



# Establishing a pediatric interventional radiology inpatient consult service

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## Abstract

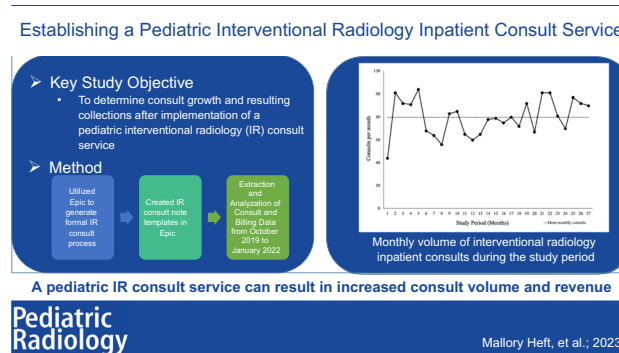
**Objective** To delineate pediatric interventional radiology (IR) inpatient consult growth and resulting collections after implementation of a pediatric IR consult service.

**Methods** An inpatient IR consult process was created at a single academic children’s hospital in October 2019. IR consult note templates were created in Epic (Epic Systems Corporation, Verona, Wisconsin) and utilized by 4 IR physicians. Automatic charge generation was linked to differing levels of evaluation and management (E&M) service relating to current procedural terminology (CPT) inpatient consult codes 99251–99255. The children’s hospital informatics division identified IR consult notes entered from the implementation of the consult service: October 2019 to January 2022. The university radiology department billing office provided IR service E&M charge, payment, and relative value units (RVU) information during this study period. A chart review was performed to determine the IR procedure conversion rate. Mann-Whitney and a two-sample t-test statistical analyses compared use of the 25-modifier, monthly consult growth and monthly payment growth. *P*-value < 0.05 was considered statistically significant.

**Results** Within this 27-month period, a total of 2153 inpatient IR consults were performed during 1757 Epic hospital encounters; monthly consult peak was reached 5 months into the study period. Consult level breakdown by CPT codes: 99251–8.7%, 99252–81.7%, and 99253–8.8%. 69.7% of IR consults had consult-specific billing with payments in 96.4% resulting in \$143,976 new revenue. From 2020 to 2021, IR consult volume trended upward by 13.4% (*P*=0.069), and consult-specific payments increased by 84.1% (*P*<0.001). IR consult procedure conversion rate was 96.5%.

**Conclusion** An inpatient pediatric IR consult service was quickly established and maintained by four physicians over a 27-month study period. Annual IR consult volume trended upward and consult-specific payments increased, resulting in previously uncaptured IR service revenue.

## Graphical abstract



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## Introduction

While diagnostic catheter angiography originated in 1953, it was not until 1994 that interventional radiology (IR) was recognized as a specialty by the American Board of Medical Specialties [1, 2]. Though IR remains a relatively new medical specialty, it has evolved to drastically influence numerous fields in medicine. It is approximated that in the USA, 1 in 10 hospitalized patients receive treatment from IR [3]. Yet even with this substantial influence, there continues to be a decline in reimbursements and competition from other specialties gaining endovascular skills, increasing the need for IR to establish an even more visible clinical presence. This goal can be achieved through evaluation and management (E&M) services [4, 5].

Though IR procedures and protocols are intuitive to IR physicians, many other medical professionals are unaware of the full capabilities of an IR practice. A study surveying 253 primary care providers reported that most rated their knowledge of IR as poor (20.3%) or adequate (56.9%) while 75.3% reported wanting to learn more about IR [6]. An essential component of creating a successful IR service line with other clinicians is the commitment to more active inpatient care via inpatient consults/rounding and outpatient clinic [7]. Creation and maintenance of service lines should increase the number of IR referrals and IR procedures performed as referring clinicians become more aware of the full scope of IR capabilities [7]. Also, the addition of IR consult note into a patient's medical record provides a documented communication to the referring service and aims to avoid miscommunications which can play a role in patient morbidity, mortality, and lawsuits [8].

There have been concerns in some radiology groups whether the revenue an IR consult service generates justifies the time it requires. Reading one cross-sectional imaging study may result in much higher relative value units (RVU) compared to one IR inpatient E&M visit [9]. An efficient radiologist can typically read several imaging studies in the time it takes to complete a new IR consult [9]. In addition, some institutions do not have appropriate billing methods to automate charge capture for IR clinical E&M services during consult note entry. White et al. demonstrated that one IR practice's E&M work largely went unbilled due to inadequate documentation of patient encounters; however, with appropriate E&M billing methods, total E&M collections increased by 831% [10]. Despite some skepticism about the clinical expansion of an IR practice, several studies have shown that IR E&M services increase IR procedural services [4, 9, 11].

In October 2019, an IR team at a large (336 beds), free-standing tertiary care academic children's hospital implemented a new IR inpatient consult service, striving for a more

clinically visible practice [12]. The primary aim of this retrospective study was to evaluate the volume of IR consults and related E&M charges, payments, and RVUs generated since the onset of this consult service. A secondary aim of the study was to delineate IR procedure volume trends during the study period. Most literature concerning a more clinically focused IR is based on data derived from adult practices; there is a lack of literature on more clinically focused pediatric IR practices. To our knowledge, only one other group has published a paper concerning the benefits of a consultation service to a pediatric IR practice [11].

## Methods

### Consult service implementation

A pediatric IR section leader worked with the electronic medical record (Epic) implementation team for 4 months to create and integrate IR consult note templates into Epic. This IR leader then informed 3 pediatric IR physician colleagues on the number of consult note elements required for Level 1 (focused, 20 min), Level 2 (expanded, 40 min), and Level 3 (detailed low, 55 min) evaluation and management (E&M) services as delineated by current procedural terminology (CPT). As these 3 E&M codes covered a majority of expected pediatric IR consult requests, the use of Level 4 (complicated moderate, 80 min) and Level 5 (complicated high, 110 min) E&M codes was less emphasized; this conservative approach addressed a concern to avoid overbilling on IR consults when implementing this new process into a busy daily IR workflow.

This new IR consult service was launched on October 1, 2019. To promote an efficient workflow, two IR physician staff were assigned to the IR consult service each weekday and shared the workload of IR procedures and new IR consults. No resident physicians or advanced practice providers (APPs) were involved in workup or drafting notes for IR consults. An IR consult request was initiated via the referring physician placing an order for an IR consult in Epic, which included the clinical indication and the IR procedure they wish performed. One of the IR physicians reviewed the medical record (clinical indication, imaging exams, laboratory data), evaluated the patient, and wrote an IR consult note. If an IR procedure was indicated, the IR physician entered the most relevant CPT procedure code as an order in Epic then an IR schedule coordinator posted the planned procedure on the IR lab procedure schedule. Per the Centers for Medicare and Medicaid Services (CMS), an IR physician furnishing a consultation is considered a treating physician and allowed to place the correct order needed for the management of the patient [13].

The IR consult note template included the following: referring physician request, chief complaint (CC), history of present illness (HPI), review of system (ROS), physical exam, labs, imaging, past surgical history (PSH), assessment, and plan. Note that Level 1 and Level 2 consults do not need data under some of these headings; for instance, past surgical history is only required for Level 3 and above consults. The IR physicians primarily focused on the elements associated with each level of consult and did not put the time spent on the consult in the IR note. The need for sedation or anesthesia was included in the consult plan. When signing the consult note in Epic, the IR physician chose the appropriate level of E&M service, which automatically generated a clinical charge.

Consults performed before IR procedure day were performed on the clinical unit; consults performed on IR procedure day were performed either on the clinical unit or in the radiology department. The IR team aimed to do the consults before IR procedure day. We did as many as possible of the requested inpatient IR consults with one exception being a repeat IR consult for the same or similar IR procedure on the same hospital admission (example: peripherally inserted central catheter (PICC) exchange requested 4 weeks after PICC placement). Note that a majority of our gastrostomy-jejunostomy (GJ) tube exchanges/replacements are done on an outpatient basis. Within the first month following the initiation of consult service, the IR physicians were instructed to include a 25 modifier to the E&M charge when an IR consult was entered on the same day as the related IR procedure; this modifier relates to a significant, separate identifiable E&M service by the same physician on the day of a procedure. An institutional review board (IRB) exemption was granted for retrospective data collection and review of this newly established pediatric IR consult service.

### Children’s hospital consult data collection

The children’s hospital clinical informatics division queried Epic to identify all inpatient consult notes entered by the 4 pediatric IR physicians between October 1, 2019, and January 1, 2022, and recorded the level of service associated with each consultation. The informatics division released a password-encrypted file with no patient identifiers to the principal investigator. The original dataset included the level of service for the consult, the provider’s name, and the date of consult service. The level of service was listed as one of the following:

- Level 1: CPT 99251, focused (20 min)
- Level 2: CPT 99252, expanded (40 min)
- Level 3: CPT 99253, detailed, low (55 min)
- Level 4: CPT 99254, complicated, moderate (80 min)
- Level 5: CPT 99255, complicated, high (110 min)

### University radiology department billing data collection

The affiliated university radiology department billing office provided a separate deidentified dataset on pediatric IR E&M CPT charges, payments, and relative value units (RVUs) corresponding to the same time range as the children’s hospital inpatient consult data. When the pediatric IR physician signed the IR consult note in Epic, an automatic charge was generated based on the level of service they selected corresponding to CPT codes 99251–99255. Payor mix in this dataset included Medicare 65.1%, commercial payors 29.5%, and Medicare 1.6%. Only during data analysis phase of this project (April–June 2022) were the IR physicians made aware that Medicare had previously stopped (January 2010) reimbursement for inpatient consult codes CPT 99251–99255. However, our local state Medicaid and some commercial insurance payors continue to recognize these inpatient consult codes. If the commercial payor did not accept E&M codes CPT 99251–99255, or for our rare Medicare patient, the radiology department billing office adjusted the inpatient consult code to E&M codes CPT 99221–99225, levels of service associated with initial hospital inpatient care, as supported in the literature [14].

Another important billing adjustment reported by the radiology department billers, related to the caveat that only one payment for an inpatient consult can be received per hospital encounter of the same patient. Therefore, the radiology department billers would adapt and submit a second IR consult during the same hospital encounter as a “subsequent hospital care” CPT code, 99231–99233.

Radiology billing options for IR consults entered in Epic:

1st IR consult in given encounter (consult-specific codes):

- Inpatient Consult: CPT 99251–99255 (or)
- Initial hospital inpatient care: CPT 99221–99225

2nd IR consult/same hospital encounter (nonspecific code):

- Subsequent hospital care: CPT 99231–99233

In the aggregate billing data, payments for these “subsequent hospital care” CPT codes were nonspecific as 2nd consult payments were blended in with the payments for post-procedure IR rounding notes which used the same subsequent hospital care codes (Table 3). The consideration to re-link the children’s hospital patient data (Epic IR consults) to the university radiology department billing data was deemed by the children’s hospital compliance manager to be outside the scope of our approved IRB protocol.

### Additional data collection

After the study period, one of the four IR physicians tabulated the actual number of minutes required for each consult

component for 23 new IR consults ( $n=20$  Level 2 consults,  $n=3$  Level 3 consults). The consult components tabulated were as follows: chart review (including imaging/lab review), physical exam, and formatting of a templated IR consult note in Epic.

A selected chart review of 1757 hospital encounters in Epic was performed to determine IR procedural conversion rate from the IR consults. The chart review also aimed to identify IR consults where IR physicians declined a requested procedure, or any canceled IR consult orders (IR procedure performed with no IR consult note). To delineate charts appropriate for review, the children's hospital clinical informatics division sorted the initial database and identified 561 Epic encounters with any discordance between IR consult order entry, IR consult order completion, IR consult note, and IR procedure note. Two subsets of charts were then reviewed by 3 of the co-authors. One chart review focused on Epic encounters with an IR consult note done without an IR post-procedure note. The other chart review focused on Epic encounters with no IR consult note, but an IR procedure was performed.

Annual overall IR procedure volume (inpatient plus outpatient) was determined from the Slicer Dicer function in Epic for 2018 (before consult service) and for the full years after the consult service (2020 and 2021). This Epic Slicer Dicer function was used to obtain annual inpatient IR procedure volume for these specific procedures comparing 2018 and 2021: cerebral angiography, tunneled central venous line (CVL), PICC, primary gastrostomy tube placement, primary cecostomy tube placement, venous interventions, renal biopsy, chest tube placement, abscess drainage, and lumbar puncture. Note that for uncommon procedures with less than 10 total cases per year, Slicer Dicer lists the annual procedure volume at 10.

## Statistical analysis

Statistical analyses included a Mann-Whitney and a two-sample  $t$ -test for comparison of median and mean payments with and without the use of the 25 modifier. Further analyses were performed on the total monthly IR consults and total monthly payments for both consult-specific codes and subsequent hospital care codes. For these measures, medians of monthly totals in 2020 and 2021 were compared using the Mann-Whitney test. Summary of IR consults based on year and CPT code is summarized via frequency and percentages. Percent change calculations were performed to summarize changes in variables between 2020 and 2021:

$$\left( \frac{\text{Value from 2021} - \text{Value from 2020}}{\text{Value from 2020}} \right) * 100\%$$

= percent change from 2020 to 2021.

All statistical analyses were performed using the software package R (R Core Team, Version 4.2.1, R Foundation for Statistical Computing, 2022).  $P$ -value  $< 0.05$  was considered statistically significant.

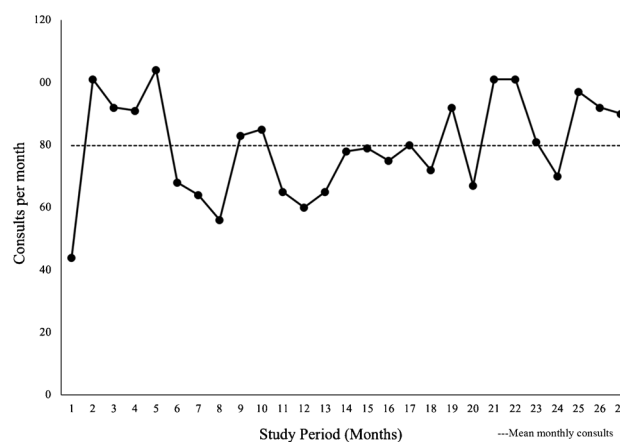
## Results

### IR consult results

Over the 27-month period, 2153 inpatient IR consults were performed relating to 1757 unique Epic hospital encounters. This pediatric IR consult service entered 44 consult notes in the initial month following project implementation, neared peak volume of consult entry in the second month, and reached monthly peak volume with 104 consults (February 2020) 5 months following project implementation (Fig. 1). The IR consult service did experience a decline in March 2020 relating to the onset of the COVID-19 pandemic yet showed regrowth near the end of 2020 and into 2021 (Fig. 1). Of the total IR consults, 81.7% (1760/2153) of consults were coded as a Level 2 charge (Table 1).

As the consult service continued to develop, Level 1 consults decreased while Level 2 and Level 3 consults increased between 2020 and 2021 (Table 1). Overall, consult volume increased by 13.4%  $\left( \left( \frac{1018-898}{898} \right) * 100\% = 13.4\% \text{percent change} \right)$  from 2020 to 2021, an upward trend that neared significance ( $P=0.069$ ) (Table 1). Only 0.7% (16/2153) of total consults in the study period were Level 4 consults, and no Level 5 were entered (Table 1).

The actual time required for the IR consult process tabulated in 23 new consults ( $n=20$  Level 2,  $n=3$  Level 3) post-study period included chart review, 5 min (range: 3–11 min); physical exam, 3 min (range: 2–6 min); and formatting of a



**Fig. 1** Monthly volume of interventional radiology inpatient consults throughout the study period

**Table 1** Volume of interventional radiology consults by the level of service

Level of Service of Inpatient Consults	IR consults per year			Total
	2019*	2020	2021	
Level 1, 99251				
Focused (20 min)	23	89	75	187
Level 2, 99252				
Expanded (40 min)	205	728	827	1760
Level 3, 99253				
Detailed, low (55 min)	9	78	103	190
Level 4, 99254				
Complicated, moderate (80 min)	–	3	13	16
Level 5, 99255				
Complicated, high (110 min)	–	–	–	–
<b>Total</b>	<b>237</b>	<b>898</b>	<b>1018</b>	<b>2153</b>

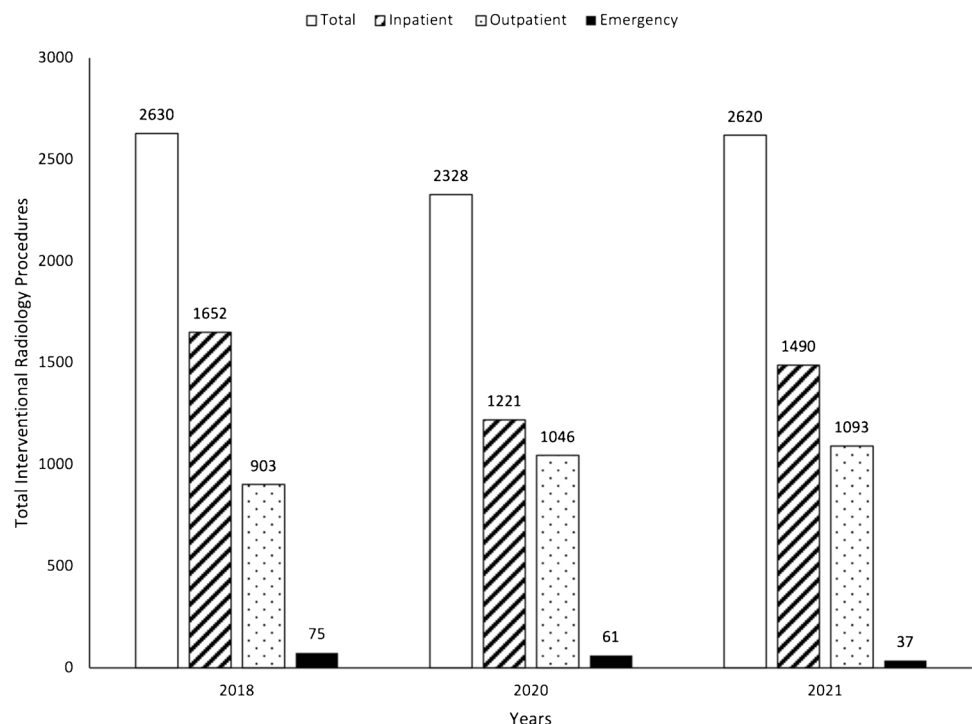
\*Partial year: October 1, 2019, to December 31, 2019

templated IR consult note, 12 min (range: 8–34 min). The median total time for these IR consults was 20 min. The total annual IR procedure volume with inpatient/outpatient breakdown for pre-consult service establishment year 2018 and post-consult service establishment years 2020 and 2019 is displayed in Fig. 2. Annual IR procedure growth increased by 22% (269/1221) from 2020 to 2021 (Fig. 2).

The procedural conversion rate from consults was calculated from the 1757 unique Epic encounters that related to the 2153 inpatient IR consult notes. Specifically, 561 encounters of the 1757 Epic encounters showed any discrepancy between IR consult order entry, IR consult order completion, IR consult note, and IR post-procedure note. Selected chart review of 215 of these discordant encounters with an IR consult note without a documented IR post-procedure note; 76 of these 215 encounters had no IR procedure performed. Reasons for no procedure included IR decline of procedure ( $n=40$ ), the primary team changed clinical plan ( $n=26$ ), IR delay to potential future procedure ( $n=8$ ), or IR recommended other service treatment ( $n=2$ ). Examples of a declined IR procedure include fluid collections too small to drain, infants with spinal canal hematoma limiting additional lumbar puncture (LP) attempts, bilateral segmental pulmonary embolus with no right heart strain, significant bilateral venous stenosis preventing upper extremity PICC placement, small pneumothorax not warranting a chest tube, lack of safe window for deep fluid collection drainage, or patients with resolving clinical symptoms. Given only 76 IR consults in the study period without an IR procedure, the procedural conversion rate from entered IR consults was 96.5% (2077/2153).

From the selected chart review mentioned above we identified only 2.5% (44/1757) encounters with no IR consult note, but an IR procedure was performed. 59.1% (26/44) of these

**Fig. 2** Annualized interventional radiology procedural volume pre-consult service (2018) and post-consult service (2020–2021) separated by source of referral



canceled IR consult orders were low complexity IR consult requests including ultrasound-guided peripheral intravenous (PIV) placement, GJ tube maintenance, nasojejun tube placement, contrast injection of existing bowel tube, and infusaport catheter contrast check. The remaining 40.9% (18/44) with a canceled IR consult order included commonly performed IR procedures such as tunneled CVL placement or routine biopsy.

**Billing data results**

Table 2 represents information provided by the university radiology department billing office concerning charges, RVUs, and payments. Radiology department billing data was available in 2757 patients which included both billing specific to IR consult CPT codes and billing of subsequent hospital care CPT codes (includes both 2nd IR consult/same encounter and post-procedure IR rounding notes). Specifically, 54.4% (1500/2757) was billing data specific to IR consults entered at the children’s hospital (CPT codes: 99251–99255 or adjusted CPT codes: 99221–99225). The remaining 45.6% (1257/2757) of the radiology department billing data included subsequent hospital care CPT codes 99231–99233 for both post-procedure IR rounding notes and any adjusted CPT codes for second IR consult/same hospital stay.

Payments were received on 96.4% (1446/1500) of billed IR consult-specific codes (CPT 99251–99255 and CPT 99221–99225) (Table 3). Payments were received on 87.8% (1042/1187) of subsequent hospital care CPT codes CPT 99231–99233. From 2020 to 2021, code entry 99252 increased by 13.6% (99/728) and code entry 99253 increased by 32.1% (25/78). Each radiology department billing adjusted code increased from 2020 to 2021: 99221 by 43.3% (13/30), 99222 by 60.6% (175/289), and 99223 by 43.2% (16/37). 69.7% (1500/2153) of the IR consults in the study period had consult-specific payment data associated with previously uncaptured total revenue of \$143,976. Annualized payments from these IR consult-specific codes (CPT

99251–99255 and CPT 99221–99225) increased by 84.1% (\$39,307.48/\$46,721.87) from 2020 to 2021, an increase that reached significance ( $P<0.001$ ) (Table 3). Payment information of the remaining 30.3% (653/2153) of IR consults could not be extracted from payments for IR post-procedure rounding notes as any billing adjustment for a 2nd IR consult/same hospital encounter used the same subsequent hospital care CPT codes 99231–99233 as post-procedure IR rounding. Note that annualized payments from subsequent hospital care codes decreased by 49.8% (\$16,005/\$32,160) from 2020 to 2021 ( $P=0.007$ ).

Table 3 also shows the annualized volume of subsequent hospital care E&M codes CPT 99231–99233 during the 27-month study period. This additional \$55,334 in payments relates to both subsequent IR consults within the same hospital stay and IR post-procedure rounding notes. Consideration to separate this additional IR consult revenue from the post-procedure IR rounding note revenue by re-linking children’s hospital data to the university radiology department billing data was deemed by our children’s hospital

**Table 3** Annualized payments from interventional radiology consults and subsequent hospital care

Year	Total payments (\$USD)	Volume of billed codes receiving payment	Percent of billed codes receiving payment
Annualized payments: inpatient consult-specific CPT codes			
2019	11,225.32	130	96.3%
2020	46,721.87	466	95.3%
2021	86,029.35	823	94.0%
Total	143,976.54	1419	94.6%
Annualized payments: subsequent hospital care CPT codes*			
2019	7018.78	146	91.8%
2020	32,160.18	546	86.4%
2021	16,155.28	350	88.4%
Total	55,334.24	1042	87.8%

\*2nd IR consult/same hospital stay plus post-procedure IR rounding notes

**Table 2** Billing data associated with interventional radiology inpatient consults

CPT code used for billing*	Charge (\$USD)	Payment (\$USD)	RVU	Volume of consults billed for with CPT code
99251	\$208	\$53.00	1.00	80
99252	\$208	\$72.60	1.50	842
99253	\$208	\$98.56	2.27	93
99221	\$208	\$128.67	1.92	80
99222	\$264	\$158.73	2.61	374
99223	\$388	\$208.58	3.86	23

\*99251–99253: codes entered in Epic at children’s hospital; 99221–99223: radiology department billing office adjusted codes

CPT, current procedural terminology; RVU, relative value units

compliance manager to be outside the scope of our approved IRB protocol.

The mean consult payment with the 25 modifier (\$94.70) and without the 25 modifier (\$99.90) did not significantly differ ( $P=0.071$ ). The median consult payment in the 1500 patients with and without the 25 modifier was identical at \$72.60. Payor mix from the billing data in this study included Medicaid 65.1% (1796/2757), commercial payors 29.5% (810/2757), and Medicare 1.6% (45/2757). Other payors (self-pay, workers' compensation, and agency) represented 3.8% (106/2757) of the payor mix.

## IR procedure results

Overall IR procedure volume of 2630 in 2018 did not differ from the 2620 performed in 2021 (Fig. 2) in part related to a drop in diagnostic cerebral angiography of 33.6% during the study period (125 in 2018 compared to 83 in 2021). After the annual IR inpatient procedure volume dropped 26.1% (431/1652) from 2018 to 2020 relating to the COVID-19 pandemic, this inpatient IR procedure volume rebounded with a 22% increase (269/1221) in 2021 (Fig. 2). Specific inpatient IR procedures that increased from 2018 to 2021 include tunneled CVL (1780% increase; 20 to 376), renal biopsy (92.9% increase; 14 to 27), abscess drainage (68.9% increase; 45 to 76), primary gastrostomy tube placement (30% increase; 10 to 13), and chest tube placement (8.2% increase; 49 to 53). In addition to the drop in cerebral angiography, inpatient IR procedures that decreased from 2018 to 2021 include PICC (70.0% decrease; 814 to 244) and LP (14.5% decrease; 172 to 147).

## Discussion

In October 2019, the IR team at a large, free-standing tertiary care children's hospital launched an inpatient consultation service with the goal of providing a more clinically focused service. This study showed that since project implementation, this service was maintained by the 4 IR physicians with annualized IR consult volume trending upward and associated payment growth resulting in previously uncaptured IR service revenue. The pediatric IR service aimed to improve communication with other hospital care teams through consistently documented IR consult notes. This process increased the ownership of the IR service to the IR physicians as an indicated IR procedure order was now directly entered by a consulted IR physician. The primary value of this service to the patient and referring physicians is having a consistently documented IR consult note in the medical record with specialized IR input to help with the continuity of patient care. Any provider caring for the patient can see this note at any time in the future.

This study focused on consult volume and the related financial impact establishment of a pediatric IR consult service. Though we did not explicitly measure other improvements derived from the newly established service, benefits were realized by the 4 IR physicians. In situations where the consult was performed on the clinical unit, an IR workflow improvement was realized when procedure consent was obtained at the patient's bedside before the procedure. Likewise, the IR procedure ordering became more consistent as the IR physicians as a group agreed on overall indications for different types of venous access devices (e.g., tunneled femoral or internal jugular vein tunneled CVL versus arm PICC). Also, the IR physicians no longer had to rely on the IR flow coordinator that day (lead IR technologist or IR nurse) to guess what IR procedure they wanted to do. Currently, an IR physician new to the team after the study period is learning the basics of correct IR procedure coding by participating in this IR consult process.

In the past two decades, the Society of Interventional Radiology and the American College of Radiology have encouraged an expansion of clinical practice for IR and DR [4, 5, 9, 15]. This call to action is founded on the idea that radiology groups offering diagnostic and consult services are more valuable to patients and other providers [15]. Literature suggests many IR physicians have been moved to this call to action. Duszak et al. analyzed 15 years of data from the Annual Medicare Physician Supplier Procedure Summary (PSPS) [16]. This study found that from 1993 to 2008, IR claims for E&M services increased by 1200%, with payment denial rates decreasing from 22 to 11% [16].

Though much literature discusses the value of a clinical IR practice, there is a lack of information concerning pediatric IR practices. To our knowledge, only one study has been published to analyze the impact of a more clinically expanded Pediatric IR service. This study examined pediatric inpatient and outpatient IR consults within a large children's hospital following the expansion of E&M services via an outpatient clinic and consult service. Following the implementation of these services, estimated E&M service revenue increased by 158%, and estimated procedural revenue from outpatient visits increased by 228% [11]. On average, this IR service saw 5.5 new outpatient visits per month and 8.3 new inpatient consults per month, with 7.3 subsequent hospital encounters [11].

Misono et al. published a study to provide a financial model for the potential revenue that an adult IR consult service could generate. The model assumes a consult service receives 2 new consults per day while continuing care for 35 patients [17]. Similarly, the model estimated most new consults, 74%, would be Level 2 consults [17]. This model estimates total annual charges of \$2,264,672 with a collected revenue of \$389,612 [17]. While this model differs significantly from the \$143,976 generated over 27 months in this

pediatric study group, the model study attributed 95% of their estimated annual collected revenue to care for existing patients [17]. However, in their pediatric IR consult service, Edalat saw more new patient consults per month (8.3 per month) compared to existing patients (7.3 per month) [11]. Similarly in this study, more new patient consult notes were documented compared to IR rounding notes of existing patients with rounding notes receiving fewer annualized payments per year (Table 3). These mismatches from the Misono model found in this study and Edalat emphasize the importance of separately evaluating pediatric IR practices.

It is important to note that the pediatric IR consult service in this study is being run solely by the 4 IR physicians. The 4 IR physicians aimed to perform a consult on as many as possible requested IR consults. On the selected chart review, we identified only 2.5% (44/1757) of Epic encounters with no IR consult note, but an IR procedure. The IR physician may have opted out of the IR consult note entry during a busy workday, but as evidenced by the data this did not happen often. A median IR consult time of 20 min was tabulated in 23 new IR consults after the study period; note that a portion of this time, up to 8 min (chart review plus physical exam), would have been spent in undocumented time before implementation of the IR consult service. This means implementation of this service added a median of 12 additional min per IR consult. While 12 min can add up to a significant amount of time within a busy week, the value of documented specialized IR input in the medical record and additional revenue brought in by the consult itself justifies the time spent. The authors realize physician burnout can result with added work effort; however, burnout for radiologists often comes from the pressure to meet RVU requirements, social isolation, and the moral injury of feeling like a technician rather than a fellow physician colleague [18]. This latter burnout factor can partially be relieved by doing clinical assessments and providing the patient with specialized IR care [18].

The Misono model for an IR consult service assumed advanced practice providers (APPs) such as nurse practitioners and physician assistants provided a valuable resource to the IR team, with 4,400 patients evaluated annually per APP representing an estimated collected revenue of \$194,806 per APP [16]. In addition to APPs performing select invasive IR procedures, APPs can bill for inpatient and outpatient E&M services for new and existing IR patients [19]. One caveat is that APP services bill for 85% of that of an attending physician; however, this additional support increases the total volume of patients who can be evaluated by an IR team [19]. More specifically in this study, the 4 IR physicians realized improvement in the workflow when the IR consult was performed at the patient's bedside a day before the procedure. Due to the demands of a busy IR service, 75.8% (1137/1500) of the completed IR consults in this study were

performed on the same day as the IR procedure. The authors are convinced APPs would be extremely beneficial to help improve this workflow. However, regardless of the day an IR consult is performed, much of the work (review of procedure indication, HPI, imaging/lab review, IR procedure order) had already been completed by an IR staff in the IR procedure suite area.

Only 0.7% (16/2153) of total consults in the study period were Level 4 consults and no Level 5 consults were entered. The highest-level E&M codes were rare in this study group which mainly relates to the less complicated nature of most consults requested of this pediatric IR service. In addition, a conservative coding approach was favored by this team to avoid potential IR consult overbilling in a busy IR workflow. Within a month of project implementation, the 25 modifier was added to the CPT code when the consult was entered on the same day as the IR procedure day given concern that consults entered on procedure day would be denied payment. However, no significant difference was found comparing payments with and without the 25 modifier in the 1500 patients with the radiology department billing data. While no difference was found in that comparison, the use of the 25 modifier is still recommended by our university compliance manager, to distinguish a separately identifiable E&M service (IR consult) from an IR procedure performed on the same day; without the 25 modifier, the IR procedure charge could get denied.

This study calculated a procedural conversion rate of 96.5% (2077/2153). This is comparable to other studies, such as Edalat et al., who found new inpatient IR consults resulted in a procedural conversion rate of 88% at their institution [11]. Similarly, Soares et al. found that greater than 85% of clinic visits led to IR procedures [9]. Other studies found when IR physicians performed more E&M services compared to total procedures; this was associated with a higher payment per procedure [4]. Of note, IR physicians frequently communicated via phone with the ordering physician to clarify the need for a certain IR procedure or communicate any modification in procedure type or expected procedure delay.

Overall IR procedure volume did not change in the study period when comparing the pre-consult service establishment year 2018 to post-consult service establishment years 2020 and 2021. The lack of overall procedure growth was in part related to the loss of the diagnostic cerebral angiography service line which was being shifted from pediatric IR to adult interventional neuroradiology team during the study period. In addition, during the study period, more options for PICC placement outside of the IR team became available and increased use of extended dwelling peripheral IVs by the vascular access team occurred. The IR consult service did play a role as annual IR inpatient procedure volume grew 22% (269/1221) in 2021 after a dropping 26.1% (431/1652)



from 2018 to 2020 relating to the COVID-19 pandemic (Fig. 2). The IR procedure that changed the most in annual volume from 2018 to 2021 was a 1780% increase in tunneled CVL placement as the IR team shifted away from arm PICC placement in infants/small children. Note that from 2018 to 2021, the drop in inpatient PICC placement ( $n=570$ ) was much greater than the increase in inpatient tunneled CVL placement ( $n=350$ ); other inpatient IR procedures increased during these 3 years to help stabilize overall IR procedure volume including renal biopsy, abscess drainage, primary gastrostomy tube placement, and chest tube placement.

This study did not specifically measure when ordered procedures by the referring physicians was converted to a more appropriate procedure per IR physicians. However, the 4 IR physicians frequently had to make an IR procedure order conversion when the primary team ordered a PICC in patients under 10 kg. Several months before implementing the IR consult service, the 4 IR physicians were evolving as a group and began recommending tunneled CVL placement (femoral or jugular) over a requested PICC placement to preserve arm vein access in infants and small patients under 10 kg. Early in the IR consult service, we often communicated this preference to requesting providers in a phone conversation or sometimes included the rationale in the assessment/plan of the IR consult note to clarify the change for the requesting service.

It should be noted that an 84% increase in consult-specific code payments occurred from 2020 to 2021 while IR consults grew only 13.4%. We think this lack of correlation is attributed to an increase in consult code level and increase use of billing code-adjusted CPT codes. From 2020 to 2021, code entry 99252 increased by 13.6%, and code entry 99253 increased by 32.1%. Each radiology department billing adjusted code increased from 2020 to 2021: 99221 by 43.3%, 99222 by 60.6%, and 99223 by 43.2%. According to data provided by the radiology department, CPT codes 99221–99223 resulted in increased payment compared to CPT 99251–99253 (Table 2). As the consult-specific code payments increased, the annualized subsequent hospital care code payments decreased by 49.8% from 2020 to 2021. We think these changes could reflect the maturity of the consult service over time as IR physicians entered more data elements in their IR consult notes and the university radiology department billers got more proficient at their job. However, we do not have data to support this. In addition, other centers may realize a different financial impact than in this study if the respective state Medicaid does not accept inpatient consult codes or if there is a higher percentage of commercial payors or Medicare in their payor mix (resulting in more initial inpatient hospital care codes).

As we strive to improve clinical presence, we are aware of recent cutbacks on reimbursement by CMS. Specifically, there has been a cut in the Medicare conversion factor from

\$34.61 to \$33.06 (decrease by \$1.55 or 4.5%) [20]. This converts to a drop in Medicare payment cut by 2% in total [20]. Diagnostic and interventional radiology are specifically seeing a 3% and 4% drop respectively [20]. The Supporting Medicare Providers Act of 2022 has been introduced to extend a payment increase under Medicare's physician fee schedule through the end of 2023 (currently set to expire at the end of 2022) [21]. The IR team needs to stay informed of such annual changes in reimbursement and E&M CPT coding changes. For instance, the CPT code 99251 representing a Level 1 inpatient consult used in this study period was deleted by CMS beginning in January 2023 [22]. Therefore, CPT 99251 has been removed from the IR consult note charge capture in Epic at our hospital. Also, as of January 1, 2023, the American Medical Association notes billing requirements have shifted placing more emphasis on medical decision-making, problem-focused data elements, or total consult time [22].

The findings in this report highlight the importance of IR physicians obtaining recurring feedback regarding financial billing and collection data relating to their clinical services. Awareness of changes in E&M service reimbursement, including potential greater emphasis on medical decision-making and time spent in an IR consult, will also be important for pediatric IR service providers in the future.

A limitation of our study is that we could not separate IR consult payment on 2nd IR consults during the same hospital admission from IR post-procedure rounding notes as they use the same E&M CPT codes for subsequent hospital care. In addition, we could not determine the frequency of IR order conversion as the IR consult order with procedure request was no longer available on retrospective Epic chart review. Also, during the selected chart review, we were unable to delineate the nature of a canceled IR consult order where no IR documented note was available in Epic; some entered IR consult orders represented an incorrect order subsequently canceled by referring physicians. Lastly, we did not have access to revenue information relating to those procedures that grew in volume during the study period as that information was beyond the original scope of this study.

Given the small size of our provider group (4 physicians), we never administered an official survey about the transition to an official IR consult service. Discussion and open feedback were welcomed and encouraged in the recurring IR team meetings; overall satisfaction was good among providers. The consensus has been that the modest increase in consult entry time is well justified by the clarity and posterity provided by this consult documentation in the medical record. We feel the familiarity of the pediatric IR division among other hospital services has improved. It is worth noting that all 4 IR physicians who performed these consults are co-authors in this publication and thus strongly believe in the benefit of the IR consult service.

## Conclusion

An inpatient pediatric IR consult service was quickly established and maintained by four physicians over a 27-month study period. Annual IR consult volume trended upward, and associated consult-specific payments increased, resulting in previously uncaptured IR service revenue.

## Declarations

**Conflicts of interest** None

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