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Original Contribution

National specialty trends in billable diagnostic ultrasound in the Emergency Department setting: analysis of Medicare claims data☆,☆☆

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ABSTRACT

Objective: To assess recent national specialty trends in the use of diagnostic ultrasound (US) services in the Emergency Department (ED) setting.
Methods: We searched aggregated 1998-2012 Medicare Part B Master Files for ED diagnostic US studies, excluding cardiac and ophthalmic examinations. Studies were classified by body part and interpreting specialty. Subsequent analysis was performed for higher-volume services rendered by emergency physicians for which discrete codes were present longitudinally for complete vs limited examinations. National trends were analyzed.
Results: From 1998 to 2012, paid ED US studies interpreted by radiologists, emergency physicians, and all other physicians increased by 332% (from 221 712 to 735 858 examinations), 4454% (from 561 to 24 992), and 251% (from 26 961 to 67 787), respectively. The fraction of ED US examinations interpreted remained around 90% for radiologists, increased from 0.2% to 3% for emergency physicians, and decreased from 11% to 8% for other physicians. The fraction of complete abdominal and complete retroperitoneal studies interpreted by emergency physicians remained less than 1% from 1998 through 2012. However, emergency physicians experienced disproportionate growth in limited examinations (from 1% to 9% for abdominal studies and from <1% to 20% for retroperitoneal studies). Likewise, the fraction of (typically targeted) chest studies interpreted by emergency physicians increased from less than 1% to 63%.
Conclusion: From 1998 to 2012, there was substantial growth in ED US studies for Medicare beneficiaries interpreted by radiologists and emergency physicians alike. For more commonly performed services distinguishable as complete vs limited in nature, growth in services by emergency physicians was most dramatic for less complex services.

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1. Introduction

Ultrasonography in the emergency department (ED) setting offers tremendous potential benefit for patient care. For numerous conditions, compared with other imaging modalities, ultrasound can provide a rapid and accurate diagnosis at lower cost and without radiation exposure [1–12]. In addition, the appropriate application of ultrasound in the ED setting can decrease length of stay and improve patient satisfaction [13–16]. In at least some centers, when emergency physicians directly perform and interpret ultrasound examinations, they achieve faster examination times and increased imaging access at off-hours when radiology-performed ultrasound may not be available [5,17–21]. To this end, emergency physicians have been actively promoting the expansion of ultrasound services by the specialty by incorporating basic ultrasonography training into residency programs, creating dedicated emergency ultrasound fellowships, and allocating funds toward the acquisition of ultrasound equipment [22,19,23–25,20,26,21]. Because of these ongoing and aligned efforts, ultrasonography performed by emergency physicians is likely to exhibit continued growth [27–29,26].

Although the use of ultrasound by emergency physicians has expanded, overall ultrasound use in the ED setting across all specialties has undergone substantial growth as well [30]. Relative changes in the performance of ED ultrasound by emergency vs other physician specialties remain unknown, particularly with regard to paid services. This knowledge gap could be critically important in fully understanding changes in care delivery and appropriate physician compensation. If the growth in ultrasonography by emergency physicians is less than that by other specialties, then current specialty expansion efforts may in fact not be having their intended effect. On the other hand, if growth in ultrasound by emergency physicians is outpacing growth by other specialties, then a more precise knowledge of the specific ultrasound

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examinations with the greatest growth (and growth potential) could be useful in better understanding the nuances of these successful expansion efforts. Such information is important for guiding decisions regarding the optimal allocation of clinical and education-related resources.

Given the above considerations, our aim was to assess national specialty trends in diagnostic ultrasound services in the ED setting from 1998 to 2012, using Medicare Part B data to identify paid services. Analyses were performed for various categories of ultrasound examinations, as well as for select individual complexity-differentiatable ultrasound examinations performed at a relatively higher volume. Our intent was to provide insights into the volume of ED ultrasound examinations interpreted and billed by different specialties over time, and identify potential shifts in the distribution of certain examinations between such specialties during the study period.

2. Methods

2.1. Study design

This was a retrospective descriptive study using annual Medicare Physician Supplier Procedure Summary (PSPS) Master Files from 1998 through 2012, which were obtained from the Center for Medicare & Medicaid Services. These designated Public Use Files contain no patient-specific data. Accordingly, this study has been deemed to not represent human subject research and was deemed review-exempt by our institutional review board.

Physician Supplier Procedure Summary files contain aggregated Medicare Part B billing claims, providing total use data stratified by procedure code (based on Healthcare Common Procedure Coding System and Current Procedural Terminology [CPT] codes), place of service (eg, ED, inpatient, or hospital outpatient facility), and provider specialty. Unique codes are used to document each of these parameters. The data include claims for more than 39 million Medicare fee-for-service beneficiaries and exclude patients in Medicare Advantage plans.

We used Medicare's Berenson-Eggers Types of Service categorization [31], which assigns codes corresponding to clinical categories of services to all Healthcare Common Procedure Coding System codes, to identify all ultrasound examinations performed in the ED setting. Cardiac and ophthalmic examinations, which were almost always same-specialty performed, as well as nondiagnostic ultrasound guidance services (eg, such as for central venous catheterization) were excluded as aggregated claims data precluded identification of the associated base service. Examination counts were then separated by interpreting specialty using 3 categories: emergency physician (Medicare specialty code 93), radiologist (specialty codes 30, 94, and 36, for diagnostic radiology, interventional radiology, and nuclear medicine, respectively), and all others. Examinations were also classified based on 10 possible body or systems areas (vascular, abdomen, retroperitoneum, neurologic, head and neck, chest, breast, obstetric, pelvic, and extremity) based on CPT codes assigned to each service.

Physician Supplier Procedure Summary data permitted inclusion of all paid physician claims, regardless of (1) whether the patient was subsequently admitted and (2) whether the hospital billed separately from the physician. Technical-only claims were specifically excluded so as to avoid potential duplicate counting of a single imaging examination.

2.2. Data analysis

Paid claims volumes for ED ultrasound examinations were extracted by specialty and body region on an annual basis for each year from 1998 through 2012. National trends from 1998 to 2012 in ultrasound use in the ED setting among the different body regions, by interpreting specialty, were assessed, including shifts in the relative frequency with which each specialty group performed various examinations over time.

For body regions for which distinct complete vs limited CPT codes existed longitudinally throughout all years studied, and for which emergency physicians submitted paid Medicare claims for more than 1000 examinations for at least 1 year during the study interval, an additional targeted evaluation was undertaken to identify potential shifts in the level of complexities of services rendered. Although many ultrasound services are not distinguishable with complete vs limited CPT codes, such a distinction does in fact exist for abdominal and retroperitoneal studies. As a rule, complete examinations are more complex and more time intensive and require considerably more physician documentation to support payment, but paid at a higher amount. National average Medicare professional payments for complete abdominal and retroperitoneal examinations are currently $41.20 and $37.61, respectively [32]. In contrast, payments for limited examinations are only $29.73 and $29.37 [32]. For abdominal examinations, CPT rules require evaluation and documentation of at least 8 abdominal organ systems for complete examinations. Less detailed studies (such as those for ascites search or gallbladder evaluation) are reported as limited examinations, and their documentation burden for payment is thus lower. Similar coding rules are in place for retroperitoneal studies.

Data are presented in terms of the number of examinations in each body area, as well as the percentage of all examinations in each body area, performed by each specialty annually. Initial analysis of Master Files was performed using SAS software, version 9.3 for Windows (SAS Institute, Inc, Cary, NC). Subanalyses of extracted data sets were performed using Microsoft Excel for Mac 2011, Version 14.3.5 (Microsoft Corporation, Redmond, WA).

3. Results

Table 1 shows trends in ED ultrasound use overall and by different specialties during the study period. The total number of paid ultrasound examinations performed in the ED setting on Medicare Part B beneficiaries increased by 332% from 1998 to 2012 (from 249 234 to 828 637 examinations, respectively). During this time, the number of paid studies interpreted by radiologists increased by 332% (from 221 712 to 735 858 examinations); by emergency physicians, 4454% (from 561 to 24 992 examinations); and by other physicians, 251% (from 26 961 to 67 787 examinations).

Table 2 shows trends in use in the 10 different body areas. In terms of the highest-volume categories, paid examinations interpreted by radiologists increased by 465% for vascular, 222% for abdomen, 261% for chest, and 155% for retroperitoneum; by emergency physicians, increased by 1917% for vascular, 3705% for abdomen, 86 400% for chest, and 14 800% for retroperitoneum; and by other specialists, increased by 309% for vascular and 1382% for chest, while decreasing by 39% for abdomen and 68% for retroperitoneum.

Table 1
Use of ultrasonography in the ED setting among Medicare fee-for-service beneficiaries from 1998 to 2012, stratified by the physician specialty interpreting and billing for the examination

	1998	2000	2002	2004	2006	2008	2010	2012	Change[a]
Emergency physicians	561	1039	2002	4478	6727	11 666	17 506	24 992	+4454%
Radiologists	221 712	267 923	330 327	395 568	459 294	522 090	603 557	735 858	+332%
Other physicians	26 961	35 400	42 446	50 572	57 496	66 348	64 568	67 787	+251%
Total	249 234	304 362	374 775	450 618	523 517	600 104	685 631	828 637	+332%

Data from alternate years are provided and refer to numbers of ultrasound examination.
[a] Percentage growth from 1998 to 2012.

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Table 2
Change in use of ED ultrasonography examinations of different body areas from 1998 to 2012, stratified by the physician specialty interpreting and billing for the examination

	Emergency physicians			Radiologists			Other physicians		
	1998	2012	Change[a]	1998	2012	Change[a]	1998	2012	Change[a]
Vascular	134	2569	+1917%	87 833	408 320	+465%	20 511	63 435	+309%
Abdomen	352	13 041	+3705%	82 831	183 535	+222%	3932	2406	−39%
Complete	63	141	+224%	53 374	52 531	−2%	2789	551	−80%
Limited	289	12 896	+4462%	29 457	128 267	+435%	1143	1828	+160%
Neuro	0	4	–	21	96	+457%	1	0	−100%
Retroperitoneum	27	3996	+14 800%	26 377	40 919	+155%	1212	384	−68%
Complete	4	133	+3325%	19 485	25 905	+133%	1026	148	−86%
Limited	23	3863	+16 796%	6892	15 014	+218%	186	236	+127%
Head/neck	3	135	+4500%	1010	2471	+245%	34	23	−32%
Chest	3	2592	+86 400%	494	1287	+261%	17	235	+1382%
Breast	1	35	+3500%	2298	2154	−6%	50	30	−40%
Obstetrics	9	632	+7022%	830	14 052	+1693%	79	464	+587%
Pelvis	32	848	+2650%	20 017	74 314	+371%	1125	709	−37%
Extremity	0	1140	–	1	8710	+871 000%	0	97	–

Data refer to numbers of ultrasound examination.
[a] Percentage growth from 1998 to 2012.

During the study period, the fraction of all paid ED ultrasound examinations interpreted by radiologists remained consistently around 90% (89% in both 1998 and 2012); by emergency physicians, increased from 0.2% to 3%; and by other physicians, decreased minimally from 11% to 8%. Table 3 shows trends in the frequency of examinations of the various body areas performed by the different specialists. In terms of the highest-volume categories, paid vascular studies interpreted by radiologists varied from 81% (1998) to 86% (2012); by emergency physicians, remained less than 1% throughout; and by other physicians, from 19% to 13%. The fraction of paid abdomen studies interpreted by radiologists varied from 95% to 92%; by emergency physicians, increased from less than 1% to 7%; and by other physicians, decreased from 5% to 1%. The fraction of paid chest studies interpreted by radiologists decreased from 96% to 33%; by emergency physicians, increased from less than 1% to 63%; and by other physicians, varied from 3% to 6%. The fraction of paid retroperitoneal studies interpreted by radiologists decreased from 96% to 90%; by emergency physicians, increased from less than 1% to 9%; and by other physicians, decreased from 4% to less than 1%.

Additional targeted evaluation of complete vs limited examinations showed that for paid abdominal examinations, interpretation of complete studies increased from 95% to 99% for radiologists, remained less than 1% for emergency physicians, and decreased from 5% to 1% for other physicians. In comparison, paid interpretation of limited abdomen studies by radiologists decreased from 95% to 90%; by emergency physicians, increased from 1% to 9%; and by other physicians, decreased from 4% to 1%. Similarly, paid interpretation of complete retroperitoneal studies increased from 95% to 99% for radiologists, remained less than 1% for emergency physicians, and decreased from 5% to less than 1% for other physicians, whereas paid interpretation of limited retroperitoneal studies decreased from 97% to 79% for radiologist, increased from less than 1% to 20% for emergency radiologists, and varied from 3% to 1% for other physicians (Figure).

Table 3
Fraction of ED ultrasound examinations of different body areas interpreted and billed by different physician specialties in 1998 and 2012

	Emergency physicians		Radiologists		Other physicians	
	1998	2012	1998	2012	1998	2012
Vascular	<1%	<1%	81%	86%	19%	13%
Abdomen	<1%	7%	95%	92%	5%	1%
Complete	<1%	<1%	95%	99%	5%	1%
Limited	1%	9%	95%	90%	4%	1%
Retroperitoneum	<1%	9%	96^	90%	4%	<1%
Complete	<1%	<1%	95%	99%	5%	<1%
Limited	<1%	20%	97%	79%	3%	1%
Chest	<1%	63%	96%	31%	3%	6%

4. Discussion

Between 1998 and 2012, there was substantial growth (by >300%) in paid ultrasound examinations performed in the ED setting on Medicare fee-for-service beneficiaries. This growth was observed across all body areas evaluated for radiologists, emergency physicians, and other specialists alike. Thus, the growth cannot be attributed to changes in patterns of care by any single specialty but likely reflects broader trends in the role of ultrasonography in acute patient evaluation and management in the ED setting. Of note, ultrasound technology has steadily improved during this time, and the literature continues to document a range of clinical circumstances in which ultrasound provides added value to patient diagnosis [2,3,7,9,10,12]. Accordingly, the growth in ultrasound use during this time is not unexpected. It is particularly noteworthy that the growth persisted into the final years of the study interval. During these more recent years, various factors including federal health care reform, the recession, and expansion of appropriateness criteria as well as clinical decision support to guide the ordering of advanced imaging examinations have all had the potential to contribute to a reduction in the previous growth in use. Indeed, growth in advanced cross-sectional imaging has previously been shown to have undergone a distinct slow-down during this time [33–35]. Perhaps relating to its relatively lower cost, lack of ionizing radiation, and compelling role in the ED setting in which speed and accessibility of diagnostic testing are paramount, ED ultrasound has not shown the overall slow-down observed for other advanced imaging modalities.

Emergency physicians have strived to expand their role in the performance and interpretation of ultrasound examinations. This endeavor has included investment of resources to improve overall access as well as greater focus on ultrasound skills and other training in ED training programs. Not surprisingly, then, emergency physicians showed the greatest percent growth in paid ultrasound examinations, growing by more than 4000%. Nonetheless, the percentage of all Medicare-paid ED ultrasound examinations performed by emergency physicians remained low (<10%) at the conclusion of the study period. Thus, although emergency physicians have made progress in expanding the role of their specialty in ultrasonography, they continue to occupy only a small relative role overall in the performance of paid examinations in the ED setting. Further initiatives, perhaps entailing more intensive training programs or novel forms of collaboration with local radiology departments, may be required to yield a more substantial role for emergency physicians in this area should the specialty and local health systems choose to advance in this direction. Because the only available metric available from Medicare was paid claims (ie, an

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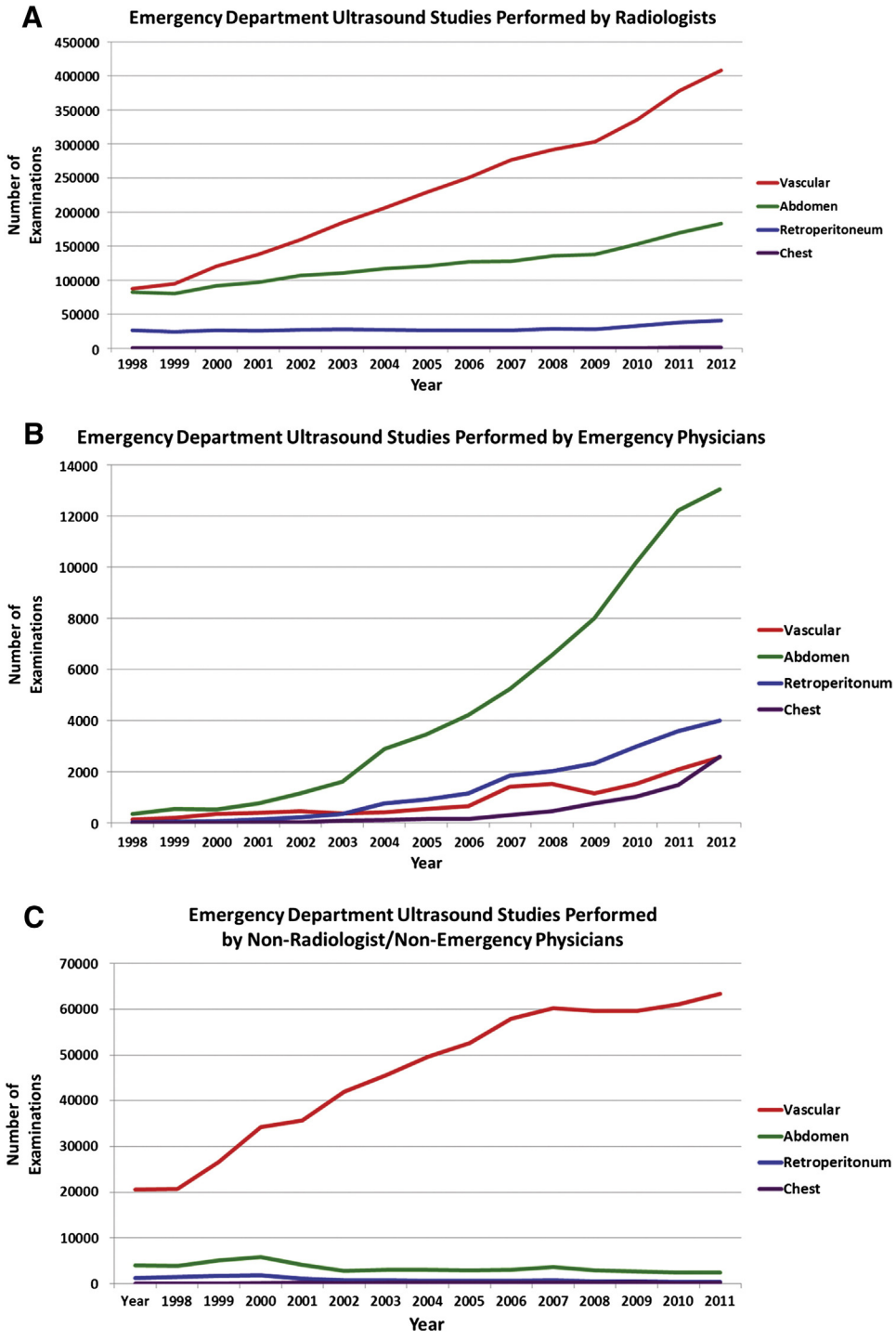

Figure. Use of ultrasonography in the ED setting for Medicare fee-for-service beneficiaries from 1998 to 2012, stratified by various high-volume examinations, for radiologists (A), emergency physicians (B), and other specialists (C).

examination performed but never billed cannot be captured), initiatives at the practice level, focusing on improving documentation, charge capture, and billing, might help increase these numbers as well.

An intriguing finding of our study was that, although all specialists showed substantial growth in use of ED ultrasonography, disparities exhibited between specialists in terms of the relative complexity of examinations showing the greatest growth. Namely, emergency physicians showed particularly rapid growth in limited abdominal and limited retroperitoneal studies. In comparison, complete abdominal and complete retroperitoneal ultrasounds, although evaluating similar and overlapping general body regions, did not show any substantial relative growth by emergency physicians. A number of factors likely contributed to these differences. The former studies represent quicker and more focused examinations that may lend themselves to rapid performance and interpretation at the patient bedside, thus seeming well suited to the hectic workflow of emergency physicians. These examinations are also anticipated to be easier to learn to perform and interpret, thereby providing an entry point as emergency physicians seek to provide services in this area. In addition, higher documentation burdens for higher complexity examinations may reflect obstacles to charge capture. An important consideration relates to potential voids in access to emergency ultrasound services offered by radiology practices. Some radiology

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practices either choose or are unable to provide 24/7 emergency ultrasound services, creating an important coverage gap as ultrasonography plays an increasing role in emergency care. The observed growth of paid emergency physician ultrasound may relate to this lack of 24/7 emergency ultrasound coverage, with emergency physicians filling a service void by offering time-sensitive performance of less detailed examinations focused on specific clinical questions at hand. For at least some of these reasons, the overall rapid growth in emergency ultrasonography over the last 15 years appears to be associated with distinct alterations in how ultrasonography is performed in the ED setting, shifting away from the traditional comprehensive examinations typically offered almost exclusively by radiologists.

Note that although the largest growth for emergency physicians was in chest ultrasound examinations, CPT coding rules do not differentiate these services by complex vs limited examination type. As such, a targeted scan for pleural effusion would accurately be reported using the generic chest ultrasound code as would a detailed examination evaluating, for example, anterior mediastinal lymphadenopathy. In view of this coding scheme, the dramatic relative increase in thoracic ultrasonography by emergency physicians is, we believe, similarly explained as a disproportionate increase in lower-complexity chest ultrasound studies, reflective of the typical services provided by emergency physicians in this setting.

5. Limitations

A primary limitation of this study is its derivation from an administrative Medicare claims data set that focuses exclusively on a Medicare fee-for-service population. We acknowledge that trends may be different within the general population of non-Medicare patients being cared for in the ED setting. However, similar data sets pertaining to the privately insured population are generally proprietary and not publicly available for analysis. Such data sources represent opportunities for future complementary investigation. In addition, the data set that we used only reflects ultrasound examinations that were paid by Medicare, which requires complete documentation, reporting, and correct billing of the examination. Examinations performed but not billed are, by definition, excluded from claims data sets. This may introduce bias into the results given a potential for emergency physicians to perform unbilled examinations on an emergent basis at the bedside for which charges might not be captured. Nonetheless, from a policy perspective, it is ultimately only those examinations that are fully documented, reported, and then subsequently billed that impact health care costs. An additional limitation inherent to the use of PSPS files is that only aggregate claims data are available; individual encounter-related information is unknown. Therefore, it is not possible to evaluate differences in patient outcomes between those whose ultrasound examinations are performed by different specialists, or to identify factors that may predict which specialist is more likely to perform an ultrasound examination in a given context. Furthermore, aggregated PSPS master files preclude identification—and therefore comparison—of services performed at academic vs community facilities. It is expected that academic facilities engaged in a large amount of teaching would likely show more substantial growth in emergency physician–performed ultrasound. Such associations could be explored via use of the CMS Research Identifiable Files, but these files entail considerably far more cost and labor to interrogate. Also, because procedural, cardiac, and ocular ultrasound examinations were not evaluated, we acknowledge that these may have exhibited different trends than we report and merit further investigation in separate studies. It is our experience, however, that these are far less frequently performed by emergency physicians than the examinations we studied. Finally, a cost-analysis exploring trends in expenditures for ED ultrasound examinations performed by different specialties was not performed; nonetheless, variation in costs would be expected to generally parallel the observed trends in use.

6. Conclusion

From 1998 to 2012, there was substantial growth in ultrasound use in the ED setting among Medicare fee-for-service beneficiaries. There were also specialty shifts in examination complexity during this period, with emergency physicians showing greatest growth in less complex abdominal and less complex retroperitoneal studies and what we believe are less complex chest studies, whereas nonemergency nonradiology physicians showed the greatest growth in vascular studies. Although the relative overall growth in paid services was by far the greatest for emergency physicians, emergency physicians continue to be paid for only a relatively small fraction of all ED ultrasound examinations. Further studies may explore factors associated with differences in these specialty trends, as well as whether these specialty differences are associated with differences in clinical outcomes.

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