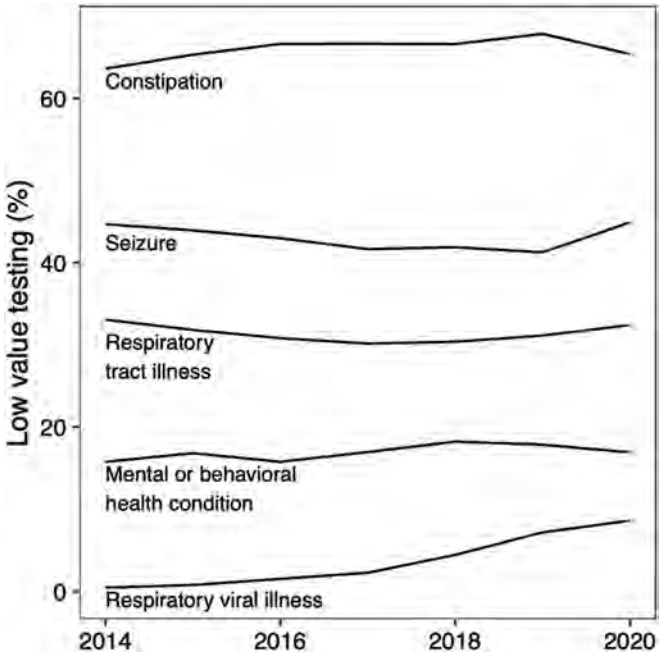

Figure 3. Longitudinal testing for low-value testing by condition.

DISCUSSION

In 8 states, we found that low-value tests were obtained in approximately 1 in 5 visits (19.3%) among children for 5 common conditions, with particularly high rates of low-value testing for seizure and constipation. Across all study conditions, there was no consistent association of the ED volume of pediatric patients and the frequency of obtained low-value tests. Low-value tests became more common over the study period. Taken together, our findings indicate that, prior to the announcement of Choosing Wisely recommendations for pediatric emergency medicine in 2022, low-value tests were common, suggesting a major opportunity for improvement in EDs of all volumes.

There are several potential reasons for our findings related to low-value testing by ED volume. First, resources, capabilities, and throughput may differ between EDs.[28] This may influence different departments' standard operating practices which can affect care. In some EDs, triage teams (often staffed by nurses) begin complaint-related workups by ordering imaging or laboratory studies prior to clinician evaluation. Second, clinician training and environments likely differ between high- and low-pediatric volume EDs.[28] Prior work evaluating pediatric versus community general EDs demonstrates significant differences in imaging utilization.[29] Staff background (eg, pediatric emergency medicine fellowship completion and proportion of patients cared for by nonphysician clinicians) can also affect clinical decisionmaking.[30,31] Third, the expectations, demands, and medical complexity of patients and their parents may differ between settings. For example, families typically choose a higher-volume ED when they return to care, and revisits may prompt clinicians to obtain more testing for diagnostic purposes or because of patient preference.[32-34] Finally, those with significant medical history may self-select to their medical home ED.[35]

The Choosing Wisely campaign framework is predicated on diagnoses rather than chief concern at presentation. Our goal was not to evaluate the appropriateness or phrasing of the Choosing Wisely recommendations, but rather to test how often the recommendations were followed for the affected conditions. Further, the aim is not to reduce imaging rates to zero, but rather to decrease routine use of testing. To this end, the concept of an ABC can be used to identify reasonable targets for improvement. ABCs are determined based on the level of performance that is possible to attain by a segment of high-performing clinicians or settings.[36] For instance, prior work using only high-volume pediatric centers indicates that the ABC for obtaining a chest radiography in patients discharged with bronchiolitis is 7.3% and we found using EDs of varying

pediatric volumes an ABC of 3.6% for our respiratory tract illness cohort.[27] In our sample of EDs, the overall chest radiography rate for this group was 31.3%, highlighting notable opportunities for improvement.

Low-value testing increased 5.8% per year. This is largely explained by increased viral testing in respiratory viral illnesses, which was increasing before the pandemic but accelerated in 2020.[37] The lack of improvement over the 7 years of this study suggests that, without intervention, low-value testing would continue to persist. Although this study includes data predating the release of the Choosing Wisely recommendations, it establishes a baseline from which to improve.

Decreasing the frequency of low-value testing is important. Patients are spared the time, the procedure, and downstream workups of incidentally found conditions when unnecessary tests are performed, and health care systems are able to provide more efficient, evidence-based care.[1,10] Accomplishing this will require effort from hospital systems and clinicians to alter practice patterns, a concept termed deimplementation. At the hospital level, teams can deimplement low-value testing by (1) evaluating barriers to change (2) findings solutions for the barriers, and (3) providing education at the clinician level.[38] Next, they can follow the results of their teaching with modalities such as quality improvement. In general EDs, having a pediatric emergency care coordinator is associated with stronger pediatric policies and outcomes, suggesting that coordinators could help with protocol development that would support deimplementation.[39]

This study has several limitations. First, billing data lacks the clinical context that might reveal specific indications for testing. We mitigated this risk by excluding medically complex patients and restricting to visit dispositions generally associated with lower medical severity. Second, the Choosing Wisely recommendations do not include specific administrative billing codes for each condition. Third, we could not evaluate the effect of Choosing Wisely recommendations on testing practices because our study predated their publication. However, at least in the case of viral testing, other data sources indicate test ordering did not abate after the Choosing Wisely recommendations.[37] Fourth, we are unable to discern the types of clinicians staffing the EDs and whether they are fellowship trained in pediatric emergency medicine versus general emergency medicine trained. However, because there are fewer pediatric emergency medicine-boarded physicians than EDs in the United States, it is unlikely that most included EDs had access to pediatric emergency medicine-boarded physicians. Finally, in some situations, such as for constipation, the diagnosis may be made after testing was performed to evaluate for other potential conditions. If this testing had revealed an alternative diagnosis, the visit would have been excluded from our analyses, potentially conferring selection bias. Although we would have preferred to evaluate the frequency of low-value testing among visits for *suspected* conditions (eg, suspected constipation, suspected respiratory viral illness) to align with the exact wording of the Choosing Wisely Guidelines rather than among visits with *confirmed* conditions (based on billing diagnosis codes), our cohort definitions represent reasonable proxies using available data elements. However, our findings provide a foundation for postrecommendation improvement efforts by providing an initial point which individual EDs may use to benchmark their care compared with similar volume EDs. Furthermore, by operationalizing electronic health record-based measures for each Choosing Wisely recommendation, data can be tracked over time to measure progress as sites conducting quality improvement efforts.

Low-value testing is being conducted in approximately one fifth of ED visits for children with the conditions of respiratory tract illness, mental and behavioral health conditions, seizures, constipation, and respiratory viral illnesses as defined by the 2022 pediatric emergency medicine Choosing Wisely campaign. There was no consistent relationship between ED volume of pediatric patients and testing patterns, suggesting a need for deimplementation in hospitals of all sizes.

Supervising editor: Lise E. Nigrovic, MD, MPH. Specific detailed information about possible conflict of interest for individual editors is available at https://www.annemergmed.com/editors.

Author affiliations: From the Division of Emergency Medicine (Corcoran, Ramgopal, Hoffmann, Michelson), Ann & Robert H. Lurie Children's Hospital of Chicago, Northwestern University Feinberg School of Medicine, Chicago, IL.

Author contributions: TFC, JH, and KM conceived the study idea. TFC and KM designed the study. TFC and KM managed the data and carried out the analysis. All authors provided advice on study design and analysis. TFC drafted the manuscript and all authors contributed substantially to its revision. All authors take responsibility for the paper as a whole. TFC takes final responsibility for the paper.

Data sharing statement: We cannot share the primary source data because of data use agreements prohibiting this; however, the HCUP databases are available for purchase. We will share analytic code upon reasonable request.

All authors attest to meeting the four ICMJE.org authorship criteria: (1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND (2) Drafting the work or revising it critically for important intellectual content; AND (3) Final approval of the version to be

published; AND (4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding and support: By *Annals*' policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). Dr. Michelson was supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development award R01HD112321. The other authors report no conflict of interest.

Publication dates: Received for publication October 29, 2024. Revision received January 31, 2025. Accepted for publication February 6, 2025.

REFERENCES

1. Porter ME. What is value in health care? *N Engl J Med*. 2010;363:2477-2481.
2. Morgan SR, Smith MA, Pitts SR, et al. Measuring value for low-acuity care across settings. *Am J Manag Care*. 2012;18:e356-e363.
3. Berwick DM, Hackbarth AD. Eliminating waste in US health care. *JAMA*. 2012;307:1513-1516.
4. Trapani S, Montemaggi A, Indolfi G. Choosing Wisely in pediatric healthcare: a narrative review. *Front Pediatr*. 2023;10:1071088.
5. Bentley TGK, Effros RM, Palar K, et al. Waste in the U.S. health care system: a conceptual framework. *Milbank Q*. 2008;86:629-659.
6. Badgery-Parker T, Pearson S-A, Dunn S, et al. Measuring hospital-acquired complications associated with low-value care. *JAMA Intern Med*. 2019;179:499-505.
7. Ganguli I, Simpkin AL, Lupo C, et al. Cascades of care after incidental findings in a US national survey of physicians. *JAMA Netw Open*. 2019;2:e1913325.
8. Mold JW, Stein HF. The cascade effect in the clinical care of patients. *N Engl J Med*. 1986;314:512-514.
9. Berlin L. The incidentaloma: a medicolegal dilemma. *Radiol Clin North Am*. 2011;49:245-255.
10. Nathaniel E, Tchou MJ. An explosive workup for diarrhea: the cascade effect from an incidental finding on a laboratory panel. *Hosp Pediatr*. 2020;10:620-622.
11. Roben E, Johnson J, Verghese GR. Value-based health care in the pediatric emergency department. *Clin Pediatr Emerg Med*. 2018;19:312-316.
12. Choosing Wisely. Accessed January 10, 2025. http://www.choosingwisely.org
13. Cliff BQ, Avanceña ALV, Hirth RA, et al. The impact of Choosing Wisely interventions on low-value medical services: a systematic review. *Milbank Q*. 2021;99:1024-1058.
14. Bennett A. Choosing Wisely: is it working? how we can measure success. *Crit Values*. 2015;8:34-35.
15. Mullan PC, Levasseur KA, Bajaj L, et al. Recommendations for Choosing Wisely in pediatric emergency medicine: five opportunities to improve value. *Ann Emerg Med*. 2024;84:167-175.
16. Michelson KA, Hudgins JD, Lyons TW, et al. Trends in capability of hospitals to provide definitive acute care for children: 2008 to 2016. *Pediatrics*. 2020;145:e20192203.
17. Remick KE, Bartley KA, Gonzales L, et al. Consensus-driven model to establish paediatric emergency care measures for low-volume emergency departments. *BMJ Open Qual*. 2022;11:e001803.
18. National Pediatric Readiness Project. Emergency Medical Services for Chidren. Accessed January 10, 2025. https://emscimprovement.center/domains/pediatric-readiness-project/
19. Data from: Healthcare Cost and Utilization Project SEDD Overview. Accessed August 2, 2024. https://hcup-us.ahrq.gov/databases.jsp
20. Von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet*. 2007;370:1453-1457.
21. Cutler GJ, Rodean J, Zima BT, et al. Trends in pediatric emergency department visits for mental health conditions and disposition by presence of a psychiatric unit. *Acad Pediatr*. 2019;19:948-955.
22. Elsamadicy AA, Koo AB, David WB, et al. Post-traumatic seizures following pediatric traumatic brain injury. *Clin Neurol Neurosurg*. 2021;203:106556.
23. Chan V, Thurairajah P, Colantonio A. Defining pediatric traumatic brain injury using International Classification of Diseases Version 10 Codes: a systematic review. *BMC Neurol*. 2015;15:7.
24. Feudtner C, Feinstein JA, Zhong W, et al. Pediatric complex chronic conditions classification system version 2: updated for ICD-10 and complex medical technology dependence and transplantation. *BMC Pediatr*. 2014;14:199.
25. Gausche-Hill M, Ely M, Schmuhl P, et al. A national assessment of pediatric readiness of emergency departments. *JAMA Pediatr*. 2015;169:527-534.
26. Ramgopal S, Rodean J, Alpern ER, et al. Ambulatory follow-up among publicly insured children discharged from the emergency department. *Acad Emerg Med*. 2023;30:721-730.
27. Ralston SL, House SA, Harrison W, et al. The evolution of quality benchmarks for bronchiolitis. *Pediatrics*. 2021;148:e2021050710.
28. Remick KE, Hewes HA, Ely M, et al. National assessment of pediatric readiness of US emergency departments during the COVID-19 pandemic. *JAMA Netw Open*. 2023;6:e2321707.
29. Reznek MA, Michael SS, Harbertson CA, et al. Clinical operations of academic versus non-academic emergency departments: a descriptive comparison of two large emergency department operations surveys. *BMC Emerg Med*. 2019;19:72.
30. Doctor K, Breslin K, Chamberlain JM, et al. Practice pattern variation in test ordering for low-acuity pediatric emergency department patients. *Pediatr Emerg Care*. 2021;37:e116-e123.
31. Mafi JN, Chen A, Guo R, et al. US emergency care patterns among nurse practitioners and physician assistants compared with physicians: a cross-sectional analysis. *BMJ Open*. 2022;12:e055138.
32. Michelson KA, Lyons TW, Bachur RG, et al. Timing and location of emergency department revisits. *Pediatrics*. 2018;141:e20174087.
33. Rising KL, Padrez KA, O'Brien M, et al. Return visits to the emergency department: the patient perspective. *Ann Emerg Med*. 2015;65:377-386.e3.
34. Duseja R, Bardach NS, Lin GA, et al. Revisit rates and associated costs after an emergency department encounter: a multistate analysis. *Ann Intern Med*. 2015;162:750-756.
35. Lin SC, Margolis B, Yu SM, et al. The role of medical home in emergency department use for children with developmental disabilities in the United States. *Pediatr Emerg Care*. 2014;30:534-539.
36. Weissman NW, Allison JJ, Kiefe CI, et al. Achievable benchmarks of care: the ABCs of benchmarking. *J Eval Clin Pract*. 1999;5:269-281.
37. Ramgopal S, Badaki-Makun O, Eltorki M, et al. Trends in respiratory viral testing in pediatric emergency departments following the COVID-19 pandemic. *Ann Emerg Med*. 2025;85:111-121.
38. Schondelmeyer AC, Harris CD, Bonafide CP. The path to large-scale high-flow nasal cannula deimplementation in bronchiolitis. *Hosp Pediatr*. 2023;13:e99-e101.
39. Foster A, Hoffmann J, Li J, et al. 182 Emergency department characteristics associated with pediatric behavioral health readiness. *Ann Emerg Med*. 2023;82:S82-S83.