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The Productivity Requirements of Implementing a Medical Scribe Program

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Background: Economic analyses of medical scribes have been limited to individual, specialty-specific clinics.

Objective: To determine the number of additional patient visits various specialties would need to recover the costs of implementing scribes in their practice at 1 year.

Design: Modeling study based on 2015 data from the Centers for Medicare & Medicaid Services (CMS) and National Ambulatory Medical Care Survey. Scribe costs were based on literature review and a third-party contractor model. Revenue was calculated from direct visit billing, CPT (Current Procedural Terminology) billing, and data from the National Ambulatory Medical Care Survey.

Data Sources: 2015 data from CMS and the National Ambulatory Medical Care Survey.

Target Population: Health care providers.

Time Horizon: 1 year.

Perspective: Office-based clinic.

Outcome Measures: The number of additional patient visits a physician must have to recover the costs of a scribe program at 1 year.

Results of Base-Case Analysis: An average of 1.34 additional new patient visits per day (295 per year) were required to recover scribe costs (range, 0.89 [cardiology] to 1.80 [orthopedic surgery] new patient visits per day). For returning patients, an average of 2.15 additional visits per day (472 per year) were required (range, 1.65 [cardiology] to 2.78 [orthopedic surgery] returning visits per day). The addition of 2 new patient (or 3 returning) visits per day was profitable for all specialties.

Results of Sensitivity Analysis: Results were not sensitive to most inputs, with the exception of hourly scribe cost and inclusion of CPT revenue.

Limitation: Use of Medicare data and failure to account for indirect costs, downstream revenue, or changes in documentation quality.

Conclusion: For all specialties, modest increases in productivity due to scribes may allow physicians to see more patients and offset scribe costs, making scribe programs revenue-neutral.

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Electronic health record documentation has replaced paper records for most physicians (1). However, electronic health records present notable disadvantages, including decreased face-to-face interaction time with patients, increased documentation burden, and increased burnout (2–8). Medical scribe programs are an increasingly common strategy to counteract burdensome documentation requirements, decrease physician documentation time, and increase workplace satisfaction (9–13).

However, integration of scribes into clinical care represents a new cost to the health care system, and whether practices can justify the additional expense remains unclear. Preliminary evidence from single specialties provides some justification. For example, studies in family medicine and emergency medicine have demonstrated that scribes can increase productivity (14–20), which could lead to increased revenue from visit billing, laboratory tests, and radiology. In addition, reports from cardiology, gastroenterology, and urology have described increased revenue after implementation of scribe programs (14, 21–24). For primary care, Basu and colleagues (25) developed a simulation model to analyze the cost–benefit ratio for scribes employed and trained by primary care clinics. This model found that primary care physicians could recover the costs of a scribe program after 1 year if each physician scheduled 351 additional visits. However, most physicians will find it infeasible to train scribes, and the financial impact of implementing scribe programs remains unknown for many specialties.

To obtain more generalizable findings, we estimated the number of additional patient visits needed to recover the costs of hiring scribes via a third-party contractor for 32 provider types designated by the Centers for Medicare & Medicaid Services (CMS), comprising 30 physician specialties, physician assistants, and nurse practitioners. We hypothesized that scribes can recover costs for all provider types through modest increases in daily patient visits.

Methods

We used an economic analysis from the office-based clinic perspective, calculating changes to costs and fee-for-service revenues for 1 year after the implementation of a scribe program. Both costs and revenues were calculated for 1 full-time scribe working with 1 full-time health care professional (HCP) (physician, physician assistant, or nurse practitioner).

Scribe Costs

We chose to evaluate the third-party contractor model for scribes—as opposed to HCPs employing and training scribes directly or training medical assistants to act as scribes—because it can be more readily imple-

Table. Costs of Medical Scribe Program and Revenue for New Visits for Selected Specialties*

Variable	Value
Scribe program costs, $	
1-time initial cost per health care professional	3000
Human resources onboarding cost per scribe	400
Hourly cost	25
Mean scribe hires per year (SD), *n*	1.49 (0.75)
Mean total cost at 1 y (SD), $	47 594 (301.02)
Mean revenue per new visit, $	
Evaluation and management codes	
Cardiology (SD)	163.99 (31.28)
Internal medicine (SD)	152.60 (37.20)
Orthopedic surgery (SD)	120.37 (28.99)
CPT codes	
Cardiology	84.52
Internal medicine	31.81
Orthopedic surgery	2.24
Mean total revenue per new visit (SD), $	
Cardiology	248.51 (31.28)
Internal medicine	184.41 (37.20)
Orthopedic surgery	122.61 (28.99)
Additional new visits at 1 y needed to recover costs of scribe program with 90% confidence, *n*	
Cardiology	195
Internal medicine	263
Orthopedic surgery	395
Additional new visits per day needed to recover costs of scribe program with 90% confidence, *n*	
Cardiology	0.9
Internal medicine	1.2
Orthopedic surgery	1.8

CPT = Current Procedural Terminology.
* A simplified example of the calculations used to estimate the number of additional visits needed to recover the costs of a scribe program for 3 specialties. The number of additional visits needed to recover the costs at 1 y is approximately the total costs of the scribe program divided by the total revenue per visit.

mented, especially in non–primary care specialties. In this model, a contractor is paid by a clinic to hire, train, and manage scribes, who act as clerical documentation assistants (26). Unexpected costs are limited because the contractor absorbs these costs (26, 27). In addition, with the third-party contractor model, scribes receive training in medical terminology and billing procedures, as well as practice shifts. Clerical documentation assistants can document both inside and outside a clinic room (28).

In our economic analysis, clinics had 3 costs when implementing a scribe program (**Table**). Our assumptions were based on previously reported scribe costs, which parallel costs our institution faced when we contracted to hire scribes for a previous study (11, 21, 29). First, clinics paid a 1-time, initial cost of $3000 that included the per-HCP fee to the third-party contractor and the cost of a laptop computer for the scribe. Second, there was a $400-per-scribe onboarding cost for human resources and information technology support in providing electronic health record access. Third, clinics paid a $25 hourly rate for the scribe. Although exact rates vary by contract and location, published rates for third-party contractors and total costs for practices training their own scribes exist in a tight range around $25 per hour (21, 24, 29).

Because scribe programs face turnover, which increases the number of times a clinic pays the onboarding cost, we developed a Monte Carlo model for scribe turnover. On the basis of previous work, we assumed that 25% of new hires would quit at 1 month or fail initial training (30). Scribes who remained after 1 month were assumed to work for a mean of 15 months (SD, 3), in line with the 1-year minimum term many companies require (31). We assumed that service would be continuous, so that a scribe leaving would be immediately replaced, as stipulated by the contract with the third-party company. We also assumed that scribe quality would be continuous and that the third-party contractor would fully train each scribe before they worked on their own, which is usual practice. We ran 1000 simulations using the @Risk Excel plugin, version 7.6 (Palisade), to calculate the mean and SD for the number of scribes a clinic would need to hire per HCP in the first year of the program.

Scribe Revenue

We estimated gross revenues from both direct visit billing and CPT (Current Procedural Terminology) codes for each additional patient visit for each medical specialty. To estimate billing revenue, we used 2015 CMS national billing data from the Medicare Provider Utilization and Payment Data files for 32 provider types (32). We limited our analysis to evaluation and management (E/M) level-of-service billing codes for new and established outpatient visits (99201-99205 and 99211-99215), representing approximately 210 million visits. For each provider type, we calculated the percentage of new and returning visits that were billed to Medicare at each E/M level of service nationally. Each code was matched with its corresponding 2015 nonfacility price E/M reimbursement rate (**Appendix Table 1**, available at Annals.org). Using the percentage of visits billed for each reimbursement rate, we calculated a mean and SD for the billing revenue received from each new and returning visit for each provider type. To account for revenue from laboratory tests and radiology services ordered during visits, we used specialty-specific data from the 2012-to-2016 National Ambulatory Medical Care Survey. These data provided the percentage of 24 laboratory tests and radiology services (designated by CPT codes) ordered at new and returning visits for each specialty (the footnote of **Appendix Table 2**, available at Annals.org, gives the full list). The percentage of visits with each individual service was multiplied by the mean revenue per CPT code from 2015 CMS billing data to derive estimates of mean CPT revenue by provider type. Specialties as listed in National Ambulatory Medical Care Survey data did not align perfectly with CMS provider types and required some extrapolation (for example, internal medicine data were used for geriatrics). The revenue from billing by provider type was

then added to the mean CPT revenue for each provider type, resulting in specialty-specific data on total revenue per visit (Table and Appendix Table 2). We could not include revenue for downstream procedures or operations because literature to support the rate of specialty visits that lead to such events is scant.

Data and Sensitivity Analysis

We calculated the additional number of patient visits needed to have 90% confidence (margin of safety) that scribe revenues would be at least equal to scribe costs after 1 year. We assumed that HCPs would work 220 eight-hour clinic days per year (5 clinic days per week for 44 weeks per year) and that scribe shifts would match this schedule (25). Our model's output was the number of additional visits in the first year needed to recover costs, which we divided by 220 clinic days to calculate daily additional visits. The scribe program was defined to have recovered its costs if gross revenue from additional patient visits was equal to total cost (that is, net revenue was $0) and to be profitable if gross revenue exceeded cost.

Sensitivity analyses were done on the percentage of scribes who leave after 1 month, the mean length of scribe tenure, each of the 3 scribe costs, and the number of clinic days per year. We also did sensitivity analyses on the distribution of E/M level-of-service codes, which might be higher on average in our Medicare data set than in the overall population, and examined how a change in CPT revenue affected results. In addition, we used our scribe cost data alongside the monthly capitation payment assumed by Basu and colleagues (25) ($19.43 per person per month; 2.2 average patient visits per year) to calculate the number of additional patients who would need to be empaneled under a capitated payment model for primary care. The University of Chicago Institutional Review Board deemed this study secondary research exempt from approval under protocol IRB19-0761.

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RESULTS

Base-Case Analysis

The mean cost of implementing a scribe program was estimated to be $47 594 (SD, $301) for the first year. For all provider types, the implementation of scribes was profitable at 1 year using our model when HCPs saw an additional 2 new or 3 returning patients each day (the Table gives specific examples). Averaging among provider types, we found that the mean number of additional new visits needed to recover costs was 1.34 per day or 295 per year. The mean number of additional returning visits needed to recover costs was 2.15 per day or 472 per year. The exact number of additional visits varied between provider types by only about 1 additional visit per day (Figure 1). Cardiology required the fewest new or returning visits to recover costs (an additional 0.89 new or 1.65 returning visits per day or 195 new or 364 returning visits per year).

Procedural and surgical specialties tended to have lower E/M codes and less CPT revenue, leading to more visits needed to recover costs, when procedural or surgical revenue streams were not considered. Of note, orthopedic surgery required the most new or returning visits: an additional 1.80 new or 2.78 returning visits per day (395 new or 612 returning visits per year). Excluding procedural and surgical specialties (radiation oncology; otolaryngology; ophthalmology; and general, vascular, and orthopedic surgery) reduced the mean number of new visits needed to recover costs by 9 per year (286 per year or 1.30 per day) and the mean number of returning visits needed by 21 per year (451 per year or 2.05 per day).

Sensitivity Analysis

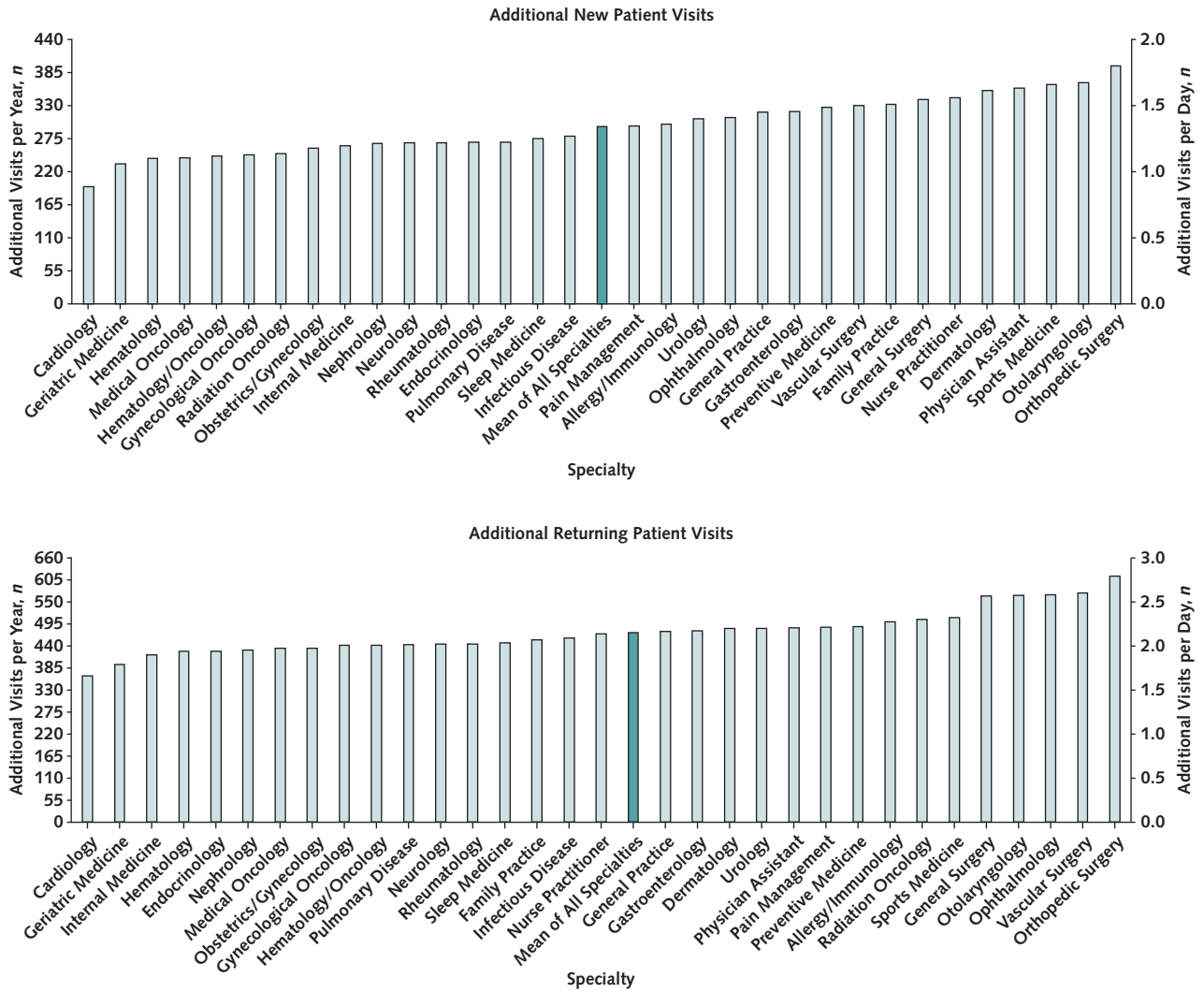
Results were not sensitive to changes in scribe turnover or tenure (Appendix Table 3, available at Annals.org). Increasing the scribe turnover rate (that is, decreasing scribe tenure to 9 months and increasing the percentage of scribes who leave after 1 month to 35%) increased results by about 1%. Also, a lower scribe turnover rate (that is, increasing the mean scribe tenure to 21 months and decreasing the percentage of scribes who leave after 1 month to 15%) changed results by less than 1%.

Results were sensitive to changes in hourly scribe cost (Figure 2). Changing the hourly cost by $5 per hour changed the number of visits needed to recover costs by about 18% across provider types (Appendix Table 4, available at Annals.org). Results were less sensitive to other changes in scribe costs. Changing the 1-time initial cost of starting the scribe program by $2000 changed the number of additional visits required to recover costs by about 4% across provider types (Appendix Table 5, available at Annals.org). Decreasing the onboarding cost per scribe to $100 resulted in a decrease of approximately 1% in additional visits required to recover costs across provider types; in contrast, tripling the onboarding cost to $1200 increased the number of visits needed by about 3% (Appendix Table 6, available at Annals.org).

Our initial assumption was that each HCP worked full time (220 clinic days per year). We reduced this effort to 75% (165 days per year) and 50% (110 days per year) (Appendix Table 7, available at Annals.org). Compared with an HCP working at 100% of full time, an HCP working at 75% of full time would have to increase the number of additional visits per day by about 3% to recover scribe costs. Similarly, an HCP working at 50% of full time would have to increase the number of additional visits per day by about 9%, regardless of their specialty.

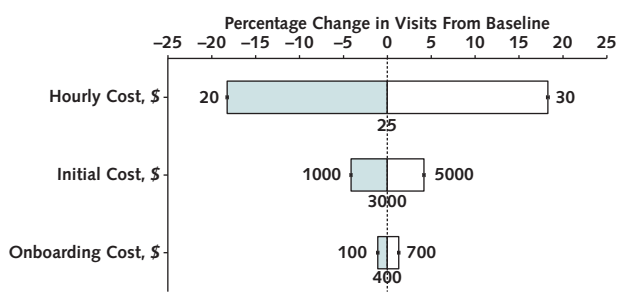
We created adjusted distributions by moving 10% of the codes originally billed at each E/M level of

Figure 1. Additional number of patient visits to recover costs after implementation of medical scribes.



Reported values are the number of additional visits required to have 90% confidence that the costs of implementing a medical scribe program will be recovered at 1 y.

Figure 2. Sensitivity analyses of input costs.



There is a small amount of variation in the percentage change in visits between provider types due to rounding because our model requires the number of visits to be an integer. As such, we report a mean and SD (*error bars*).

service per provider type down (or up) 1 level (for example, 10% of codes originally billed at level 5 became level 4 codes) (**Appendix Table 8**, available at Annals.org). For all provider types, this led to a change of only 2% to 4% in the number of additional visits needed to recover the costs of a scribe.

Results were sensitive to decreasing the laboratory and radiology revenue generated from CPT codes (**Appendix Table 9**, available at Annals.org). Cardiology, dermatology, obstetrics and gynecology, and internal medicine were the specialties most sensitive to changes. For example, removing all CPT revenue increased the number of additional visits for internal medicine by 21% for new visits and 27% for returning visits.

Using capitation in place of fee-for-service would require an HCP to empanel 206 additional patients, resulting in approximately 453 additional visits per year (2.06 visits per day).

DISCUSSION

We found that a scribe program would likely break even or be profitable for all Medicare-billing provider types when HCPs have 2 additional new patient visits or 3 additional returning patient visits each clinic day. For HCPs seeing an average of 20 patients per day, this represents a 10% to 15% increase in visits, which approximates the 10% to 20% average productivity increases reported by previous studies of scribe programs (14, 15, 18). Applying our results to this previous work suggests that the increase in productivity due to scribes should generally offset the costs of starting a scribe program. However, past studies have found large variations in the productivity increase with a scribe between specialties and even between individual physicians within a specialty (14, 15, 18, 21, 33). Taking this variability into account, our findings suggest that most, but not necessarily all, practices would be able to recover costs 1 year after the implementation of a scribe program. However, even slight increases to patient volume may not be practical or possible for every practice, and some HCPs may not want to change their documentation workflow.

Our results for primary care specialties were similar to the findings of Basu and colleagues (25), who examined scribe programs for only primary care. Their study found that a physician in a fee-for-service primary care clinic would need to schedule 351 additional visit slots over the course of the program's first year to recover the costs of using full-time scribes. This finding is similar to our result for family medicine, in which an HCP would need an additional 331 new patient visits or 454 returning patient visits to recover costs. Although the models yielded similar results, our approaches had important differences. Basu and colleagues used scribe wages as the basis for scribe costs and assumed an initial, temporary loss of productivity. In contrast, we used the third-party contractor model, which requires a higher annual scribe salary ($44 000 vs. $26 741) and requires that scribes be fully trained and competent before being allowed to work independently, thereby reducing the likelihood of major productivity decreases (28). Although Basu and colleagues modeled an initial period of decreased productivity with scribes, other studies have shown that productivity does not decrease as a scribe starts training and that physician satisfaction with a scribe does not change over time (12, 34). Still, some HCPs may find that scribes help them become more productive only over time. Because our model does not assume any specific amount of increased productivity due to a scribe and instead reports average productivity requirements, our results would not change if scribes initially decreased productivity.

Basu and colleagues' study also examined the use of medical assistants as scribes, which we did not examine because we assumed that many clinics, especially among non–primary care specialties, would not be interested in providing the additional training and supervision needed for such a model. It is also notable that the outcome of Basu and colleagues' model is additional scheduled patient visit slots, which could be affected by no-show visits. Because no-show rates differ widely by specialty and individual HCP, we report an outcome of additional patient visits, not visit slots. To apply our results to a scheduling template, it would be necessary to account for the expected no-show rate.

A strength of our model was its applicability to physicians in various clinics. Not only were we able to show specialty-specific data, but because the largest cost in our model is the hourly scribe cost, our results scaled well even for physicians who are not in the clinic full time. This finding is likely to be of special interest to procedural and surgical specialties where HCPs frequently work outside the clinic. Moreover, by separating new and returning patient visits, we could account for specialties and individual clinics that see different ratios of new and returning patients. We also showed that the number of additional visits needed to recover the costs of a scribe was sensitive to CPT revenue, such that clinics that do not receive revenue from these sources may not find a scribe program to be as financially sustainable.

Although we accounted for possible variations from our assumptions with sensitivity analyses, our approach still had some limitations. Our model did not account for downstream revenue from future appointments, tests, procedures, or operations because extant literature could not provide estimates for most specialties and revenue likely varies between HCPs within a specialty. The potential effect of downstream revenue could be large, especially for procedural and surgical specialties. For example, past work in cardiology has shown that indirect and downstream revenues from additional patients seen with a scribe can be more than 10 times the additional revenue from direct visit billing (21). Individual HCPs can estimate their potential downstream revenue and then adjust down the number of visits they would need to accommodate the cost of a scribe. Although some studies have shown increased per-patient revenue with scribes due to improved documentation (35), other studies have shown no significant change (15, 18, 36, 37). As such, we did not assume changes to per-patient revenue, although some clinics may benefit from this additional revenue as well. To our knowledge, no study to date has reported decreased per-patient revenue after scribe implementation.

The importance of CPT and downstream revenue complicates decisions for administrators who may be debating whether to implement a scribe program. Large health care systems are much more likely to capture these streams of revenue from additional patients because revenue from laboratory tests and referrals is more likely to be contained within the health system. Larger clinics also may be more equipped to train their own scribes directly. In doing so, they would face larger startup costs but could pay scribes less than the hourly fee charged by third-party contractors (34, 37). However, the third-party model will likely persist because of the upfront expense and resources required to maintain a scribe training program (26, 27). Another limitation is that our model did not account for indirect costs:

More patient visits may require a clinic to use more supplies and hire more clinic staff. Because both indirect costs and revenues are likely to vary greatly between individual clinics, attempting to model them was beyond this study's scope.

Our model's use of Medicare fee-for-service data to help determine average visit revenue was a limitation and strength. Because Medicare patients are likely to be on average older and sicker than non-Medicare patients, their visits are more likely billed at higher E/M levels of service, possibly inflating average revenue per patient across all specialties. However, when we adjusted the distribution of the E/M level-of-service codes of each provider type as part of our sensitivity analysis, the effect was minimal, suggesting that our results would not change appreciably if we considered non-Medicare patients. In addition, many practices are moving away from fee-for-service payments toward value-based systems like bundled payments and capitation. Because the Bundled Payments for Care Improvement initiative predates our CMS data, our results already included some effects of bundled care payments on reimbursement (38).

Regarding capitation, our cost model predicted that HCPs would need 453 additional visits per year to recover scribe costs, which was higher than Basu and colleagues' estimate (317 additional patient visit slots) (25). Although we used the same capitation assumptions as Basu and colleagues, our estimates were higher because we modeled a higher scribe cost. In addition, we required 90% certainty of breaking even, which translated to higher costs to accommodate the uncertainty. This analysis showed that practices can recover costs with reasonable adjustments under value-based payment systems as well.

Acknowledging our model's limitations, we found that only a modest increase in patient visits per day was needed to recover costs in all specialties—an important argument for the implementation of scribe programs. Although not every clinic may profit from scribe implementation, scribes repeatedly have been shown to increase physician satisfaction and face-to-face time between physicians and patients without decreases in patient satisfaction (9, 11, 12). It is difficult to economically quantify scribes' positive effect on physician satisfaction, but previous work has shown that there is a societal economic cost attributable to burnout (39, 40). Future work to predict the economic impact of scribes on mitigating physician burnout would be important.

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References

1. **Heisey-Grove D, Patel V.** Any, certified, and basic: quantifying physician EHR adoption through 2014. ONC data brief no. 28. Office of the National Coordinator for Health Information Technology; 2015.
2. **Friedberg MW, Chen PG, Van Busum KR, et al.** Factors affecting physician professional satisfaction and their implications for patient care, health systems, and health policy. Rand Health Q. 2014;3:1. [PMID: 28083306]
3. **Babbott S, Manwell LB, Brown R, et al.** Electronic medical records and physician stress in primary care: results from the MEMO Study. J Am Med Inform Assoc. 2014;21:e100-6. [PMID: 24005796] doi:10.1136/amiajnl-2013-001875
4. **Gregory ME, Russo E, Singh H.** Electronic health record alert-related workload as a predictor of burnout in primary care providers. Appl Clin Inform. 2017;8:686-697. [PMID: 28678892] doi:10.4338/ACI-2017-01-RA-0003
5. **Shanafelt TD, Dyrbye LN, Sinsky C, et al.** Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction. Mayo Clin Proc. 2016;91:836-48. [PMID: 27313121] doi:10.1016/j.mayocp.2016.05.007
6. **Bae J, Encinosa WE.** National estimates of the impact of electronic health records on the workload of primary care physicians. BMC Health Serv Res. 2016;16:172. [PMID: 27160147] doi:10.1186/s12913-016-1422-6
7. **Ehrenfeld JM, Wanderer JP.** Technology as friend or foe? Do electronic health records increase burnout? Curr Opin Anaesthesiol. 2018;31:357-360. [PMID: 29474217] doi:10.1097/ACO.0000000000000588
8. **Lee WW, Alkureishi MA, Ukabiala O, et al.** Patient perceptions of electronic medical record use by faculty and resident physicians: a mixed methods study. J Gen Intern Med. 2016;31:1315-1322. [PMID: 27400921] doi:10.1007/s11606-016-3774-3
9. **Berger E.** Medical scribe industry booms. Ann Emerg Med. 2015;65:11A-13A. doi:10.1016/j.annemergmed.2015.02.016
10. **The Joint Commission.** Documentation assistance provided by scribes. Accessed at www.jointcommission.org/standards/standard-faqs/behavioral-health/record-of-care-treatment-and-services-rc/000002210 on 8 August 2020.
11. **Pozdnyakova A, Laiteerapong N, Volerman A, et al.** Impact of medical scribes on physician and patient satisfaction in primary care. J Gen Intern Med. 2018;33:1109-1115. [PMID: 29700790] doi:10.1007/s11606-018-4434-6
12. **Gidwani R, Nguyen C, Kofoed A, et al.** Impact of scribes on physician satisfaction, patient satisfaction, and charting efficiency: a randomized controlled trial. Ann Fam Med. 2017;15:427-433. [PMID: 28893812] doi:10.1370/afm.2122

13. **Martel ML, Imdieke BH, Holm KM, et al.** Developing a medical scribe program at an academic hospital: the Hennepin County Medical Center experience. Jt Comm J Qual Patient Saf. 2018;44:238-249. [PMID: 29759257] doi:10.1016/j.jcjq.2018.01.001
14. **Earls ST, Savageau JA, Begley S, et al.** Can scribes boost FPs' efficiency and job satisfaction? J Fam Pract. 2017;66:206-214. [PMID: 28375393]
15. **Walker K, Ben-Meir M, O'Mullane P, et al.** Scribes in an Australian private emergency department: a description of physician productivity. Emerg Med Australas. 2014;26:543-8. [PMID: 25330990] doi:10.1111/1742-6723.12314
16. **Arya R, Salovich DM, Ohman-Strickland P, et al.** Impact of scribes on performance indicators in the emergency department. Acad Emerg Med. 2010;17:490-4. [PMID: 20536801] doi:10.1111/j.1553-2712.2010.00718.x
17. **Addesso LC, Nimmer M, Visotcky A, et al.** Impact of medical scribes on provider efficiency in the pediatric emergency department. Acad Emerg Med. 2019;26:174-182. [PMID: 30069952] doi:10.1111/acem.13544
18. **Walker KJ, Ben-Meir M, Phillips D, et al.** Medical scribes in emergency medicine produce financially significant productivity gains for some, but not all emergency physicians. Emerg Med Australas. 2016;28:262-7. [PMID: 26954293] doi:10.1111/1742-6723.12562
19. **Zallman L, Finnegan K, Roll D, et al.** Impact of medical scribes in primary care on productivity, face-to-face time, and patient comfort. J Am Board Fam Med. 2018;31:612-619. [PMID: 29986987] doi:10.3122/jabfm.2018.04.170325
20. **Heaton HA, Castaneda-Guarderas A, Trotter ER, et al.** Effect of scribes on patient throughput, revenue, and patient and provider satisfaction: a systematic review and meta-analysis. Am J Emerg Med. 2016;34:2018-2028. [PMID: 27534432] doi:10.1016/j.ajem.2016.07.056
21. **Bank AJ, Obetz C, Konrardy A, et al.** Impact of scribes on patient interaction, productivity, and revenue in a cardiology clinic: a prospective study. Clinicoecon Outcomes Res. 2013;5:399-406. [PMID: 23966799] doi:10.2147/CEOR.S49010
22. **Ewelukwa O, Perez R, Carter LE, et al.** Incorporation of scribes into the inflammatory bowel disease clinic improves quality of care and physician productivity. Inflamm Bowel Dis. 2018;24:552-557. [PMID: 29462396] doi:10.1093/ibd/izx078
23. **Golob JF Jr, Como JJ, Claridge JA.** Trauma surgeons save lives–scribes save trauma surgeons! Am Surg. 2018;84:144-148. [PMID: 29428043]
24. **McCormick BJ, Deal A, Borawski KM, et al.** Implementation of medical scribes in an academic urology practice: an analysis of productivity, revenue, and satisfaction. World J Urol. 2018;36:1691-1697. [PMID: 29637266] doi:10.1007/s00345-018-2293-8
25. **Basu S, Phillips RS, Bitton A, et al.** Finance and time use implications of team documentation for primary care: a microsimulation. Ann Fam Med. 2018;16:308-313. [PMID: 29987078] doi:10.1370/afm.2247
26. **Gellert GA, Ramirez R, Webster SL.** The rise of the medical scribe industry: implications for the advancement of electronic health records. JAMA. 2015;313:1315-6. [PMID: 25504341] doi:10.1001/jama.2014.17128
27. **Morawski K, Childs-Roshak J, Weitberg A.** Scribes: re-writing the story on patient and provider experience. Healthc (Amst). 2017;5:95-97. [PMID: 28526590] doi:10.1016/j.hjdsi.2017.04.001
28. **ScribeAmerica.** Outpatient medical scribes for doctors & physicians. Accessed at www.scribeamerica.com/outpatient-scribes on 18 May 2020.
29. **Chesanow N.** Hate dealing with an EHR? Use a scribe and profits increase. Medscape. 27 February 2014. Accessed at www.medscape.com/viewarticle/820716_7 on 25 January 2020.
30. **Meyer H.** The doctor (and his scribe) will see you now. Hosp Health Netw. 2010;84:41-2, 44. [PMID: 21268503]
31. **Rich N.** The impact of working as a medical scribe [Letter]. Am J Emerg Med. 2017;35:517. [PMID: 28089242] doi:10.1016/j.ajem.2016.12.020
32. **Centers for Medicare & Medicaid Services.** Medicare provider utilization and payment data: physician and other supplier PUF CY2015. Accessed at www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Provider-Charge-Data/Physician-and-Other-Supplier2015 on 2 November 2019.
33. **Walker K, Ben-Meir M, Dunlop W, et al.** Impact of scribes on emergency medicine doctors' productivity and patient throughput: multicentre randomised trial. BMJ. 2019;364:l121. [PMID: 30700408] doi:10.1136/bmj.l121
34. **Walker KJ, Dunlop W, Liew D, et al.** An economic evaluation of the costs of training a medical scribe to work in emergency medicine. Emerg Med J. 2016;33:865-869. [PMID: 27352788] doi:10.1136/emermed-2016-205934
35. **Gupta NJ, Kopp M, Becker BM.** Scribes in an academic emergency department lead to increased charges and decreased down coding. Ann Emerg Med. 2014;64(Suppl):S88. doi:10.1016/j.annemergmed.2014.07.274
36. **Marshall JS, Verdick CM, Tanaka MS, et al.** Implementation of medical scribes in an academic emergency department: effect on emergency department throughput, clinical productivity, and emergency physician professional fees. Ann Emerg Med. 2012;60(Suppl):S105. doi:10.1016/j.annemergmed.2012.06.274
37. **Glassdoor.** Salary: medical scribe. Accessed at www.glassdoor.com/Salaries/medical-scribe-salary-SRCH_KO0,14.htm on 22 July 2019.
38. **Chen LM, Meara E, Birkmeyer JD.** Medicare's Bundled Payments for Care Improvement initiative: expanding enrollment suggests potential for large impact. Am J Manag Care. 2015;21:814-20. [PMID: 26633254]
39. **Han S, Shanafelt TD, Sinsky CA, et al.** Estimating the attributable cost of physician burnout in the United States. Ann Intern Med. 2019;170:784-790. [PMID: 31132791] doi:10.7326/M18-1422
40. **Shanafelt T, Goh J, Sinsky C.** The business case for investing in physician well-being. JAMA Intern Med. 2017;177:1826-1832. [PMID: 28973070] doi:10.1001/jamainternmed.2017.4340

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Appendix Table 1. Prevalence and Reimbursement of E/M Billing Levels, by Provider Type, Using 2015 Data From the Centers for Medicare & Medicaid Services*

Provider Type	New Patients					Returning Patients				
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 1	Level 2	Level 3	Level 4	Level 5
Direct clinical revenue, $	43.98	75.08	109.05	165.90	208.45	20.02	43.98	72.94	108.34	146.24
Allergy/immunology	0.04	1.30	31.57	59.50	7.58	2.63	4.31	53.83	37.02	2.22
Cardiology	0.06	1.27	15.88	63.17	19.61	6.35	1.82	28.14	57.95	5.75
Dermatology	4.61	43.11	50.21	1.97	0.10	0.49	22.09	61.09	16.16	0.16
Endocrinology	0.03	0.42	12.67	64.07	22.81	0.60	1.04	24.37	66.85	7.14
Family practice	0.27	11.99	53.07	31.22	3.45	2.08	2.42	43.69	49.14	2.67
Gastroenterology	0.36	6.94	38.00	49.16	5.55	0.52	4.89	48.30	42.00	4.29
General practice	0.27	11.23	46.73	34.98	6.80	2.11	5.84	50.64	38.43	2.98
General surgery	1.66	12.20	43.57	33.98	8.59	1.29	20.29	50.69	24.04	3.69
Geriatric medicine	0.06	1.78	12.49	39.55	46.12	3.08	1.96	25.80	59.52	9.65
Gynecological oncology	0.17	1.26	9.05	33.85	55.67	0.36	2.60	37.38	47.72	11.94
Hematology	0.22	0.36	5.61	33.33	60.48	1.05	1.97	27.70	55.17	14.11
Hematology/oncology	0.03	0.46	7.24	36.38	55.90	2.09	2.45	32.17	52.24	11.05
Infectious disease	0.17	2.29	20.58	52.98	23.98	1.51	4.23	38.84	47.42	8.00
Internal medicine	0.16	3.85	28.82	51.26	15.91	2.64	2.59	40.77	49.65	4.35
Medical oncology	0.16	0.55	6.82	30.99	61.48	1.81	2.12	30.16	52.64	13.26
Nephrology	0.01	0.78	12.69	59.09	27.43	0.94	1.12	27.13	62.14	8.67
Neurology	0.15	0.85	8.94	52.32	37.75	0.29	1.75	28.57	54.95	14.44
Nurse practitioner	1.14	18.14	49.61	27.13	3.98	1.64	5.42	48.88	41.44	2.62
Obstetrics/gynecology	0.38	8.21	38.95	40.95	11.50	0.78	9.30	54.53	31.31	4.08
Ophthalmology	0.13	1.99	18.46	74.86	4.56	0.65	11.86	51.60	33.12	2.77
Orthopedic surgery	0.37	7.15	69.21	21.50	1.78	0.28	13.23	62.52	22.83	1.14
Otolaryngology	0.40	6.95	66.44	24.68	1.54	0.38	9.97	62.39	26.18	1.08
Pain management	0.13	1.42	28.19	63.01	7.25	1.23	4.02	50.42	42.71	1.63
Physician assistant	1.55	21.31	53.35	22.07	1.72	0.65	8.19	54.28	35.23	1.65
Preventive medicine	0.82	5.27	47.03	38.02	8.87	0.48	7.35	50.22	37.45	4.50
Pulmonary disease	0.05	0.81	13.58	60.05	25.50	0.54	1.27	35.80	55.20	7.20
Radiation oncology	0.16	1.46	9.06	36.55	52.76	1.05	11.39	53.93	26.14	7.49
Rheumatology	0.12	0.54	12.20	63.33	23.80	0.56	1.87	33.26	59.85	4.46
Sleep medicine	0.23	1.62	15.87	61.41	20.87	0.60	2.26	35.86	55.18	6.11
Sports medicine	0.09	3.17	74.25	22.06	0.43	0.16	7.76	58.97	32.07	1.04
Urology	0.31	4.55	35.86	53.55	5.73	1.69	7.20	52.13	35.85	3.12
Vascular surgery	1.05	8.77	42.88	39.17	8.13	1.53	19.48	53.28	23.27	2.44

E/M = evaluation and management.
* Values are percentages unless otherwise indicated. Sum of prevalence across billing levels may not equal 1 due to rounding.

Appendix Table 2. Direct Visit Revenue, by Provider Type, Using 2015 Data From the Centers for Medicare & Medicaid Services and National Ambulatory Medical Care Survey

Provider Type	Mean Billing Revenue (SD), $		Current Procedural Terminology Revenue, $*		Mean Total Revenue (SD), $	
	New Patient	Returning Patient	New Patient	Returning Patient	New Patient	Returning Patient
Allergy/immunology	149.94 (32.04)	85.04 (23.49)	11.99	12.24	161.93 (31.88)	97.28 (23.38)
Cardiology	163.99 (31.28)	93.79 (28.17)	84.52	39.32	248.51 (31.28)	133.11 (28.17)
Dermatology	92.63 (22.28)	72.12 (20.24)	43.86	28.20	136.49 (22.28)	100.32 (20.23)
Endocrinology	167.98 (29.28)	101.22 (21.15)	11.99	12.24	179.97 (29.28)	113.46 (21.15)
Family practice	125.99 (34.83)	90.49 (23.02)	20.52	16.01	146.51 (34.83)	106.51 (23.02)
Gastroenterology	149.92 (35.77)	89.27 (23.36)	11.99	12.24	151.91 (35.77)	101.51 (23.36)
General practice	131.71 (37.81)	85.92 (24.11)	20.52	16.01	152.23 (37.81)	101.93 (24.11)
General surgery	131.68 (40.57)	77.60 (26.16)	12.04	8.60	143.72 (40.57)	86.20 (26.16)
Geriatric medicine	176.73 (35.74)	98.88 (26.34)	31.81	24.51	208.54 (35.74)	123.39 (26.34)
Gynecological oncology	183.09 (33.67)	97.64 (25.72)	11.99	12.24	195.08 (33.67)	109.88 (25.72)
Hematology	187.85 (29.28)	101.68 (25.87)	11.99	12.24	199.84 (29.28)	113.93 (25.87)
Hematology/oncology	185.12 (30.31)	97.72 (26.71)	11.99	12.24	197.11 (30.31)	109.96 (26.71)
Infectious disease	162.12 (36.05)	93.57 (26.01)	11.99	12.24	174.11 (36.05)	105.81 (26.01)
Internal medicine	152.60 (37.20)	91.55 (24.60)	31.81	24.51	184.41 (37.20)	116.06 (24.60)
Medical oncology	187.48 (30.61)	99.72 (26.90)	11.99	12.24	199.47 (30.61)	111.96 (26.90)
Nephrology	169.64 (30.96)	100.47 (22.85)	11.99	12.24	181.63 (30.96)	112.72 (22.85)
Neurology	175.93 (31.05)	102.32 (24.98)	5.14	6.87	181.07 (31.05)	109.20 (24.98)
Nurse practitioner	121.52 (37.04)	87.09 (23.48)	20.52	16.01	142.04 (37.04)	103.11 (23.48)
Obstetrics/gynecology	140.73 (39.59)	83.91 (24.31)	46.87	27.95	187.60 (39.59)	111.85 (24.31)
Ophthalmology	155.38 (27.43)	82.92 (24.13)	0.54	2.76	155.91 (27.43)	85.68 (24.13)
Orthopedic surgery	120.37 (28.99)	77.87 (21.02)	2.24	1.22	122.61 (28.99)	79.10 (21.02)
Otolaryngology	122.00 (29.65)	79.91 (20.78)	10.28	5.89	132.27 (29.65)	85.81 (20.78)
Pain management	151.52 (31.17)	87.44 (21.92)	11.99	12.24	163.51 (31.17)	99.69 (21.92)
Physician assistant	115.06 (34.05)	83.90 (22.29)	20.52	16.01	135.58 (34.05)	91.92 (22.29)
Preventive medicine	137.16 (37.55)	87.12 (24.19)	11.99	12.24	149.15 (37.55)	99.36 (24.19)
Pulmonary disease	168.23 (31.14)	97.10 (22.81)	11.99	12.24	180.22 (31.14)	109.35 (22.81)
Radiation oncology	181.67 (33.82)	83.83 (27.13)	11.99	12.24	193.66 (33.82)	96.07 (27.13)
Rheumatology	168.45 (29.70)	96.56 (21.52)	11.99	12.24	180.44 (29.70)	108.80 (21.52)
Sleep medicine	164.00 (32.48)	95.98 (22.90)	11.99	12.24	175.99 (32.48)	108.23 (22.90)
Sports medicine	120.89 (25.61)	82.72 (20.78)	11.99	12.24	132.88 (25.61)	94.97 (20.78)
Urology	142.44 (34.35)	84.94 (24.10)	14.11	15.62	157.55 (34.35)	100.56 (24.10)
Vascular surgery	135.74 (38.77)	76.51 (24.82)	12.04	8.60	147.78 (38.77)	85.11 (24.82)

* Included revenue from the following laboratory tests, radiology services, and procedures: complete blood count, comprehensive metabolic panel, basic metabolic panel, renal function panel, hepatic function panel, glycohemoglobin, serum glucose, thyroid-stimulating hormone, vitamin D, human immunodeficiency virus, gonorrhea, chlamydia, human papillomavirus DNA, blood culture, pregnancy human chorionic gonadotropin, prostate serum antigen, rapid strep, urinalysis, urine culture, pelvic examination, bone mineral density, biopsy, echocardiography (for cardiology only), and audiometry (for otolaryngology only).

Appendix Table 3. Sensitivity Analysis to Scribe Turnover and Tenure, Additional Visits per Year

Provider Type	Higher Scribe Turnover*				Lower Scribe Turnover†			
	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %
Allergy/immunology	302	503	1.0	1.0	298	496	−0.3	−0.4
Cardiology	197	368	1.0	1.1	194	363	−0.5	−0.3
Dermatology	358	487	1.1	1.0	353	480	−0.3	−0.4
Endocrinology	272	430	1.1	0.9	268	424	−0.4	−0.5
Family practice	335	459	1.2	1.1	330	452	−0.3	−0.4
Gastroenterology	323	482	0.9	1.0	319	475	−0.3	−0.4
General practice	323	480	1.3	1.1	318	473	−0.3	−0.4
General surgery	342	569	0.9	1.1	338	561	−0.3	−0.4
Geriatric medicine	235	397	0.9	1.3	232	391	−0.4	−0.3
Gynecological oncology	251	445	1.2	0.9	248	439	0.0	−0.5
Hematology	245	430	1.2	1.2	241	423	−0.4	−0.5
Hematology/oncology	248	445	0.8	0.9	245	439	−0.4	−0.5
Infectious disease	282	463	1.1	1.1	278	456	−0.4	−0.4
Internal medicine	266	421	1.1	1.0	262	415	−0.4	−0.5
Medical oncology	245	437	0.8	0.9	242	431	−0.4	−0.5
Nephrology	269	434	0.7	1.2	266	427	−0.4	−0.5
Neurology	270	448	0.7	1.1	266	442	−0.7	−0.2
Nurse practitioner	346	474	1.2	1.1	341	468	−0.3	−0.2
Obstetrics/gynecology	262	437	1.2	0.9	258	431	−0.4	−0.5
Ophthalmology	314	571	1.3	0.9	309	564	−0.3	−0.4
Orthopedic surgery	400	618	1.3	1.0	394	610	−0.3	−0.3
Otolaryngology	370	570	0.8	1.1	365	562	−0.5	−0.4
Pain management	299	490	1.0	1.0	295	483	−0.3	−0.4
Physician assistant	362	489	1.1	1.0	357	482	−0.3	−0.4
Preventive medicine	329	492	0.9	1.0	325	486	−0.3	−0.2
Pulmonary disease	272	447	1.1	1.1	268	441	−0.4	−0.2
Radiation oncology	253	510	1.2	1.0	249	503	−0.4	−0.4
Rheumatology	271	449	1.1	1.1	267	443	−0.4	−0.2
Sleep medicine	278	452	1.1	1.1	274	445	−0.4	−0.4
Sports medicine	368	514	1.1	1.0	363	507	−0.3	−0.4
Urology	311	487	1.0	1.0	307	480	−0.3	−0.4
Vascular surgery	332	576	0.9	1.1	328	568	−0.3	−0.4
Average	298	477	1.0	1.0	294	471	−0.4	−0.4

* Mean scribe tenure is 9 mo (vs. 15 mo), and 35% of scribes leave at 1 mo (vs. 25%).
† Mean scribe tenure is 21 mo (vs. 15 mo), and 15% of scribes leave at 1 mo (vs. 25%).

Appendix Table 4. Sensitivity Analysis: Scribe Hourly Salary, Additional Visits per Year

Provider Type	$30 per Hour (vs. $25)				$20 per Hour (vs. $25)			
	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %
Allergy/immunology	354	589	18.4	18.3	245	407	−18.1	−18.3
Cardiology	230	430	17.9	18.1	159	297	−18.5	−18.4
Dermatology	419	570	18.4	18.3	289	394	−18.4	−18.3
Endocrinology	318	504	18.2	18.3	220	348	−18.2	−18.3
Family practice	392	537	18.4	18.3	271	371	−18.1	−18.3
Gastroenterology	378	564	18.1	18.2	261	390	−18.4	−18.2
General practice	378	562	18.5	18.3	261	388	−18.2	−18.3
General surgery	401	666	18.3	18.3	277	460	−18.3	−18.3
Geriatric medicine	275	464	18.0	18.4	190	321	−18.5	−18.1
Gynecological oncology	294	521	18.5	18.1	203	360	−18.1	−18.4
Hematology	286	503	18.2	18.4	198	347	−18.2	−18.4
Hematology/oncology	290	521	17.9	18.1	201	360	−18.3	−18.4
Infectious disease	330	542	18.3	18.3	228	374	−18.3	−18.3
Internal medicine	311	493	18.3	18.2	215	341	−18.3	−18.2
Medical oncology	287	512	18.1	18.2	198	354	−18.5	−18.2
Nephrology	315	508	18.0	18.4	218	351	−18.4	−18.2
Neurology	316	525	17.9	18.5	219	362	−18.3	−18.3
Nurse practitioner	405	555	18.4	18.3	280	384	−18.1	−18.1
Obstetrics/gynecology	306	512	18.1	18.2	212	354	−18.1	−18.2
Ophthalmology	367	669	18.4	18.2	254	462	−18.1	−18.4
Orthopedic surgery	468	724	18.5	18.3	323	500	−18.2	−18.3
Otolaryngology	434	667	18.3	18.3	300	461	−18.3	−18.3
Pain management	351	574	18.6	18.4	242	396	−18.2	−18.4
Physician assistant	424	573	18.4	18.4	293	396	−18.2	−18.2
Preventive medicine	385	577	18.1	18.5	266	398	−18.4	−18.3
Pulmonary disease	318	523	18.2	18.3	220	361	−18.2	−18.3
Radiation oncology	296	597	18.4	18.2	205	413	−18.0	−18.2
Rheumatology	317	526	18.3	18.5	219	363	−18.3	−18.2
Sleep medicine	326	529	18.5	18.3	225	365	−18.2	−18.3
Sports medicine	431	602	18.4	18.3	298	416	−18.1	−18.3
Urology	364	570	18.2	18.3	252	393	−18.2	−18.5
Vascular surgery	389	674	18.2	18.2	269	466	−18.2	−18.2
Average	349	559	18.3	18.3	241	386	−18.2	−18.3

Appendix Table 5. Sensitivity Analysis: Initial 1-Time Cost, Additional Visits per Year

Provider Type	$5000 (vs. $3000)				$1000 (vs. $3000)			
	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %
Allergy/immunology	312	518	4.3	4.0	287	477	−4.0	−4.2
Cardiology	203	379	4.1	4.1	187	349	−4.1	−4.1
Dermatology	369	502	4.2	4.1	339	462	−4.2	−4.1
Endocrinology	280	444	4.1	4.2	258	408	−4.1	−4.2
Family practice	345	473	4.2	4.2	318	435	−3.9	−4.2
Gastroenterology	333	497	4.1	4.2	306	457	−4.4	−4.2
General practice	333	495	4.4	4.2	306	455	−4.1	−4.2
General surgery	353	586	4.1	4.1	325	540	−4.1	−4.1
Geriatric medicine	242	409	3.9	4.3	223	376	−4.3	−4.1
Gynecological oncology	259	459	4.4	4.1	238	423	−4.0	−4.1
Hematology	252	443	4.1	4.2	232	407	−4.1	−4.2
Hematology/oncology	256	459	4.1	4.1	235	422	−4.5	−4.3
Infectious disease	290	477	3.9	4.1	267	439	−4.3	−4.1
Internal medicine	274	434	4.2	4.1	252	400	−4.2	−4.1
Medical oncology	253	451	4.1	4.2	233	415	−4.1	−4.2
Nephrology	278	447	4.1	4.2	256	411	−4.1	−4.2
Neurology	279	462	4.1	4.3	256	425	−4.5	−4.1
Nurse practitioner	357	489	4.4	4.3	328	450	−4.1	−4.1
Obstetrics/gynecology	270	451	4.2	4.2	248	415	−4.2	−4.2
Ophthalmology	323	589	4.2	4.1	298	542	−3.9	−4.2
Orthopedic surgery	412	637	4.3	4.1	379	586	−4.1	−4.2
Otolaryngology	382	587	4.1	4.1	351	540	−4.4	−4.3
Pain management	309	505	4.4	4.1	284	465	−4.1	−4.1
Physician assistant	373	504	4.2	4.1	343	464	−4.2	−4.1
Preventive medicine	339	508	4.0	4.3	312	467	−4.3	−4.1
Pulmonary disease	280	461	4.1	4.3	258	424	−4.1	−4.1
Radiation oncology	261	526	4.4	4.2	240	484	−4.0	−4.2
Rheumatology	279	463	4.1	4.3	257	426	−4.1	−4.1
Sleep medicine	287	466	4.4	4.3	264	428	−4.0	−4.3
Sports medicine	379	530	4.1	4.1	349	488	−4.1	−4.1
Urology	321	502	4.2	4.1	295	462	−4.2	−4.1
Vascular surgery	343	593	4.3	4.0	316	546	−4.0	−4.2
Average	307	492	4.2	4.2	283	453	−4.1	−4.2

Appendix Table 6. Sensitivity Analysis: Change in Onboarding Costs, Additional Visits per Year

Provider Type	$1200 (vs. $400)				$100 (vs. $400)			
	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %
Allergy/immunology	310	516	3.7	3.6	296	492	−1.0	−1.2
Cardiology	202	377	3.6	3.6	192	360	−1.5	−1.1
Dermatology	367	500	3.7	3.7	350	476	−1.1	−1.2
Endocrinology	279	442	3.7	3.8	266	421	−1.1	−1.2
Family practice	343	471	3.6	3.7	328	449	−0.9	−1.1
Gastroenterology	331	494	3.4	3.6	316	471	−1.3	−1.3
General practice	330	492	3.4	3.6	316	470	−0.9	−1.1
General surgery	350	583	3.2	3.6	335	557	−1.2	−1.1
Geriatric medicine	241	407	3.4	3.8	230	388	−1.3	−1.0
Gynecological oncology	257	457	3.6	3.6	246	436	−0.8	−1.1
Hematology	251	441	3.7	3.8	239	420	−1.2	−1.2
Hematology/oncology	255	457	3.7	3.6	243	436	−1.2	−1.1
Infectious disease	289	474	3.6	3.5	276	453	−1.1	−1.1
Internal medicine	273	432	3.8	3.6	260	412	−1.1	−1.2
Medical oncology	252	448	3.7	3.5	240	428	−1.2	−1.2
Nephrology	276	445	3.4	3.7	264	424	−1.1	−1.2
Neurology	277	460	3.4	3.8	264	438	−1.5	−1.1
Nurse practitioner	354	487	3.5	3.8	339	464	−0.9	−1.1
Obstetrics/gynecology	268	449	3.5	3.7	256	428	−1.2	−1.2
Ophthalmology	322	586	3.9	3.5	307	559	−1.0	−1.2
Orthopedic surgery	410	634	3.8	3.6	391	605	−1.0	−1.1
Otolaryngology	380	584	3.5	3.5	362	557	−1.4	−1.2
Pain management	307	503	3.7	3.7	293	480	−1.0	−1.0
Physician assistant	371	502	3.6	3.7	354	479	−1.1	−1.0
Preventive medicine	337	505	3.4	3.7	322	482	−1.2	−1.0
Pulmonary disease	279	459	3.7	3.8	266	437	−1.1	−1.1
Radiation oncology	259	523	3.6	3.6	248	498	−0.8	−1.4
Rheumatology	278	461	3.7	3.8	265	439	−1.1	−1.1
Sleep medicine	285	463	3.6	3.6	272	442	−1.1	−1.1
Sports medicine	378	528	3.8	3.7	360	503	−1.1	−1.2
Urology	319	499	3.6	3.5	305	476	−1.0	−1.2
Vascular surgery	341	590	3.6	3.5	326	563	−0.9	−1.2
Average	305	490	3.6	3.7	291	467	−1.1	−1.1

Appendix Table 7. Sensitivity Analysis: Full-Time Equivalents, Additional Visits per Day

Provider Type	0.75 Full-Time Equivalents (vs. 1.00)				0.50 Full-Time Equivalents (vs. 1.00)			
	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %
Allergy/immunology	1.4	2.3	3.0	2.8	1.5	2.5	9.0	8.4
Cardiology	0.9	1.7	2.6	2.9	1.0	1.8	8.7	8.8
Dermatology	1.7	2.3	2.8	2.9	1.7	2.4	8.5	8.3
Endocrinology	1.3	2.0	3.1	3.0	1.3	2.1	8.6	8.5
Family practice	1.6	2.1	3.1	2.8	1.6	2.2	8.8	8.4
Gastroenterology	1.5	2.2	2.9	2.9	1.6	2.4	8.8	8.6
General practice	1.5	2.2	2.8	2.7	1.6	2.3	9.1	8.6
General surgery	1.6	2.6	3.0	2.8	1.7	2.8	8.6	8.7
Geriatric medicine	1.1	1.8	2.4	3.1	1.1	1.9	8.2	8.7
Gynecological oncology	1.2	2.1	3.2	2.8	1.2	2.2	8.9	8.4
Hematology	1.1	2.0	3.0	2.9	1.2	2.1	8.3	8.7
Hematology/oncology	1.1	2.1	2.4	2.8	1.2	2.2	8.1	8.4
Infectious disease	1.3	2.1	2.7	2.8	1.4	2.3	8.2	8.7
Internal medicine	1.2	2.0	2.9	3.0	1.3	2.1	8.7	8.4
Medical oncology	1.1	2.0	2.6	2.8	1.2	2.1	8.6	8.5
Nephrology	1.2	2.0	2.9	2.9	1.3	2.1	8.6	8.6
Neurology	1.2	2.1	2.5	2.9	1.3	2.2	8.2	8.8
Nurse practitioner	1.6	2.2	2.9	2.9	1.7	2.3	8.8	8.7
Obstetrics/gynecology	1.2	2.0	3.0	2.8	1.3	2.1	8.9	8.5
Ophthalmology	1.4	2.6	2.8	2.7	1.5	2.8	8.4	8.5
Orthopedic surgery	1.8	2.9	3.0	2.8	2.0	3.0	8.9	8.5
Otolaryngology	1.7	2.6	2.8	2.8	1.8	2.8	8.4	8.5
Pain management	1.4	2.3	3.2	2.8	1.5	2.4	8.8	8.5
Physician assistant	1.7	2.3	2.8	2.8	1.8	2.4	8.9	8.7
Preventive medicine	1.5	2.3	3.1	2.9	1.6	2.4	8.6	8.4
Pulmonary disease	1.3	2.1	2.6	2.9	1.3	2.2	8.6	8.6
Radiation oncology	1.2	2.4	2.9	3.0	1.2	2.5	8.8	8.5
Rheumatology	1.3	2.1	3.0	3.0	1.3	2.2	9.0	8.6
Sleep medicine	1.3	2.1	3.3	2.9	1.4	2.2	9.1	8.3
Sports medicine	1.7	2.4	2.9	2.9	1.8	2.5	8.8	8.4
Urology	1.4	2.2	3.0	2.6	1.5	2.4	8.4	8.3
Vascular surgery	1.5	2.7	2.9	2.9	1.6	2.8	8.8	8.4
Average	1.4	2.2	2.9	2.9	1.5	2.3	8.7	8.5

Appendix Table 8. Sensitivity Analysis: Evaluation and Management Codes, Additional Visits per Year

Provider Type	Lower Distribution of Codes				Higher Distribution of Codes			
	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %
Allergy/immunology	309	514	3.3	3.2	292	481	−2.3	−3.4
Cardiology	199	373	2.1	2.5	192	355	−1.5	−2.5
Dermatology	363	496	2.5	2.9	343	466	−3.1	−3.3
Endocrinology	277	439	3.0	3.1	264	414	−1.9	−2.8
Family practice	341	469	3.0	3.3	321	440	−3.0	−3.1
Gastroenterology	330	493	3.1	3.4	311	462	−2.8	−3.1
General practice	329	490	3.1	3.2	310	460	−2.8	−3.2
General surgery	349	583	2.9	3.6	329	542	−2.9	−3.7
Geriatric medicine	238	403	2.1	2.8	230	382	−1.3	−2.6
Gynecological oncology	255	455	2.8	3.2	246	429	−0.8	−2.7
Hematology	248	438	2.5	3.1	240	414	−0.8	−2.6
Hematology/oncology	252	455	2.4	3.2	243	428	−1.2	−2.9
Infectious disease	287	473	2.9	3.3	273	444	−2.2	−3.1
Internal medicine	270	429	2.7	2.9	258	405	−1.9	−2.9
Medical oncology	249	446	2.5	3.0	241	421	−0.8	−2.8
Nephrology	275	443	3.0	3.3	262	417	−1.9	−2.8
Neurology	275	458	2.6	3.4	263	431	−1.9	−2.7
Nurse practitioner	352	484	2.9	3.2	332	454	−2.9	−3.2
Obstetrics/gynecology	265	445	2.3	2.8	253	420	−2.3	−3.0
Ophthalmology	322	587	3.9	3.7	302	544	−2.6	−3.9
Orthopedic surgery	409	637	3.5	4.1	380	587	−3.8	−4.1
Otolaryngology	378	585	3.0	3.7	353	542	−3.8	−3.9
Pain management	306	501	3.4	3.3	289	469	−2.4	−3.3
Physician assistant	369	500	3.1	3.3	347	468	−3.1	−3.3
Preventive medicine	336	504	3.1	3.5	317	472	−2.8	−3.1
Pulmonary disease	277	457	3.0	3.4	264	429	−1.9	−2.9
Radiation oncology	257	522	2.8	3.4	248	489	−0.8	−3.2
Rheumatology	276	459	3.0	3.4	263	431	−1.9	−2.9
Sleep medicine	284	461	3.3	3.1	270	434	−1.8	−2.9
Sports medicine	376	527	3.3	3.5	351	491	−3.6	−3.5
Urology	318	497	3.2	3.1	300	466	−2.6	−3.3
Vascular surgery	339	590	3.0	3.5	320	549	−2.7	−3.7
Average	303	488	2.9	3.3	288	457	−2.3	−3.1

Appendix Table 9. Sensitivity Analysis: Current Procedural Terminology Revenue, Additional Visits per Year*

Provider Type	50% (vs. 100%)				0% (vs. 100%)			
	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %	New Visits, *n*	Return Visits, *n*	Change in New Visits, %	Change in Return Visits, %
Allergy/immunology	311	531	4.0	6.6	323	570	8.0	14.5
Cardiology	235	427	20.5	17.3	296	518	51.8	42.3
Dermatology	422	561	19.2	16.4	523	671	47.7	39.2
Endocrinology	278	450	3.3	5.6	288	478	7.1	12.2
Family practice	357	491	7.9	8.1	386	535	16.6	17.8
Gastroenterology	333	508	4.1	6.5	347	543	8.4	13.8
General practice	343	516	7.5	8.6	369	564	15.7	18.7
General surgery	354	593	4.4	5.3	370	626	9.1	11.2
Geriatric medicine	252	436	8.2	11.2	275	490	18.0	25.0
Gynecological oncology	256	467	3.2	5.9	265	496	6.9	12.5
Hematology	250	449	3.3	5.6	258	477	6.6	12.2
Hematology/oncology	253	467	2.8	5.9	262	496	6.5	12.5
Infectious disease	289	486	3.6	6.1	300	518	7.5	13.1
Internal medicine	288	467	9.5	12.0	319	529	21.3	26.9
Medical oncology	250	458	2.9	5.8	258	486	6.2	12.2
Nephrology	276	454	3.4	5.8	286	482	7.1	12.4
Neurology	271	458	1.1	3.4	275	473	2.6	6.8
Nurse practitioner	369	509	7.9	8.5	401	556	17.3	18.6
Obstetrics/gynecology	296	495	14.3	14.3	346	578	33.6	33.5
Ophthalmology	311	575	0.3	1.6	312	585	0.6	3.4
Orthopedic surgery	399	617	1.0	0.8	403	622	2.0	1.6
Otolaryngology	381	584	3.8	3.5	398	606	8.4	7.4
Pain management	308	517	4.1	6.6	320	554	8.1	14.2
Physician assistant	388	527	8.4	8.9	423	577	18.2	19.2
Preventive medicine	340	520	4.3	6.8	355	556	8.9	14.2
Pulmonary disease	278	469	3.3	6.1	288	498	7.1	12.7
Radiation oncology	258	516	3.2	2.2	267	534	6.8	5.7
Rheumatology	278	471	3.7	6.1	288	501	7.5	12.8
Sleep medicine	285	474	3.6	6.0	296	504	7.6	12.8
Sports medicine	381	544	4.7	6.9	400	585	9.9	14.9
Urology	323	522	4.9	8.3	339	571	10.1	18.5
Vascular surgery	343	600	4.3	5.3	359	634	9.1	11.2
Average	311	505	5.6	7.1	331	544	12.6	15.8

* Included revenue from the following laboratory tests, radiology services, and procedures: complete blood count, comprehensive metabolic panel, basic metabolic panel, renal function panel, hepatic function panel, glycohemoglobin, serum glucose, thyroid-stimulating hormone, vitamin D, human immunodeficiency virus, gonorrhea, chlamydia, human papillomavirus DNA, blood culture, pregnancy human chorionic gonadotropin, prostate serum antigen, rapid strep, urinalysis, urine culture, pelvic examination, bone mineral density, biopsy, echocardiography (for cardiology only), and audiometry (for otolaryngology only).