# A Retrospective Study of Children Transferred from General Emergency Departments to a Pediatric Emergency Department: Which Transfers Are Potentially Amenable to Telemedicine?

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**Objective** To characterize children who experienced interfacility emergency department (ED) transfers with discharge home, and identify care potentially amenable to telemedicine in lieu of transfer.

**Study design** Retrospective cohort study (July 2016 to June 2017) of patients transferred from general EDs to an academic pediatric ED and discharged home. The primary outcome was care potentially amenable to telemedicine defined as pediatric emergency medicine (PEM) provider assessment without other in-person subspecialty evaluation, diagnostic evaluation available in a general ED (electrocardiogram, point-of-care, or urine tests), and/or referrals and medications available in a general ED. Analysis included descriptive and $\chi^2$ statistics.

**Results** Of the 1733 patients transferred, 529 (31%) were discharged home and 22% of those discharged home had care potentially amenable to telemedicine. Patients amenable to telemedicine were more likely to be <2 years old (32% vs 17%; $P = .002$) and to have neurologic (29% vs 17%; $P = .005$), respiratory (16% vs 4%; $P < .001$), or urinary (5% vs 1%; $P = .004$) diagnoses than those whose care was not. Eight in 10 patients received their entire diagnostic evaluation before transfer and one-half received only a PEM provider assessment. An additional 281 cases were evaluated by a subspecialist in person, received routine imaging, or routine interventions.

**Conclusions** Children receiving care potentially amenable to telemedicine in lieu of transfer often received their entire diagnostic evaluation before transfer; PEM provider assessment was the mainstay of care after transfer. These findings have implications for informing telemedicine to improve access to PEM expertise and potentially decrease some interfacility transfers. *(J Pediatr 2021;230:126-32)*.

More than 80% of US children with emergency care needs are treated in general emergency departments (EDs). General EDs have varying pediatric readiness and pediatric expertise has largely been centralized in pediatric hospitals.[1-3] Centralization of care is associated with improved outcomes for children requiring pediatric-specific expertise, but it has also contributed to increases in transfers of children with common conditions, such as asthma and croup, by as much as 10%-15% per year.[4-7] In 2017, >200 000 children were transferred from general EDs to pediatric EDs to access pediatric expertise and/or specialized medical technology and staff (eg, pediatric ultrasound examination).[8,9]

A number of studies have described unnecessary, avoidable, or preventable transfers, but few have examined these transfers in the context of strategies to meet the needs of children in the care of emergency physicians in general and community hospitals.[10-14] Telemedicine is feasible, reliable, and effective for assessing acutely ill and injured children before transfer to a pediatric facility.[15-17] Furthermore, telemedicine can decrease transfers from general hospitals to pediatric intensive care units, but little is known regarding the potential for telemedicine to expand access in general EDs to pediatric expertise that would allow some children without critical care or emergent subspecialty needs to be managed in their home communities.[14,18,19]

To inform future telemedicine interventions to reduce some interfacility transfers, we must first identify which pediatric ED transfer patients receive care that could readily be delivered in a general ED with telemedicine support

| | |
|---|---|
| CCC | Complex chronic conditions |
| CT | Computed tomography |
| ED | Emergency department |
| EKG | Electrocardiogram |
| ICD-10-CM | *International Classification of Diseases version 10 Clinical Modification* |
| IV | Intravenous |
| PEM | Pediatric emergency medicine |
| PRISA2 | Pediatric Risk of Admission-2 |

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The authors declare no conflicts of interest.

Portions of this study were presented at the American Academy of Pediatrics National Conference and Exhibition (AAP-NCE), October 25–29, 2019, New Orleans, LA.


https://doi.org/10.1016/j.jpeds.2020.10.070

from a pediatric emergency medicine (PEM) provider. The objectives of this study were to describe the clinical characteristics of children who were transferred from general EDs to an academic free-standing pediatric ED and subsequently discharged home and characterize transfers where evaluation and management were potentially amenable to clinical management via telemedicine, using an a priori definition based on care provided before and after transfer.

## Methods

### Study Design

We conducted a retrospective, cross-sectional study of patients transferred from a general ED to a single academic free standing pediatric ED and discharged home from July 1, 2016, to June 30, 2017. Data were collected in 2019. This study was approved by the Lurie Children's Institutional Review Board. The STROBE checklist was used in manuscript development.

Study data were collected and managed using REDCap electronic data capture tools hosted at Northwestern University Feinberg School of Medicine (Chicago, Illinois).[20] We created a manual of operations with predefined data abstraction terms that were used during review to ensure consistency. Data were abstracted and reviewed from the referring and receiving ED records by 2 investigators. A 10% sample of charts were reviewed by both investigators, on which Kappa testing of interrater reliability was performed and found to exceed 0.8.

### Setting

The study was performed at Ann & Robert H. Lurie Children's Hospital of Chicago, an academic independent pediatric hospital with approximately 56 000 ED visits annually, of which roughly 2000 are interfacility ED transfers. The ED is staffed by physicians with fellowship training in PEM.

### Patient Population

Patients <21 years who were transferred from a general ED to the pediatric ED were considered eligible. Patients transferred to the pediatric ED with a psychiatric diagnosis or as a trauma system activation were excluded. Likewise, we excluded patients who were directly admitted to an inpatient unit. There were no intrahospital transfers out of our pediatric ED during the study period.

### Variables

The following data were abstracted from medical records from both the referring and receiving hospital EDs: patient demographics, use of diagnostic evaluation, interventions, subspecialty consultations, and secondary radiologic interpretations. Diagnostic evaluation included electrocardiogram (EKG), imaging, laboratory tests, urine studies, and point-of-care tests, such as rapid streptococcal antigen test, glucose, rapid influenza or respiratory syncytial virus test, and blood gas. Of these, EKGs, urine studies, and point-of-care tests were considered readily available in a general ED. Interventions included medications (receipt or prescriptions), outpatient referrals, intravenous (IV) fluids, respiratory support, and procedures such as incision and drainage, foreign body removal, and gastrostomy tube replacement. Of these, oral medications, discharge prescriptions, and outpatient referrals were considered readily available in a general ED. Subspecialty consultations were categorized as medical or surgical. Radiographs or computed tomography (CT) scans performed at the general ED that required secondary interpretation by a pediatric radiologist were included. Ultrasound examinations were not included in this group because the ultrasound images are rarely overread owing to variation in techniques. Laboratory test results and vital signs were extracted to calculate Pediatric Risk of Admission-2 (PRISA2) scores before transfer.[21] As specified in the published literature, PRISA2 scores were used to determine the probability of mandatory admission as follows: probability = $1/(1 + e^{-R})$, where $R = -4.0250 + 0.2888 * (\text{PRISA2 score}) - 0.00279 * (\text{PRISA2 score})$.[21] Undocumented laboratory and vital sign values required for PRISA2 calculations were assumed to be normal.[21]

Discharge diagnosis codes were extracted from the receiving hospital's electronic medical record. The *International Classification of Diseases version 10 Clinical Modification* (ICD-10-CM) codes were used to further characterize the patient population and the ED visits. Complex chronic conditions (CCCs) were identified from ICD-10-CM codes using the classification scheme by Feudtner et al.[22] The principal discharge diagnosis was categorized using an adaptation of the PECARN Diagnosis Grouping System modified for use with ICD-10-CM codes.[23]

A list of referring hospitals was obtained from the Lurie Children's Transport Team Communication Center's database. Referring hospital characteristics included presence of licensed inpatient pediatric unit and pediatric intensive care unit. The referring hospital address was used to calculate the driving distance from the general ED to our pediatric ED using Google Maps (Google LLC, Menlo Park, California). The percentage of pediatric patients seen by the general EDs annually was obtained from COMPdata Informatics, managed by Illinois Health and Hospital Association (Naperville, Illinois), based on information from July 1, 2016, through June 30, 2017; this information was unavailable for 6 referring hospitals outside of Illinois. The Emergency Departments Approved for Pediatrics designation was obtained from publicly available data published by the Illinois Department of Public Health; this information was also unavailable for the 6 referring hospitals outside of Illinois.[24]

### Outcome

Our primary outcome was an interfacility ED transfer (general ED to pediatric ED) with evaluation and management that was potentially amenable to clinical management via telemedicine, defined as a child who received a PEM provider assessment without any other in-person specialty consultation at the receiving pediatric ED, diagnostic evaluation only at the referring ED or diagnostic evaluation at the

receiving ED that would be readily available in a general ED (EKG, point-of-care tests, or urine studies), and/or interventions that could readily be performed in a general ED (oral medications, discharge prescriptions, and outpatient referrals). IV fluids and medications were not considered interventions that were potentially amenable to telemedicine, because obtaining IV access in pediatric patients can be challenging.[3] Secondary interpretations by a pediatric radiologist of radiographs or CT scans performed before transfer were considered potentially amenable to telemedicine.

### Statistical Analyses

Descriptive statistics were calculated to characterize the patient population and referring hospitals. We used $\chi^2$ statistics to compare characteristics of patients whose management was potentially amenable to telemedicine to those patients whose management did not fit our definition. A stepwise multivariable logistic regression was used to identify patient level predictors of management amenable to telemedicine. Demographics, CCCs, hospital characteristics, and Diagnosis Grouping System were included in this order, but the sample size was insufficient to draw conclusions from the model (results not shown). To avoid the exclusion of patients who may be amenable to telemedicine with subspecialty support, a sensitivity analysis was performed where patients who received an in-person subspecialty evaluation, routine imaging (radiographs or CT scans), IV fluids, or medications after transfer were included as being potentially amenable to telemedicine. Ultrasound examinations were excluded from the sensitivity analysis because the imaging and their interpretation can vary based on the technician's skill with pediatric patients.

## Results

### Characteristics of Patients Transferred Then Discharged Home

Overall, 1733 patients were transferred to our pediatric ED during the study period; 1204 (69%) were admitted and 529 (31%) were discharged home from our ED after interfacility transfer. Patients were transferred from 87 general EDs, 6 (7%) of which were out of state, with a median distance traveled of 11.1 miles (IQR, 8.8-25.7). Seventy percent (n = 61) of the referring hospitals had a pediatric inpatient unit, 63% (n = 55) had the Emergency Departments Approved for Pediatrics designation, and 13% (n = 11) had a pediatric intensive care unit. Pediatric patients were about one-fifth (median, 19%; IQR, 17%-21%) of the total patient volume in the referring general EDs during the study period (Table I).

Of the 529 patients who were the focus of our investigation, more than one-half were ≥5 years of age (n = 292 [55%]). Slightly more than one-third (38%, n = 200) were Hispanic/Latinx and almost two-thirds (n = 280 [62%]) had public health insurance. One-fifth (n = 326 [20%]) had ≥1 CCC associated with the ED visit, and 9% (n = 46) had >1 CCC associated with the ED visit. The most common Diagnosis Grouping System categories were gastrointestinal (n = 155 [29%]), neurologic (n = 105 [20%]), and musculoskeletal (n = 93 [18%]) (Table I). The median PRISA2 score before transfer was 0.0 (IQR, −2 to 9), which correlates with a 2% probability of mandatory admission. A subanalysis of patients for whom laboratory values and vital signs necessary to calculate PRISA2 scores were completely documented (n = 242 [46%]) yielded a median score of 4.5 (IQR, 0-12), which corresponds with a 6% probability of mandatory admission.

**Table I. Patient and hospital characteristics**

| Discharged patient characteristics (n = 529) | No. (%) |
|---|---|
| Age, years | |
| <2 | 106 (20) |
| 2 to <5 | 131 (25) |
| 5 to <12 | 160 (30) |
| ≥12 | 132 (25) |
| Race/ethnicity | |
| Non-Hispanic, white | 133 (25) |
| Non-Hispanic, black | 145 (27) |
| Hispanic | 200 (38) |
| Non-Hispanic, other | 51 (10) |
| Payer | |
| Public | 326 (62) |
| Private | 118 (22) |
| Self-pay | 85 (16) |
| Any CCCs | 107 (20) |
| ≥2 CCCs | 46 (9) |
| Common diagnoses | |
| Gastrointestinal | 155 (29) |
| Neurologic | 105 (20) |
| Musculoskeletal | 93 (18) |
| Respiratory | 35 (7) |
| Ear/nose/throat/dental | 45 (9) |
| Genital/reproductive | 25 (5) |
| Other | 71 (12) |
| PRISA2 severity scoring before transfer, median (IQR) | |
| All patients | 0.0 (−2 to 9) |
| Patients with complete documentation (n = 242 [46%]) | 4.5 (0 to 12) |
| Originating hospital characteristics (n = 87 hospitals) | |
| Distance to receiving pediatric ED, median (IQR) | 11.1 miles (8.8 to 25.7) |
| Presence of pediatric inpatient beds | 70% (61) |
| EDAP designation | 63% (55) |
| Presence of pediatric intensive care unit | 13% (11) |
| Proportion of ED visits made by children, median (IQR) | 19% (17 to 21) |

*EDAP*, Emergency Departments Approved for Pediatrics.

### Primary Outcome

**Transfers Potentially Amenable to Telemedicine.** Overall, 22% of the patients (n = 117) met our definition for transfers potentially amenable to clinical management via telemedicine. Of those 117 patients, slightly more than one-half received only a PEM provider assessment at the receiving pediatric ED (n = 64 [55%]). One-quarter of patients received a PEM provider assessment plus oral medications in the ED or prescriptions for medications at discharge (n = 33 [28%]). The most common oral medications administered at the

pediatric ED were acetaminophen (n = 19), ibuprofen (n = 18), and amoxicillin (n = 6), with many children having received multiple medications. A majority of patients (n = 97 [83%]) had their entire diagnostic evaluation before transfer. Few patients (n = 11 [9%]) had a PEM provider assessment plus diagnostic evaluations that were readily available in a general ED such as urinalysis, rapid strep testing, or EKG. Nine patients (8%) had both oral medications as well as diagnostic evaluations readily available in a general ED (**Table II**). One-third of patients (n = 44 [38%]) had imaging (radiograph or CT scan) that was subject to secondary interpretation by a pediatric radiologist after transfer.

**Table III** provides a comparison of patients who met our definition of being potentially amenable to telemedicine vs patients who did not. Transfers considered amenable to telemedicine were more often experienced by patients who were <2 years of age and those who had neurologic, respiratory, or urinary diagnoses (**Figure 1** and **2**; **Figure 2** available at www.jpeds.com). In contrast, transfers considered less likely to be amenable to telemedicine were experienced by patients who had gastrointestinal, musculoskeletal, or reproductive diagnoses. There were no other statistically significant differences between the two groups.

Two-thirds of the patients whose care in the receiving pediatric ED did not meet our criteria for being potentially amenable to telemedicine were evaluated by a consulting subspecialty provider in person (n = 270/412 [66%]). The most common were a pediatric orthopedic (n = 57/270 [21%]), pediatric surgery (n = 51/270 [19%]), or pediatric neurology (n = 36/270 [13%]) provider. More than one-half of the patients whose care was not considered potentially amenable to telemedicine had imaging (n = 225/412 [55%]), the most common modalities being radiographs (n = 122/225 [54%]) and ultrasound examinations (n = 80/225 [36%]). Nearly one-half of the radiographs (n = 53/122 [42%]) were for musculoskeletal diagnoses, and three-quarters of ultrasound examinations (n = 60/80 [75%]) were for gastrointestinal diagnoses. One-fifth (n = 90/412 [22%]) underwent laboratory testing. Nearly one-quarter (n = 100/412 [24%]) required procedures in our pediatric ED, including ultrasound-guided incision and drainage, gastrostomy tube replacement, wound care, foreign body removal, laceration repair, or fracture reduction. About one-third (n = 38/100 [38%]) received sedation with ketamine (n = 36) or nitrous oxide (n = 2) for procedures. The most common procedure requiring sedation was fracture reduction by a pediatric orthopedic provider (n = 31/100 [31%]). Fewer than one-fifth of patients (n = 71/412 [17%]) received IV fluids and few patients (n = 19/412 [5%]) received IV medications apart from procedures, the most common of which were ketorolac and metoclopramide (n = 5) for the treatment of migraine headache or levetiracetam (n = 3) for seizure control in patients with epilepsy. One patient received ceftriaxone and one received methylprednisolone owing to subtherapeutic dosing at the referring hospital. Most patients whose care was not amenable to telemedicine received a combination of the listed diagnostic evaluations and interventions.

**Table III. Comparison of patients whose management was potentially amenable to telemedicine vs patients whose management was not amenable to telemedicine**

| Patient characteristics | Amenable (n = 117) | Not amenable (n = 412) | *P* value |
|---|---|---|---|
| Age, years | | | .002 |
| <2 | 38 (32) | 68 (17) | |
| 2 to <5 | 28 (24) | 103 (25) | |
| 5 to <12 | 27 (23) | 133 (32) | |
| ≥12 | 24 (21) | 108 (26) | |
| Sex | | | .368 |
| Female | 51 (44) | 199 (48) | |
| Male | 66 (56) | 213 (52) | |
| Race/ethnicity | | | .939 |
| Non-Hispanic, white | 27 (23) | 106 (26) | |
| Non-Hispanic, black | 32 (28) | 113 (27) | |
| Hispanic | 46 (39) | 154 (37) | |
| Non-Hispanic, other | 12 (10) | 39 (10) | |
| Payer | | | .962 |
| Public | 73 (63) | 253 (61) | |
| Private | 25 (21) | 93 (23) | |
| Self-pay | 19 (16) | 66 (16) | |
| Any chronic care condition | 30 (26) | 77 (19) | .099 |
| Most common diagnoses | | | |
| Gastrointestinal | 24 (21) | 131 (32) | .018 |
| Neurologic | 34 (29) | 71 (17) | .005 |
| Musculoskeletal | 7 (6) | 86 (21) | <.001 |
| Respiratory | 19 (16) | 16 (4) | <.001 |
| Ear/nose/throat/dental | 13 (11) | 32 (8) | .253 |
| Urinary | 6 (5) | 4 (1) | .004 |
| Genital/reproductive | 1 (1) | 24 (6) | .025 |
| Other | 13 (11) | 48 (11) | .213 |
| PRISA2 | | | |
| Before transfer | 3 (0-10) | 0 (0-8) | .0912 |

Values are number (%) or median (IQR).

**Table II. Patients whose management was amenable to telemedicine**

| Transfers amenable to telemedicine (n = 117) | No. (%) |
|---|---|
| PEM provider assessment only | 64 (55) |
| PEM provider assessment and oral medications or discharge prescriptions | 33 (28) |
| PEM provider assessment and evaluation readily available in a general ED | 11 (9) |
| PEM provider assessment and evaluation readily available in a general ED and oral medications or discharge prescriptions | 9 (8) |

## Sensitivity Analysis

In our sensitivity analysis that considered patients with in-person subspecialty evaluations, routine imaging (radiographs, CT scans), IV fluids, or IV medications as potentially amenable to telemedicine, we found that more than one-half of patients (n = 281/529 [53%]) met the expanded criteria. Of those, nearly two-thirds (n = 172/281 [61%]) were evaluated by subspecialty providers, the majority receiving in-person evaluations (n = 120/172 [70%]). One-half of the patients (n = 62/120 [52%]) evaluated by subspecialty providers in-person did not receive any further diagnostic

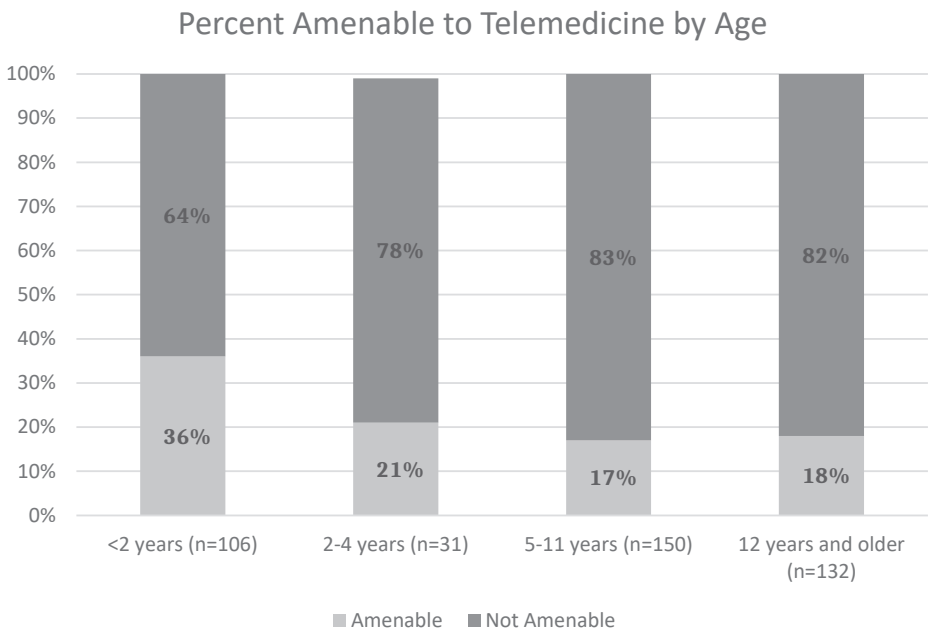


**Figure 1.** Proportion of patients potentially amenable to telemedicine by age.

evaluation. One-third (n = 103/281 [37%]) had a routine imaging study that was subject to secondary interpretation by a pediatric radiologist after transfer. The most common subspecialty providers were neurology (n = 35/281 [12%]), pediatric surgery (n = 31/281 [11%]), and neurosurgery (n = 16/281 [6%]). Nearly one-fifth (n = 52/281 [19%]) received testing readily available in the community, one-quarter (n = 68/281 [24%]) received radiographs, and few (n = 10/278 [4%]) received CT scans; 80% of patients (22/281) received IV fluids or IV medications without other interventions after transfer. Of those patients, most patients were referred by general EDs with the Emergency Departments Approved for Pediatrics designation (n = 14/22 [64%]) or had inpatient pediatric capabilities (n = 16/22 [73%]).

## Discussion

Overall, we found that nearly one-third of interfacility ED transfers were discharged directly from our pediatric ED and 117 patients in 1 year fit our definition of being potentially amenable to telemedicine. The majority of these patients received diagnostic evaluation before transfer and a PEM provider assessment was the main form of care provided after transfer. Prior studies have similarly found some transfers of children from general EDs to pediatric EDs may be avoidable, preventable, or even unnecessary. Our study expands on the existing literature by collecting detailed information about the care received before and after transfer, allowing for a rich understanding of opportunities to better support the care of children in general EDs through telemedicine. By characterizing this population of patients, we identify a starting point for telemedicine consultation services to address potential gaps in resources or pediatric-specific expertise in general EDs. The development of telemedicine programs to address this patient population should consider the perspectives of PEM providers within the context of the technology and referring hospital resources available to them for the remote assessment of patients.

Children who experienced a transfer potentially amenable to telemedicine tended to be younger and have neurologic, respiratory, or urinary diagnoses. It is possible that younger children are viewed as a low-frequency, high-stakes subpopulation of patients in general EDs, which may contribute to interfacility transfer regardless of the acuity.[25] Our results are consistent with previous studies that have described interfacility transfers that are discharged directly from the pediatric ED in that they were younger, often had gastrointestinal, neurologic, or respiratory diagnoses, and had public health insurance.[10-14,25] Insurance status and race/ethnicity were not significant predictors of being potentially amenable to telemedicine, indicating that this may be an area where care is delivered equitably. These perhaps surprising results should be examined in multicenter studies and nationally representative samples to determine if the finding is robust. Although patients with CCCs make up <3% of all ED visits nationally, they made up 20% of our study population.[22] Children with CCCs have higher rates of interfacility transfer than their peers without comorbidities because their conditions and medical complexity are sometimes viewed as an automatic indication for transfer; however, our study suggests the possibility that some children with CCCs could potentially be cared for in general EDs with the support of PEM expertise via telemedicine.[11]

In our sensitivity analysis that included patients who received an in-person subspecialty evaluation, routine

imaging (radiographs or CT scans), and IV fluids or medications, we found that more than one-half of our patients were potentially amenable to management via telemedicine. Of particular importance, one-half of the patients evaluated by a subspecialty provider in person had no further diagnostic evaluation in our ED. Given that subspecialty evaluation is a commonly cited reason for interfacility transfer, early involvement of subspecialty providers when establishing a telemedicine program would be beneficial for the program to achieve maximum impact on the pediatric ED transfer patient population.[26] Involving subspecialty providers would be helpful in creating infrastructure to improving access to subspecialty clinic follow-up appointments and identifying which patients in general EDs could be managed with urgent outpatient follow-up. Furthermore, one-third of patients included in our sensitivity analysis received radiographs, CT scans, or IV fluids or medications after transfer. Early consultation with a PEM provider via telemedicine could provide guidance in choosing optimal imaging studies and interventions that are routinely performed in general EDs. Assessment of referring centers' pediatric capabilities and partnership with their inpatient pediatric units would be helpful to support nurses in general EDs to obtain IV access, because it can be challenging in pediatric patients.

Patients who did not meet our definition of care potentially amenable to telemedicine frequently received in-person subspecialty consultation and/or imaging studies performed by technicians with pediatric specific training such as ultrasounds, consistent with published literature.[9,26] One-quarter required procedures that were performed in the ED after transfer, one-third of which required procedural sedation. In particular, patients with fractures frequently required reduction by pediatric orthopedic providers after transfer. Transfer for pediatric procedural sedation has been cited as a common reason for transfer, yet some procedures that were performed at our pediatric ED after transfer may be within the scope of a general ED with real-time telemedicine support from a PEM specialist.[26] These findings highlight an area where telemedicine could be used to provide remote pediatric subspecialty consultation. Further characterization of this patient population can be used to guide telemedicine efforts to augment knowledge and comfort needed to care for specific populations of children in general EDs.

Another future direction from the findings of this study is the exploration of PRISA2 or other scoring systems that may serve as a marker for telemedicine-amenable management in general EDs. Although we found no significant difference in PRISA2 scores between those who met our definition of potentially amenable to telemedicine and those who did not, more than one-third of patients had missing documentation of laboratory values or vital signs needed to calculate PRISA2 scores. A subanalysis that only included patients with complete values necessary to calculate PRISA2 scores also revealed a <10% probability of mandatory admission. Based on previous studies, we assumed undocumented values to be equivalent to normal. The absence of vital signs needed to calculate PRISA2 scores is concerning for incomplete evaluation of children before transfer. The absence of laboratory testing in the referring ED may be appropriate for children whose need is primarily for pediatric emergency subspecialty expertise. Comparing the PRISA2 scores of these patients to the scores of patients who were admitted after transfer would be more helpful in determining whether PRISA2 scores are an independent predictor of being amenable to telemedicine before transfer.

This study had several limitations. All data were extracted from the receiving hospital's electronic medical record, including scanned images of paperwork from the referring ED, which may have contributed to some missing data regarding the referring ED's clinical management. Providers in the receiving ED frequently documented telephone communication with the referring ED after transfer in an effort to obtain results that may not have been available at the time of transfer, and thus not included in the patient records. Missing data may have contributed to laboratory testing after transfer that led to them being classified as not amenable to telemedicine. As is the case with all studies based on retrospective chart review, our results are limited by the accuracy of the data in the chart and documentation of care delivered. Our results may not be generalizable to other areas with different referral patterns or local expertise but we anticipate our results may be generalizable to centers where the proportion of transfers discharged after ED to ED transfer is similar to our population.[9,10,25] Furthermore, we did not include data on return visits after discharge. Return visits are beyond the scope of this study, but ought to be further explored in future studies.

The exclusion of patients with psychiatric diagnoses from our study population is another limitation of the generalizability of our results. Telemedicine has shown promising results in pediatric psychiatry as a scheduled outpatient service, and further studies are needed to explore management of pediatric psychiatric emergencies as an opportunity for telemedicine to obviate the need for transfer to a children's hospital.[27-29] The small number of patients in our sample decreased the statistical power to identify clinical factors predictive of being a transfer potentially amenable to telemedicine.

We identified a population of patients that may be appropriate for evaluation and management via telemedicine to improve access to PEM expertise within a general ED. Although telemedicine is being increasingly used to provide pediatric critical care and trauma services before transfer, this study highlights an opportunity to provide PEM expertise outside of academic centers and reduce the transfer of some patients.[30-32] Next steps in the telemedicine program development should involve patient and provider engagement in general EDs to guide the expansion of services to address the needs of patients and the providers in the referring EDs. Our findings have potential implications for decreasing the costs incurred by interfacility transfer, including financial costs (eg, ambulance fee), opportunity costs (eg, reallocation of transport services for other

patients), family costs of being transported away from their community (eg, return transportation costs, barriers to return to work), and redundant care at the accepting institution (eg, repeat tests).[12,33,34] We believe that further efforts to understand the clinical care of children in general EDs as potentially amenable to telemedicine may strongly inform and influence the future design of pediatric telemedicine programs in tertiary and quaternary settings. ■

Submitted for publication Jul 1, 2020; last revision received Oct 13, 2020; accepted Oct 28, 2020.

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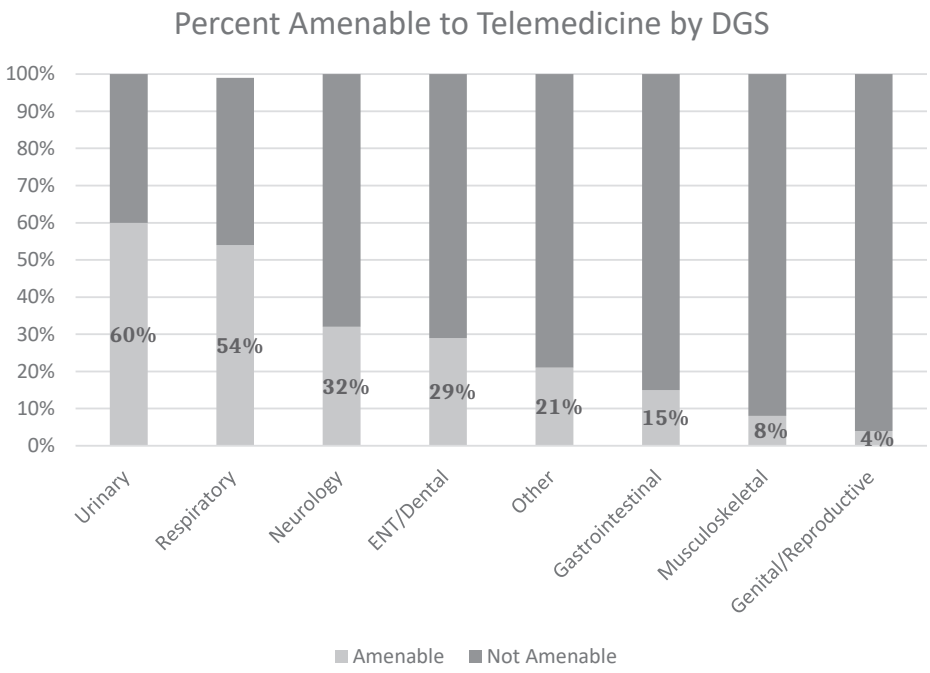


**Figure 2.** Proportion of patients potentially amenable to telemedicine by Diagnosis Grouping System (DGS).