

# Upstream and downstream revenue of upper gastrointestinal endoscopic ultrasound determined with an episode-of-care approach



## Authors

Daniel Maeng<sup>1</sup>, Beth Wall<sup>2</sup>, Dina Hassen<sup>1</sup>, David L. Diehl<sup>3</sup>

## Institutions

- 1 Department of Epidemiology and Health Services Research, Geisinger, Danville, PA, USA
- 2 Olympus Corporation of the Americas, Center Valley, PA, USA
- 3 Department of Epidemiology and Health Services Research, Geisinger, Danville, PA, USA

submitted 5.3.2019

accepted after revision 8.7.2019

## Bibliography

DOI <https://doi.org/10.1055/a-0990-9458> |

Endoscopy International Open 2019; 07: E1316–E1321

© Georg Thieme Verlag KG Stuttgart · New York

eISSN 2196-9736

## Corresponding author

Dina Hassen, MPP, 100 N. Academy Ave, Danville, PA 17822, USA

Fax: +1-570-214-9451

dahassen@geisinger.edu

Appendix Tables A1 – A4

Online content viewable at:

<https://doi.org/10.1055/a-0990-9458>

## ABSTRACT

**Background and study aims** Upper gastrointestinal endoscopic ultrasound (EUS) has clinical advantages that can lead to improved patient outcome. This study seeks to

characterize and quantify the upstream and downstream healthcare utilizations and revenues.

**Patients and methods** A retrospective claims data analysis of upper gastrointestinal EUS procedures was conducted at a large health system. Types of care and total revenues associated with each episode of care were characterized by descriptive statistics. Comparisons were made between patients who had Medicare Advantage and commercial plans as well as those with and without cancer diagnoses during the downstream period.

**Results** A total of 436 cases were identified. The most frequent downstream healthcare utilizations consisted of radiology (31%), pathology services (28%), and high-revenue services including chemotherapy and inpatient admissions. The most common upstream utilizations included radiology (18%) and lab services (22%). Average total downstream revenue was \$34 231 (95%CI: \$28 561 – \$39 901) per case, and average total upstream revenue was \$4373 (95%CI: \$3227 – \$5519). Average total revenue per case did not differ significantly between Medicare Advantage and commercial plan members. However, patients who were diagnosed with cancer at or immediately following EUS (20%) were associated with significantly higher total revenue compared to those without cancer diagnosis ( $P < 0.0001$ ).

**Conclusions** This episode-of-care approach to quantifying the revenue impact of upper gastrointestinal EUS to the providers suggests there are substantial downstream as well as upstream revenues associated with upper gastrointestinal EUS procedures, driven by patients who are diagnosed with cancer by the EUS procedures and subsequently require oncologic care.

## Introduction

The upper gastrointestinal endoscopic ultrasound (EUS) procedure has important clinical advantages including potential avoidance of surgery, hospital admission and associated risks, compared to standard endoscopy [1–4]. The relatively low Medicare reimbursement rate of EUS in the United States com-

pared to its cost, however, may be a disincentive to its widespread adoption due to concerns with its financial viability [5–8]. Such a concern appears to have led to under-investment in training of clinicians [6, 9] and disseminating the benefits of the procedure at a larger scale [7, 8]. Moreover, there are concerns about whether EUS is financially viable given its utilization among the Medicare population and the lower reimbursement

paid by Medicare compared to that by commercial insurance. Despite these concerns, however, the number of facilities in the United States performing upper gastrointestinal EUS has been growing, from approximately 1000 in 2014 to 1205 in 2016. Accordingly, the total volume of upper gastrointestinal EUS has also increased from approximately 208 000 cases in 2015 to 237 000 cases in 2017 (estimates based on proprietary data available to Olympus Corporation of the Americas, obtained from third-party vendors [10, 11]), suggesting there are increasingly higher demands for this procedure in current health-care.

Several publications have reported on potential downstream revenue generation but they are based on a relatively small sample and are not fully transparent on their methods for revenue identification [8, 12, 13]. Furthermore, there has been no new published evidence since 2009, and the referenced publications' study data are from earlier time periods ranging from 2004 to 2008. Updated evidence is needed with regard to EUS-related revenues to inform decision-making. By using the most recent data available, this study seeks to identify and characterize upstream and downstream medical care service revenues for EUS procedure-related treatment in addition to the upper gastrointestinal EUS procedure revenues to evaluate the extent to which these services improve the overall financial viability of upper gastrointestinal EUS.

## Patients/Material and methods

This study is a retrospective claims data analysis of patients who had received upper gastrointestinal EUS at Geisinger Medical Center between January 1, 2015 and December 31, 2016. This study has been reviewed and approved by Geisinger's Institutional Review Board (2018-0211). Geisinger is a large integrated healthcare delivery system located in Central Pennsylvania in the United States and has its own financing arm, Geisinger Health Plan (GHP). GHP is a full-service managed care organization offering commercial, Medicare Advantage (a government-sponsored program that allows private health insurers such as GHP to provide health insurance coverage to the disabled and the elderly, defined as those 65 years of age or older), and managed Medicaid (another government-sponsored program that allows GHP to provide health insurance coverage for the indigent population) plans. In general, approximately 40–50% of Geisinger's patients have health insurance coverage through GHP.

This study takes advantage of the availability of both the electronic health records (EHR) data and the health plan claims data for the same cohort of patients. Such availability of data allows reliable identification of upper gastrointestinal EUS patients from the EHR while also ensuring accurate and complete capture of healthcare utilization and financial information as available from their claims data.

For the purposes of this study, an upper gastrointestinal EUS case was defined as a patient for whom the Current Procedural Terminology (CPT) code of 00740 (anesthesia for upper gastrointestinal endoscopic procedure) and one or more of the CPT EUS esophagogastroduodenoscopy-related codes 43237,

43238, 43240, 43242, 43253, or 43259 occurring on the same day, i. e., the index date. These combinations of the CPT codes were determined by reviewing the claims data of a smaller cohort of patients (n = 109) who had been identified as upper gastrointestinal EUS cases via a chart review conducted by an expert Geisinger clinician using the EHR. This computer-programmable logic of identifying upper gastrointestinal EUS cases was developed to allow a transparent and reproducible method of identifying a large sample of upper gastrointestinal EUS cases efficiently from administrative data, such as the EHR and claims data. Previous studies had relied on chart reviews to identify all of the EUS cases used in the analyses [5, 8, 12, 13], which is neither transparent nor reproducible. Chart reviews are also time-consuming and high cost and therefore are not feasible when a large number of upper gastrointestinal EUS cases needs to be identified quickly. This CPT code-based approach to identifying upper gastrointestinal EUS cases reduces the need to rely on chart reviews in future research.

The following exclusion criteria were applied to obtain the final sample: 1) patients who were under the age of 18 during the study period; 2) patients who had Managed Medicaid coverage during the study period; and 3) patients who had fewer than 90 days of GHP coverage before the index date or fewer than 180 days after the index date. Also, because the goal of this study is to focus on the revenue stream from the perspective of the EUS facility, care received by the patients in non-Geisinger facilities was excluded. Because Medicaid is typically characterized by substantially low reimbursement rates [14] as well as high member turnover rates and unique coverage requirements [15] relative to other types of health insurance, this study excluded patients with Medicaid coverage; the goal was to describe as completely as possible the patterns of upstream and downstream healthcare utilizations among upper gastrointestinal EUS patients, rather than to report representative estimates across all upper gastrointestinal EUS patients regardless of insurance types.

A claims data analysis was conducted using the upper gastrointestinal EUS procedure date as the index date to calculate the average total claims allowed amounts and utilization rates associated with EUS-related care pre- and post-index date. Revenues to the provider were defined as allowed amounts, i. e., reimbursements received by the care facility via either direct payments made by the health plan to the facility or patients' out-of-pocket costs. Thus, the allowed amounts associated with the index upper gastrointestinal EUS procedure, as well as for the upstream (defined as a 30-day period before the index upper gastrointestinal EUS date) and downstream (defined as a 180-day period after the index upper gastrointestinal EUS date) care utilization were used to estimate average per-episode revenues from the provider's perspective.

Upper gastrointestinal EUS-related care utilization was defined by a predetermined list of CPT codes and/or Medicare Severity-Diagnosis Related Group (MS-DRG) codes (for inpatient hospital care) identified by the study team in conjunction with an expert Geisinger clinician, who made the final determination of what resources and care utilizations are commonly associated with upper gastrointestinal EUS procedures. The lists of CPT

► **Table 1** Upper gastrointestinal EUS patient characteristics.

	Total sample	Cancer status		
		Cancer diagnosis	Non-cancer diagnosis	P value <sup>1</sup>
Sample size, n	436	85	351	n/a
Female, n (%)	235 (53.9%)	32 (38%)	203 (58%)	0.001
Age, mean (SD), years	63 (16)	67.4 (1.3)	61.6 (0.9)	0.002
Medicare Advantage, n (%)	244 (56.0%)	56 (66%)	188 (54%)	0.04
Patients with no EUS-related intervention post-index, n (%)	83 (19%)	2 (2%)	81 (23%)	<0.0001

<sup>1</sup> "P value" refers to the comparison between cancer and non-cancer subgroups; SD, standard deviation.

and MS-DRG codes considered for this study are shown in **Appendix Tables A1 – A3**. The upper gastrointestinal EUS-related care was then categorized into upstream and downstream services. Upstream services included selected radiology, electrocardiogram (EKG), and selected lab services, while downstream upper gastrointestinal-EUS related care included subsequent upper gastrointestinal EUS (i.e., occurring after the index date), esophagogastroduodenoscopy (EGD) or endoscopic retrograde cholangiopancreatography (ERCP), selected chemotherapy, radiation therapy, pathology, radiology, and consults that occurred within 180 days after the index upper gastrointestinal EUS cases. In addition, selected downstream inpatient upper gastrointestinal-related admissions (both surgical and medical admissions) were also considered and included in calculating the total downstream revenue.

Two sub-analyses of cost and utilization were also conducted. The first was to evaluate whether upstream and downstream patterns are different for cases who had a cancer diagnosis versus those without (refer to **Appendix Table A4** for the upper gastrointestinal cancer-related diagnosis for this study), and the second was to compare if the patterns of care and costs were different for Medicare vs. commercial cases. All statistical analyses were conducted using Stata version 13.0 (StataCorp, College Station, TX, United States). The statistical significance of differences between Medicare Advantage and commercial plan patients as well as differences between cancer and non-cancer patients was obtained via *t* tests; 95% confidence intervals were obtained to compare the mean total upstream and downstream revenues between the cancer and non-cancer patients as well as between the Medicare Advantage and commercial plan members.

## Results

► **Table 1** summarizes the patient demographics. The average age of the patients was 63 years and 54% of the 436 patients were female. Moreover, 56% of these patients had Medicare Advantage coverage. Comparing the cancer vs. non-cancer patients, cancer patients were older, more likely to have Medicare Advantage, and less likely to be female. The vast majority of patients (81%) go on to have further testing and other EUS-

related utilizations following the index upper gastrointestinal EUS procedure.

► **Table 2** shows the percentage of the upper gastrointestinal EUS patients who had received each of the categories of downstream and upstream care. Across all patients, the most frequent downstream healthcare utilizations consisted of radiology (31%), pathology services (28%), and high-revenue services including chemotherapy (11%) and inpatient admissions (12%, including both medical and surgical admissions). The most common upstream utilizations included radiology (18%) and lab services (22%). Comparing the cancer vs. non-cancer patients, cancer patients were significantly more likely than non-cancer patients to use every category of downstream care (apart from EGD), particularly the high-revenue care services (46% vs. 3% for chemotherapy and 47% vs. 4% for medical or surgical inpatient admissions). Furthermore, one-quarter of the subset of patients with cancer underwent ERCP either on the same day or in the downstream period, compared to only 13% among the non-cancer patients. For upstream care utilization, cancer patients were again likely to receive more care than non-cancer patients in general, but only for radiology was the difference statistically significant at the 5% level.

► **Table 3** summarizes the mean total episode-of-care revenue to the hospital per patient. Across all patients in the sample, the mean total upstream revenue was \$4373 per patient and the total downstream revenue was \$34231 per patient. The mean total upstream and downstream revenues did not differ significantly between the Medicare Advantage and the commercial members; however, there were significant differences between the cancer and the non-cancer patients in terms of their mean total upstream and downstream revenues, suggesting that cancer patients were associated with total episode-of-care revenues that are nearly 3 to 4 times higher than those of non-cancer patients.

## Discussion

The findings from this study demonstrate the magnitude of impact that upper gastrointestinal EUS potentially can have on the provider's revenue by using an episode-of-care approach to identify upper gastrointestinal EUS cases and to attribute financial values associated with the procedure from the provider's

► **Table 2** Upper gastrointestinal EUS upstream and downstream utilization comparisons.

	All patients, n (%)	Cancer, n (%)	Non-cancer, n (%)	P value (cancer vs. non-cancer)
Downstream utilization comparison by procedure category				
EGD (downstream or same day)	221 (51%)	38 (45%)	183 (52%)	0.2189
ERCP (downstream or same day)	65 (15%)	21 (25%)	44 (13%)	0.0047
EUS	21 (5%)	9 (11%)	12 (3%)	0.0077
Chemotherapy	49 (11%)	39 (46%)	10 (3%)	<0.0001
Radiation Therapy	15 (3%)	14 (16%)	1 (<1%)	<0.0001
Pathology	124 (28%)	53 (62%)	71 (20%)	<0.0001
Radiology	136 (31%)	56 (66%)	80 (23%)	<0.0001
Consults	84 (19%)	42 (50%)	42 (12%)	<0.0001
Surgical Upper Gastrointestinal Admit	28 (6%)	21 (25%)	7 (2%)	<0.0001
Medical Upper Gastrointestinal Admit	25 (6%)	19 (22%)	6 (2%)	<0.0001
Upstream utilization comparison by procedure category				
Radiology	80 (18%)	28 (33%)	52 (15%)	0.0001
EKG	51 (12%)	14 (16%)	37 (11%)	0.1394
Lab	97 (22%)	24 (28%)	73 (21%)	0.1529

EGD, esophagogastroduodenoscopy; ERCP, Endoscopic retrograde cholangiopancreatography; EUS, endoscopic ultrasound; EKG, electrocardiogram.

► **Table 3** Total upstream and downstream revenue comparisons.

Sample category	Total upstream revenue, mean \$ per case (95%CI)	Total downstream revenue, mean \$ per case (95%CI)
Total sample (n = 436)	4373 (3227 – 5519)	34231 (28 561 – 39 901)
By plan type: Commercial (n = 192)	3826 (2247 – 5406)	33460 (26 971 – 39 950)
By plan type: Medicare (n = 244)	4803 (3167 – 6439)	34837 (26 046 – 43 629)
By diagnosis <sup>1</sup> : Non-cancer (n = 351)	2663 (1634 – 3693)	23377 (19 643 – 27 110)
By diagnosis <sup>1</sup> : Cancer (n = 85)	11432 (7669 – 15 196)	79053 (56 437 – 101 669)

CI, confidence interval.

<sup>1</sup> Statistically significant at the 5% level ( $P < 0.0001$ ).

perspective. Specifically, this episode-of-care approach allows the care provider to view the value of the upper gastrointestinal EUS procedure not as an isolated single procedure but within the broader context of comprehensive upstream and downstream of patient care. These results indicate that the estimated total revenue associated with an episode-of-care in this context can be quite substantial, especially if the downstream care is associated with cancer care. To the extent that upper gastrointestinal EUS enables a more accurate and timely diagnosis of cancer [16–19], the patterns of downstream care utilization illustrated in this study provide insights on the intensity of post-EUS care management as well as the clinical and financial justification for greater investment and adoption of EUS.

Although this is a single center study, the findings are consistent with those from other similar studies published to date.

The earlier studies by Atkinson and Schmulewitz [13] and Harewood et al. [8] have also shown large downstream revenues post-EUS. The results from the cancer vs. non-cancer comparisons reported in this study are also comparable and consistent with those reported by Sodikoff et al. [12] who demonstrated care utilization differences between EUS patients with pancreatic cancer and those with non-pancreatic cancer. In that earlier study, the authors reported that EUS patients with pancreatic masses had a 29% rate of surgery and 14% chemoradiation therapy, which is similar to this study's finding of a 25% surgery admission rate among cancer patients.

Another important contribution of this study is the development of a computer-programmable algorithm to identify upper gastrointestinal EUS patients and the associated EUS-related care utilizations from administrative data sources such as

claims data or existing EHR databases. The algorithm developed in this study uses information commonly available in large administrative data sources (CPT, Diagnosis Related Group (DRG), and International Classification of Diseases (ICD) 10 codes) to identify a large cohort of upper gastrointestinal EUS patients quickly and to capture all corresponding upper gastrointestinal-EUS related care utilization. This algorithm allows the methodological transparency needed to replicate readily the findings from this study in other settings. To our knowledge, no such method has been reported in previous studies.

This study is subject to several limitations. First, because this is a single center study, the generalizability of the findings is unknown. Geisinger is a major referral center in its service area and is the major provider of EUS and other specialty services in the area. Therefore, the downstream care capture rate is likely to be high, which may lead to an overestimation of downstream care utilization and revenue relative to other centers in different markets in which, for instance, patients may opt to have EUS treatment in one center but their follow-up care in other centers. At the same time, the capture of upstream utilization may be low because Geisinger is a tertiary care provider, which implies that not all of the upstream care provided to the patients in primary and secondary care is likely to be captured by Geisinger.

Second, the total revenue estimates were obtained from GHP, a single private health plan. To the extent that GHP may have unique contract arrangements with Geisinger and that GHP may employ its unique reimbursement and care management strategies, the upstream and downstream care utilization patterns reported in this study may reflect such unique plan-specific characteristics. Therefore, it is not clear how the results may differ if a similar study were to be conducted using data from the traditional fee-for-service Medicare rather than from a Medicare Advantage plan.

Third, the lengths of time used to define the upstream and downstream periods (60 days and 180 days, respectively) in this study are arbitrary. The patterns of care utilization and total average revenues associated with an episode of care as described in this study are therefore likely to be sensitive to different lengths of time chosen to define an episode. Further studies are necessary to develop a more refined and reliable way to define an episode of care in this context. Lastly, the data presented in this study are not representative of all of the patients who undergo upper gastrointestinal EUS procedures at Geisinger, as the sample explicitly excluded patients with Medicaid coverage or those who did not have GHP insurance coverage. Future studies may explore how the results may or may not differ if the sample had focused exclusively on the Medicaid patient population.

The episode-of-care approach to quantifying the revenue impact of upper gastrointestinal EUS to the providers, as illustrated in this study, suggests there are substantial downstream as well as upstream revenues associated with upper gastrointestinal EUS procedures, largely driven by patients who are diagnosed with cancer by the EUS procedures and subsequently require oncologic care.

## Acknowledgments

The authors would like to thank Eric Wagner (Geisinger) for providing project management and administrative support; Solomon Abera (Geisinger) for providing data support; and Olympus USA for providing funding support.

## Competing interests

Yes. Daniel Maeng, PhD, has no conflicts that are relevant to this manuscript and has nothing to disclose. Beth Wall, RN, MS, is a full-time employee in health economics and reimbursement at Olympus America, Inc. Dina Hassen, MPP, has no conflicts that are relevant to this manuscript and has nothing to disclose. David L. Diehl, MD FACP, FASGE, is a consultant and lecturer at Olympus America, Inc.

## References

- [1] Fusaroli P, Caletti G. Endoscopic ultrasonography: current clinical role. *Eur J Gastroenterol Hepatol* 2005; 17: 293–301
- [2] Quirk DM, Rattner DW, Fernandez-del Castillo C et al. The use of endoscopic ultrasonography to reduce the cost of treating ampullary tumors. *Gastrointest Endosc* 1997; 46: 334–337
- [3] Harewood GC, Wiersema MJ. A cost analysis of endoscopic ultrasound in the evaluation of pancreatic head adenocarcinoma. *Am J Gastroenterol* 2001; 96: 2651–2656
- [4] Harewood GC, Wiersema MJ. A cost analysis of endoscopic ultrasound in the evaluation of esophageal cancer. *Am J Gastroenterol* 2002; 97: 452–458
- [5] Parada KS, Peng R, Erickson RA et al. A resource utilization projection study of EUS. *Gastrointest Endosc* 2002; 55: 328–334
- [6] Aslanian HR, Ahmed AM, Jamidar PA. Is advanced endoscopy training worth it? *Clin Gastroenterol Hepatol* 2015; 13: 1218–1220
- [7] Faigel DO. Economic realities of EUS in an academic practice. *Gastrointest Endosc* 2007; 65: 287–289
- [8] Harewood GC, Stemmer W, Roth J et al. Resource-intensive endoscopy: revenue source or cash drain? *Gastrointest Endosc* 2009; 70: 272–277
- [9] Barroso AO. Advanced endoscopy procedures in private practice: is the juice worth the squeeze? *Gastrointest Endosc* 2011; 74: 913–915
- [10] IQVIA. Hospital Procedures and Diagnosis. <https://www.iqvia.com/locations/united-states/medical-device-and-diagnostic-segment/hospital-procedures-and-diagnosis> Accessed June 13, 2019
- [11] Hansen LG, Chang S. Health Research Data for the Real World: the MarketScan Databases. [http://truvenhealth.com/portals/0/assets/PH\\_11238\\_0612\\_TEMP\\_MarketScan\\_WP\\_FINAL.pdf](http://truvenhealth.com/portals/0/assets/PH_11238_0612_TEMP_MarketScan_WP_FINAL.pdf) [Accessed June 13, 2019]
- [12] Sodikoff JB, Garud SS, Keilin SA et al. Health resource utilization and multidisciplinary impact of endoscopic ultrasonography in a tertiary referral medical center. *Therap Adv Gastroenterol* 2013; 6: 199–203
- [13] Atkinson M, Schmulewitz N. Downstream hospital charges generated from endoscopic ultrasound procedures are greater than those from colonoscopies. *Clin Gastroenterol Hepatol* 2009; 7: 862–867
- [14] Perri JL, Powell RJ, Goodney PP et al. Disparity in Medicaid physician payments for vascular surgery. *J Vasc Surg* 2018; 68: 1946–1953

- [15] Maeng DD, Snyder SR, Baumgart C et al. Medicaid managed care in an integrated health care delivery system: Lessons from Geisinger's early experience. *Popul Health Manag* 2016; 19: 257–263
- [16] Jhala NC, Jhala DN, Chhieng DC et al. Endoscopic ultrasound-guided fine-needle aspiration. A cytopathologist's perspective. *Am J Clin Pathol* 2003; 120: 351–367
- [17] Eloubeidi MA, Jhala D, Chhieng DC et al. Yield of endoscopic ultrasound-guided fine-needle aspiration biopsy in patients with suspected pancreatic carcinoma. *Cancer* 2003; 99: 285–292
- [18] Eloubeidi MA, Chen VK, Eltoun IA et al. Endoscopic ultrasound-guided fine needle aspiration biopsy of patients with suspected pancreatic cancer: diagnostic accuracy and acute and 30-day complications. *Am J Gastroenterol* 2003; 98: 2663–2668
- [19] Wallace MB, Nietert PJ, Earle C et al. An analysis of multiple staging management strategies for carcinoma of the esophagus: computed tomography, endoscopic ultrasound, positron emission tomography, and thoracoscopy/laparoscopy. *Ann Thorac Surg* 2002; 74: 1026–1032