



Resident dictation of operative notes: a reimbursement comparison and mixed-methods analysis

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Abstract

Purpose Surgical documentation is crucial to ensure quality patient care and accurate coding and billing. Operative dictation also serves as a valuable educational opportunity for surgical trainees. However, resident dictations may not fully capture procedural details and complexities, resulting in missed revenue opportunities. On July 1, 2021, our university-based surgery department implemented a policy requiring attendings to dictate all operative reports. The purpose of this mixed-method study was to investigate the financial impact of this policy and explore differences in resident and attending dictations.

Methods Core general surgery operations performed by the Department of Surgery between July 1, 2020 and June 30, 2022 were identified from billing data. The surgeon, current procedural terminology (CPT) and modifier codes, and relative value units (RVUs) for each case were acquired. Surgeons not present for the entire study period or cases requiring multiple surgeons were excluded. Descriptive statistics and Kolmogorov–Smirnov (KS) non-parametric tests compared pre- and post-policy RVU distributions on overall charges and 18 key general surgery operations. Targeted thematic analysis was performed on operative reports pre- and post-policy to explore resident and attending differences.

Results A total of 42 attendings performed 16,233 cases, billing 28,560 CPT codes (50.3% pre- vs. 49.7% post-policy). There was a small but statistically significant increase in RVU distribution post-policy, mean 20.2 pre- vs. 20.3 RVUs post-, \$4372 pre- vs. \$4418 per case post-, KS=0.02 ($p=0.009$). Specifically, higher RVU distributions were seen among attending-dictated cases for melanoma ($p=0.009$), minimally invasive ventral hernia repair (VHR, $p=0.008$), parathyroidectomy ($p<0.001$), anorectal incision and drainage ($p=0.003$) and anorectal exam under anesthesia ($p=0.029$). Higher RVU distributions were noted among resident-dictated, attending-edited cases for partial colectomy ($p=0.043$), and open VHR ($p=0.004$). No differences were noted among the remaining operations ($p>0.05$). Three major themes were noted from focused sampling of 112 operative reports: billable items, clinical/surgical reasoning, and technical details. Differences in billable items and clinical and surgical reasoning were the most influential on modifying clinical implications of operative notes. Themes and differences were consistent regardless of surgeon or specialty.

Conclusion Adopting an attending-only operative dictation policy yielded a small increase in billable RVUs, predominantly from select operations. Gaps in coding-directed language and depth of clinical reasoning were noted in resident dictations. These findings reveal an educational opportunity that concomitantly optimizes patient care, resident education, and procedural revenue.

Keywords Surgical education · Resident education · Operative documentation · Billing

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Introduction

Succinct and thorough operative reports are key to communicating intraoperative events and providing crucial information for future operative planning [1]. Accurate and comprehensive dictation is similarly necessary for medico-legal purposes and to ensure accurate coding and billing for appropriate reimbursement [2, 3]. Furthermore, operative documentation serves as an important cognitive task tool for

residents, helping them understand and integrate the reasons for, and performance of, surgical procedures [4].

The three aspects of operative reports: patient care, billing, and learning, are sometimes in conflict with each other. While residents may learn from practicing dictation, prior studies have criticized the accuracy and completeness of resident-dictated operative notes, noting that key information was missing in up to 76% of cases [2, 5]. Operative notes are utilized to generate codes for billing purposes [6]. Without directed education, residents may not understand how a hospital coding team analyzes reports to generate codes for billing. As a result, deficiency in resident dictations has been estimated to reduce reimbursement by nearly 10% [2].

The Joint Commission and Centers for Medicare and Medicaid Services (CMS) require certain data in operative documentation, but there is no universally recognized operative note format that includes all required components [7]. While the Accreditation Council for Graduate Medical Education (ACGME) and ABS have set professional competency and operative experience requirements for graduation from residency and board certification in general surgery, there exist no specific requirements related to operative dictation [8, 9]. As such, even though most residents and program directors favor structured teaching on operative dictation, less than 25% of surgical residencies provide formal education on dictation skills [1, 5]. Feedback is rare and most residents rely on old operative dictations from fellow residents and attendings as resources to learn the skill [1, 10–12].

Clearly, there is a gap that needs to be addressed in trainee education, as operative reporting is an essential skill of the practicing surgeon.

On July 1, 2021, our university-based surgery department implemented a policy requiring attending surgeons to dictate all operative reports, due to concerns about note accuracy, as well as missed revenue opportunities. The policy change afforded a unique opportunity to directly examine differences in operative dictation among surgical trainees and faculty. The purpose of this study was to (1) assess the financial impact of resident operative dictation without structured education and (2) to identify educational opportunities for future intervention.

Methods

Core general surgery procedures performed at our university-affiliated medical center by the Department of Surgery between July 1, 2020 and June 30, 2022 were identified from billing data. Core procedures were selected based on the ACGME-defined category minimums for operative experience and are listed in Table 1. Operations with current procedural terminology (CPT) codes for core procedures, unique patient identification numbers, encounter numbers, and dates were included. Operations were defined as all procedures performed on the same day, by the same attending surgeon, on the same patient. Operations from the following divisions were included: emergency general surgery/trauma,

Table 1 Differences in RVU distributions among 18 general surgery operations pre-and post-policy

Operation	KS statistic	<i>p</i> -value	Favoring
All cases	0.026	0.009	Post-policy
Anorectal exam under anesthesia	0.134	0.029	Post-policy
Anorectal fissurectomy	0.260	0.028	Post-Policy
Anorectal abscess—incision/drainage	0.164	0.003	Post-policy
Arteriovenous fistula	0.154	0.998	Post-policy
Carotid endarterectomy	0.029	1.000	Post-policy
Cholecystectomy—minimally invasive	0.016	1.000	Pre-policy
Exploratory laparotomy	0.009	0.969	Pre-policy
Hemorrhoidectomy	0.114	0.506	Post-policy
Inguinal hernia repair—minimally invasive	0.042	0.867	Pre-policy
Inguinal hernia repair—open	0.038	1.000	Pre-policy
Mastectomy	0.041	0.414	Post-policy
Melanoma excision	0.137	0.009	Post-policy
Ostomy reversal	0.138	0.305	Post-policy
Parathyroidectomy	0.353	0.000	Post-policy
Partial colectomy	0.133	0.043	Pre-policy
Thyroidectomy	0.066	0.926	Post-policy
Ventral hernia repair—minimally invasive	0.154	0.008	Post-policy
Ventral hernia repair—open	0.1211	0.004	Pre-policy

Statistically significant ($p < 0.05$) findings in bold

elective/gastrointestinal surgery, colorectal surgery, surgical oncology, and vascular surgery. The thoracic and cardiac surgery divisions were excluded given the lack of resident-dictated operative notes. Fellow-dictated notes and operative notes from surgeons who were not present for the whole study period were excluded. Additionally, operations with coded modifiers 62, 80, or 82 (indicating the necessity of more than one attending surgeon and shared billing) were excluded.

Surgeon name, CPT code, modifier codes, and relative value units (RVUs) were recorded for each case. The primary outcome was the difference in RVU distributions between fiscal year (FY) 2021 and 2022. Specific operations were then analyzed to determine differences in RVU distributions between fiscal years. This study was deemed exempt from full review by our institutional review board (2023E0045).

During and prior to the study period, residents had not received structured education on operative note dictation. Operative coding for billing was performed by trained salaried operative coders, which was consistent between the pre- and post-policy periods. Institutional policy required submission of all operative notes within 24 h of the operation, including cosigning by the attending if the note is initially authored by a resident. This was consistent between the pre- and post-policy periods studied.

Quantitative analysis

The 18 core general surgery operations were summarized using descriptive statistics. The Kolmogorov–Smirnov (KS) non-parametric test was performed to examine differences between pre- and post-policy RVU distributions. The KS test was chosen given its sensitivity and applicability to non-normal distributions; the KS statistic summarizes the difference between the pre- and post-policy cumulative distributions. The threshold for statistical significance was set at $p < 0.05$. Statistical analysis was performed utilizing the SciPy Python package [13] and reviewed by a statistics expert (DW).

Qualitative document analysis

Operative reports were analyzed utilizing an explanatory sequential design. Based on the operation-specific billing comparisons, six operations were chosen to represent general surgery cases: two favored pre-policy documentation (partial colectomy, open ventral hernia repair), two favored post-policy documentation (minimally invasive ventral hernia repair, melanoma excision), and two had no statistically significant billing differences (laparoscopic cholecystectomy, mastectomy). We selected resident-dictated operative reports from these operations in FY2021, extracted the resident dictations and attending revisions

from the electronic medical record, and paired them with attending-dictated operative reports from FY2022. Reports were selected through convenience sampling and were matched on core CPT code (defined as the primary procedure performed in the operation), attending surgeon, and elective or non-elective status. The operation type, date of surgery, core CPT code, additional CPT codes, modifier codes, resident training level, and attending surgeon were recorded. Targeted thematic content analysis was performed on operative reports to compare resident dictation, attending revisions of resident dictation, and attending dictation.

Two coders (TW, JC) performed content analysis using a deductive and inductive approach [14–17]. Codes were additionally reviewed by a qualitative methodology expert (EH) and refined with ongoing analysis. Based on our quantitative results, we theorized that there would be identifiable billable differences; additional codes and themes were generated as coding progressed. Initial codes fell into “billable differences” and “clinical differences”. With further analysis, additional key concepts were identified, refined into codes, and sorted into the parent- and child-codes described in this study. Inter-coder reliability was reassessed after every 20 documents reviewed, with re-coding of prior documents after codebook modification and agreement over code application. Theoretical saturation was achieved when document review yielded no further modifications to theories or codes [18].

Frequency of codes (billable notations, surgical or clinical reasoning, and technical details) were compared between resident dictation, attending revisions of resident dictation, and attending dictation using resident dictations as the reference group. Document analysis and codebook generation were performed in Microsoft Office 365 (Microsoft, Redmond, WA).

Results

Quantitative analysis

A total of 16,233 operations with 28,560 billed CPT codes were included in the study. One-half (50%, $n = 8173$) were resident-dictated notes with attending revisions from FY2021. The remaining half (50%, $n = 8060$) were attending-dictated operative notes from FY2022 (Fig. 1). Service intensity and procedural time, represented by modifier 22 code applications, were similar between the two fiscal years (FY2021 3.53% versus FY2022 3.74%, $p = 0.304$).

RVU distributions of all operations between the two fiscal years demonstrated a KS = 0.026 ($p = 0.009$) difference favoring attending-only dictations (Fig. 2). This translated into an overall difference of 1016 RVUs or \$32,928 using

Operations by Fiscal Year

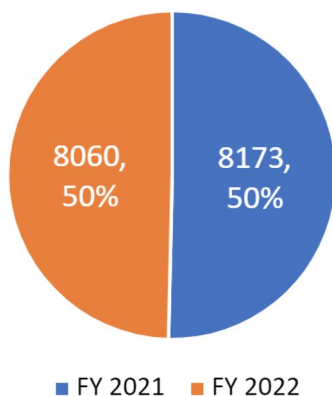


Fig. 1 Included operations by fiscal year: number and percentage of total

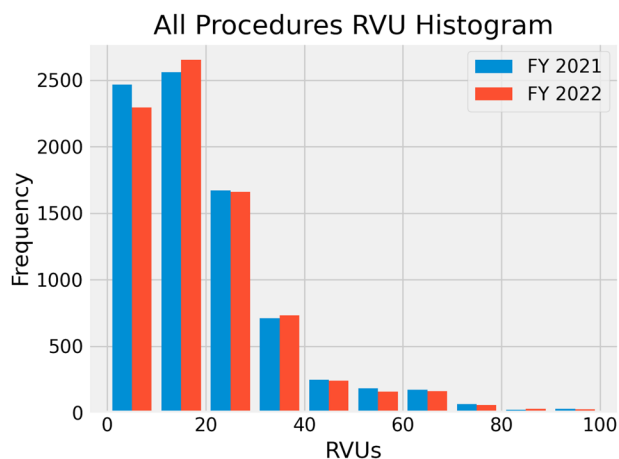


Fig. 2 RVU distribution by fiscal year displayed as number of cases per RVU. FY2021 in blue and FY2022 in red

2021 Medicare reimbursement rates of \$32.41 per RVU [19].

The KS test was then applied to 18 operations across multiple specialties that a general surgery resident would

be expected to be able to perform for board certification [8, 20]. Among these procedures, partial colectomy ($p=0.043$) and open ventral hernia repair ($p=0.004$) had higher RVU distributions pre-policy (Table 1). Melanoma excision ($p=0.009$), minimally invasive ventral hernia repair ($p=0.008$), parathyroidectomy ($p=0.000$), anorectal abscess incision and drainage ($p=0.003$), and anorectal exam under anesthesia ($p=0.029$) had higher RVU distributions post-policy (Table 1). No RVU distribution differences were seen in the remaining operations between fiscal years ($p>0.05$) (Table 1).

Qualitative document analysis

Operative notes for the following six representative operative procedures were selected for in-depth document analysis: partial colectomy, open ventral hernia repair, minimally invasive ventral hernia repair, melanoma excision, laparoscopic cholecystectomy, and mastectomy (Table 2). Most analyzed resident-dictated notes were initially dictated by post-graduate year 4 or 5 residents (range: 70–90%), except for melanoma excision (33%).

Three major themes were identified in the operative dictations: billable items, clinical or surgical reasoning, and technical details. Billable items could be described in the procedure list or body of the report, clinical or surgical reasoning could apply to preoperative planning or intraoperative judgment, and technical details described specific aspects of surgical action or anatomy encountered at the time of the operation. The final codebook is summarized in Table 3.

Both residents and attending surgeons included material in operative reports encompassing each theme. Sample quotations of each code, organized by author type, are portrayed in Table 4. Compared with resident-dictated operative notes, 43.7% of attending revisions and attending-dictated notes contained more billable notations, 27.7% contained clinical or surgical reasoning components, and 25.9% contained technical details. Thematically, billable items and clinical or surgical reasoning differences were considered

Table 2 Characteristics of operative notes analyzed by operation

Operation	Total operative notes analyzed	Total attending surgeons analyzed	Training level of residents analyzed	
			PGY* 1–3	PGY* 4–5
Partial colectomy	20	8	10% ($n=1$)	90% ($n=9$)
Ventral hernia repair—open	20	6	20% ($n=2$)	80% ($n=8$)
Ventral hernia repair—minimally invasive	20	4	30% ($n=3$)	70% ($n=7$)
Melanoma excision	12	2	66% ($n=4$)	33% ($n=2$)
Laparoscopic cholecystectomy	20	9	20% ($n=2$)	80% ($n=8$)
Mastectomy	20	2	30% ($n=3$)	70% ($n=7$)

*PGY post-graduate year

Table 3 Major themes and codes in operative dictations

Theme	Codes	Explanation
Billable items	Procedures	Billable item, either CPT code or procedure, included in procedure list
	Described in text	Billable procedure described in the body of the operative report
Clinical or surgical reasoning	Pre-operative reasoning	Description of the indication for surgical intervention
	Intra-operative reasoning	Explanation of intraoperative decisions
	Complexity explanation	Notation of above-average complexity or difficulty
Technical details	Action descriptors	Specific elaboration on techniques, such as “bluntly” or “with electrocautery” or “suture-ligated”
	Naming of materials	Description of sutures, implantable materials
	Anatomic/abnormality explanation	Specific description of related anatomy or abnormal intraoperative findings

most influential in changing the meaning of the operative note. This difference was most pronounced in procedures with a significantly higher RVU distribution in post-policy. Specifically, attending-dictated operative reports were more thorough in detailing preoperative indications for surgery and intraoperative decision-making for more complex operations.

Discussion

Our Department of Surgery’s 2021 transition from resident-dictated operative notes to attending-only dictations provided a unique opportunity to study the financial impact of resident dictation on billing accuracy during an era when no formal education on procedural billing was provided to trainees. We noted a small but statistically significant billing difference favoring the attending dictation (post-policy) period, which resulted in a calculated \$32,928 annual cost difference. In-depth analysis of operative reports dictated by residents, attending revisions of resident-dictated notes, and attending-dictated notes revealed three key themes: billable items, clinical or surgical reasoning, and technical details. Of these, billable items and clinical or surgical reasoning were thematically the most influential on billing or clinical ramifications of operative reports. Attending surgeon revisions and attending-dictated notes more frequently contained these elements. These results provide a clear path for educational intervention.

A few studies have investigated the financial impact of resident dictation across an entire surgical department. Novitsky et al. noted that deficiencies in resident dictations reduced reimbursement by \$18,200 or 9.7% in 2005 [2]. However, their study was limited to dictations from senior surgical residents (PGY 3–5) and compared these unedited resident dictations directly to attending dictations. Additionally, their study evaluated 50 operative reports over a span of 2 weeks, further limiting interpretation of their results. Although our study similarly noted reduced reimbursements

with resident dictations, the difference was much smaller at 2%. Furthermore, we were able to identify which specific operations contributed most to these differences. Our study was also unique in its ability to identify more in-depth differences between resident and attending operative dictations. Rather than limiting our investigation to quality indicators, the exploratory and inductive nature of our targeted thematic analysis allowed us to identify novel themes (i.e., billable differences, and clinical and surgical reasoning) that may serve as targets for future educational interventions [3, 4, 7].

A more recent study noted no association between the number, proportion, or types of operations senior residents dictated with first-time pass rates of both the American Board of Surgery Qualifying Exam and the Certifying Exam [21]. However, this study solely focused on the number of dictations rather than the quality of dictations. Given the lack of formal teaching on operative dictation skills, residents often have to rely on senior residents or attendings’ operative notes [1]. The impact of training progression on operative note accuracy and quality remains controversial. Zwintschler et al. noted a positive correlation between training level and improved operative note completion [7]. Porterfield et al. on the other hand, noted the opposite, whereby first-year residents had more complete documentation, presumably due to an “inverted U relationship” in data recall within the field of medicine [3]. There is no spontaneous transition from being a resident to becoming an attending that confers knowledge of accurate procedural billing phrases, though increasing awareness of the operative note as a medicolegal document may be related to more thorough documentation of clinical and surgical reasoning. One-third of attending dictations continue to remain deficient in reporting quality indicators [4]. Relying solely on other surgeons’ operative notes thereby only perpetuates the low quality of operative dictation, highlighting the importance of intentional training on operative documentation [3, 4].

There is an unmet need for residency curricula to prepare general surgery residents for “real world”, non-clinical skills, including navigating healthcare systems, finance,

Table 4 Demonstrative quotations of each code organized by author type

Themes	Codes	Resident only	Attending revisions	Attending only
Billable items	Procedure name	<p>“laparoscopic partial colectomy, partial omentectomy” (CRS4.R1)</p>	<p>“splenic flexure mobilization” added under procedures (CRS4.R1)</p>	<p>“(1) exploratory laparotomy (2) sigmoid colectomy (3) takedown of colostomy with coloproctostomy (4) on-table flexible sigmoidoscopy for anastomotic verification (5) takedown of enterocutaneous fistula with small bowel repair (6) small bowel resection and primary anastomosis (7) lysis of adhesions > 60 min (8) debridement and lavage of parasigmoid (abdominal) and pelvic abscesses” (CRS5.A1)</p>
	Description in body	<p>“The clavipectoral fascia was opened. Flaps were then raised in all directions, thereby exposing the pectoralis major muscle, the lateral chest wall, and the latissimus dorsi muscle. At the apex of the surgical field, dissection proceeded bluntly and using electrocautery.” (Onc1.R2)</p>	<p>“The mass was identified under the pectoralis major muscles and dissection off of the chest wall commenced using a combination of sharp and blunt dissection. Once this was dissected free, we proceeded with the remaining axillary LN dissection.” Added to description of operation, allowing for billing of radical excision (Onc1.R2)</p>	

Table 4 (continued)

Themes	Codes	Resident only	Attending revisions	Attending only
Clinical and surgical reasoning	Pre-operative	<p>“Imaging at the OSH showed a large intraabdominal abscess thought to be associated with a perforated diverticulitis. She was transferred for further management. An exploratory laparotomy was recommended and the patient agreed.” (ACS1.R1)</p>	<p><i>Added portions underlined:</i> “Imaging at the OSH showed a large intraabdominal abscess thought to be associated with a perforated diverticulitis although the left adnexal structures were immediately adjacent to the abscess. She was transferred for further management. She was tachycardic and had a leukocytosis and therefore an exploratory laparotomy was recommended for source control and the patient agreed.” (ACS1.R1)</p>	<p>Attending showed hemoperitoneum and inflammation of his colon. He had become hypotensive and was receiving 2 units of red blood cells upon transfer. After evaluation in Trauma Bay, it was recommended that he undergo emergent laparotomy for hemorrhage control and injury evaluation.” (ACS1.A1)</p>
		<p>“Attention was turned back to the midline incision, where a piece of mesh used for a previous abdominal wall hernia repair was noted in the anterior abdominal wall on the inferior aspect of our midline incision. The mesh as well as both hernia sacs were dissected free and passed off the table as specimen.” (ACS1.R3)</p>	<p>“The patient was hemodynamically stable and not requiring pressor support. Therefore the decision was made to proceed with bowel anastomosis... The mesh was poorly incorporated and was folded on itself. Given the contaminated nature of the case, it was decided to remove the mesh in its entirety.” added (ACS1.R3)</p>	<p>“Given the multiple serosal injuries to the small bowel and the 3 repairs of the colon in the setting of profound abscess contamination, it was felt that the best course of action would be to perform a diverting ileostomy.” (ACS2.A2)</p>
Complexity		<p>“There were adhesions between the small bowel and hernia sac. It did not appear that any bowel was obstructed entering the hernia sac, but that in fact there was an adhesive obstruction within the hernia sac. These adhesions were lysed and the bowel freed. There was no necrotic bowel. The previous small bowel anastomosis was inspected and was patent. In total the lysis of adhesions was approximately 1 h.” (ACS3.R1)</p>	<p><i>Added portions underlined:</i> “Once these adhesions were taken down, we identified a loop of ileum tethered to this inflammatory mass. This was also separated sharply, and an unavoidable serosal defect was made due to the dense nature of the adhesions and the inherent difficulty of the procedure.” (CRS3.R1)</p>	<p>“There was significant inflammation at the neck of the gallbladder that added 1 h to the dissection.” (ACS3.A2)</p>

Table 4 (continued)

Themes	Codes	Description of actions	Resident only	Attending revisions	Attending only
Technical details			<p>"The location of the left ureter was confirmed and protected away from the colon mesentery at the completion of lateral-to-medial dissection. The bowel was divided with the linear cutting stapler proximally at the mid transverse colon and distally at the mid sigmoid colon." (CRS5.R1)</p>	<p>"Based on the location of the tumor, we formally ligated the left branch of the middle colic artery and the left colic artery, taking all of the associated intervening mesentery for an oncologic lymphadenectomy. The vessels were encircled by dissection, clamped, and divided with a Ligasure, then suture ligated. The intervening mesentery was taken with Ligasure up to the bowel wall at proximal and distal transection points chosen with good perfusion, proximally at the mid transverse colon and distally at the mid sigmoid colon." <i>added</i> (CRS5.R1)</p>	<p>"These vessels were taken formally at the base. The vessel was dissected out and encircled, then clipped doubly, then ligated and divided with the Ligasure." (CRS5.A2)</p>
	Specifics in materials		<p>"Next, an 11 cm round piece of Ventralight ST mesh was introduced in the abdomen. The mesh was aligned appropriately with the defect to provide adequate coverage in all directions. There was good coverage of the defect at completion. The mesh was sutured to the anterior abominable wall using 00 V-Loc absorbable suture." (Gen3.R5)</p>	<p>"the anterior sheath was reapproximated with an #1 Stratifix Symetric suture with relative ease. Likewise, the posterior sheath was reapproximated with a 2-0 Stratifix suture to repair the herniation and facilitate placement of our retromuscular mesh. Once we were satisfied with our dissection, a 15x30 cm piece of ProGrip mesh was brought into the retromuscular space and placed with adequate coverage of the defect." <i>suture type added as underlined</i> (Gen3.R3)</p>	<p>"Utilizing 00 V-Loc suture, the posterior sheath was closed in a running fashion under direct vision...satisfied with our anterior and posterior closures, we directed our attention to placement of the mesh. We brought in a piece of light weight weight polypropylene mesh fashioned to a 20x30 cm size." (Gen2.A6)</p>
	Anatomic		<p>"We got down to the level of the fascia which was characterized by numerous swiss cheese type defects, containing omentum, preperitoneal fat, colon, and small bowel... Additionally, a large mesh conglomeration was encountered at the level of the umbilicus and it was intimately adherent to a loop of jejunum." (Gen3.R1)</p>	<p><i>Added components underlined:</i> "There was a large firm mass identified in the right lower quadrant adherent to the abdominal wall at the site of the patient's prior appendectomy scar. There was some mesentery, as well as the level of transverse colon, that appeared to be adherent to the mass as well. The white line of Toldt at the level of the cecum was completely fused." (CRS5.R2)</p>	

and membership²³. A 2019 study of program directors and chief residents in general surgery identified “coding and billing” as the most important non-clinical topic that should be formally taught during residency. Some studies have incorporated more formal educational sessions on operative dictation with notable improvements [1, 5, 10, 11, 22]. Interventions have ranged from teaching sessions with accompanying examples to the incorporation of synoptic reports. While dictation templates may provide organization, structure, and reminders of required content, synoptic reporting may also rob learners of the necessary recall, organizing, and explanation of procedures that help them better understand and integrate the reasons for, and performance steps of, operative procedures. In addition, the long-term effects of these educational interventions are unknown. However, by focusing on broader themes (i.e., billable differences, and clinical and surgical reasoning), as identified within this study, we would enhance learners' foundational knowledge of both the necessary components in operative dictations and the indications and steps of procedures. Clinical and surgical reasoning differences between attending- and resident-authored notes, in particular, may reveal deficits in the “following” of intraoperative decision-making by the trainee. When identified, these pose valuable opportunities for discussion to enhance resident understanding of decision-making.

Salaried, trained billing coders applied codes to all operations during both pre- and post-policy periods, but our study is limited by our inability to adjust for coder experience, as some billable items were notably not billed when they were described in the body of the operative report but not listed in the procedure list. In addition, divisions with recent faculty turnover were underrepresented (e.g., one division in which 5 attending surgeons were included and 13 attendings excluded). There may have also been confounders between the fiscal years studied. For example, while the overall case number and complexity were similar between the two fiscal years, the impact of the COVID-19 pandemic on elective surgeries during FY2022 may have inadvertently impacted case distributions. The greater sensitivity of the KS test may also make our study more prone to Type I errors. Finally, we note that the fiscal comparison performed was between attending-edited resident dictations and attending dictations; there would likely have been even higher billing differences in the absence of attending review of resident dictations.

This study is one of the first to evaluate the financial impact of resident operative dictation as well as qualitatively explore differences between resident and attending dictations. Differences remained minimal and primarily involved billable items and clinical and surgical reasoning. Future educational interventions should therefore focus on these themes. For example, clinical leaders in each

subspecialty should share significant billable items for residents to note during their operative dictations. Clinical and surgical reasoning should be discussed before, during, and after procedures to advance residents' clinical reasoning skills. Once residents have dictated or written operative reports, attending revisions should be discussed and presented directly as feedback. We recommend incorporating billable components and clinical reasoning into educational curricula on operative documentation, alongside a formal feedback mechanism, to serve simultaneous purposes of strengthening resident education while increasing operative dictation accuracy.

Conclusion

Operative dictation is a valuable educational tool for residents to review operative steps and clinical decision-making. Mixed-method analysis of differences between resident- and attending-dictated operative notes demonstrated meaningful differences in billable items and clinical and surgical reasoning. Incorporating formal resident education emphasizing billable items and clinical reasoning in operative dictations is necessary to prepare residents for independent practice.

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Data availability Data available on request due to privacy/ethical restrictions.

Declarations

Conflict of interest Theresa Wang, JC Chen, David Weirich, Timothy Pawlik, and Emily Huang have no conflicts of interest to disclose. Matthew Kalady is on the scientific advisory board for Activ Surgical which does not represent a conflict of interest for this study.

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