The Effect of Medical Scribes in Cardiology, Orthopedic, and Emergency Departments: A Systematic Review

September 2020

Prepared for:
Department of Veterans Affairs
Veterans Health Administration
Health Services Research & Development Service
Washington, DC 20420

Prepared by:
Evidence Synthesis Program (ESP) Center
Minneapolis VA Health Care System
Minneapolis, MN
Timothy J. Wilt, MD, MPH, Director

Authors:
Principal Investigator:
Timothy J. Wilt, MD, MPH

Co-Investigators:
Brad Bart, MD
Glennon Park, MD

Research Associates:
Kristin Ullman, MPH
Lauren McKenzie, MPH
Roderick MacDonald, MS
Eric Linskens, BS

VA | U.S. Department of Veterans Affairs
Veterans Health Administration
Health Services Research & Development Service

PREFACE

The VA Evidence Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted health care topics of importance to clinicians, managers, and policymakers as they work to improve the health and health care of Veterans. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The program is comprised of three ESP Centers across the US and a Coordinating Center located in Portland, Oregon. Center Directors are VA clinicians and recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Center Program and Cochrane Collaboration. The Coordinating Center was created to manage program operations, ensure methodological consistency and quality of products, and interface with stakeholders. To ensure responsiveness to the needs of decision-makers, the program is governed by a Steering Committee comprised of health system leadership and researchers. The program solicits nominations for review topics several times a year via the program website.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, Deputy Director, ESP Coordinating Center at Nicole.Floyd@va.gov.

Recommended citation: Ullman K, McKenzie L, Bart B, Park G, MacDonald R, Linskens E, Wilt TJ. The effect of medical scribes in cardiology, orthopedic, and emergency departments: a systematic review. Washington, DC: Evidence Synthesis Program, Health Services Research and Development Service, Office of Research and Development, Department of Veterans Affairs. VA ESP Project #09-009; 2020. Available at: https://www.hsrd.research.va.gov/publications/esp/reports.cfm.

This report is based on research conducted by the Evidence Synthesis Program (ESP) Center located at the **Minneapolis VA Health Care System, Minneapolis, MN**, funded by the Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development. The findings and conclusions in this document are those of the author(s) who are responsible for its contents; the findings and conclusions do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. No investigators have any affiliations or financial involvement (*eg*, employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

ACKNOWLEDGMENTS

This topic was developed in response to a nomination by Storm Morgan, Program Manager, Office of Nursing Services, on behalf of the Section 507 Committee, for the purpose of informing the Section 507 Committee on the effect of medical scribes in cardiology, orthopedic, or emergency department clinics. This report will be used in conjunction with an evaluation to a pilot on the effects of medical scribes which was mandated by Section 507 of the MISSION Act. The scope was further developed with input from the topic nominators (*ie*, Operational Partners), the ESP Coordinating Center, the review team, and the technical expert panel (TEP).

In designing the study questions and methodology at the outset of this report, the ESP consulted several technical and content experts. Broad expertise and perspectives were sought. Divergent and conflicting opinions are common and perceived as healthy scientific discourse that results in a thoughtful, relevant systematic review. Therefore, in the end, study questions, design, methodologic approaches, and/or conclusions do not necessarily represent the views of individual technical and content experts.

The authors gratefully acknowledge the following individuals for their contributions to this project:

Operational Partners

Operational partners are system-level stakeholders who have requested the report to inform decision-making. They recommend Technical Expert Panel (TEP) participants; assure VA relevance; help develop and approve final project scope and timeframe for completion; provide feedback on draft report; and provide consultation on strategies for dissemination of the report to field and relevant groups.

Storm Morgan, MSN, MBA, RN
Program Manager
Office of Nursing Services

Technical Expert Panel (TEP)

To ensure robust, scientifically relevant work, the TEP guides topic refinement; provides input on key questions and eligibility criteria, advising on substantive issues or possibly overlooked areas of research; assures VA relevance; and provides feedback on work in progress. TEP members are listed below:

Steve Pizer, PhD
Chief Economist, Partnered Evidence-Based Policy Resource Center
Director of Health Law, Policy and Management, Boston University
Boston, MA

Max Napolitano, MPAS
Medical Scribe and Medical Scribe Trainer (former), North Memorial Medical Center
Minneapolis, MN

Lauren Klein, MD, MS
ED and Scribe Program Director, Hennepin County Medical Center
Minneapolis, MN

Peer Reviewers

The Coordinating Center sought input from external peer reviewers to review the draft report and provide feedback on the objectives, scope, methods used, perception of bias, and omitted evidence. Peer reviewers must disclose any relevant financial or non-financial conflicts of interest. Because of their unique clinical or content expertise, individuals with potential conflicts may be retained. The Coordinating Center and the ESP Center work to balance, manage, or mitigate any potential nonfinancial conflicts of interest identified.

TABLE OF CONTENTS

EVIDENCE REPORT

INTRODUCTION

Medical scribes are individuals who assist health care clinicians (physicians, nurse practitioners, and physician assistants) with day-to-day tasks including recording and documenting information in real-time during patient visits.[1,2] In addition to documenting medical visits, primary medical scribe duties and responsibilities include communicating with patients and completing clerical tasks; verifying and correcting mistakes or inconsistencies in medical records; collecting, organizing, and cataloging data for clinicians; and attending trainings related to practice.[1] Medical scribes are most commonly unlicensed individuals with a health-degree focus[2]; however, accreditation programs do exist. Integrating medical scribes with clinicians is suggested to improve access, quality and timeliness of care, enhance patient and clinician satisfaction, and increase clinician productivity and health system revenue.[3-5]

Medical scribe use has increased markedly in the past 10 years making it the fastest-growing health care profession in the United States.[2] This increase is believed to result, in part, from implementation of Electronic Medical Records (EMRs) required by legislation. In 2009 the Health Information Technology for Economic and Clinical Health (HITECH) Act, part of the American Recovery and Reinvestment Act (ARRA), was enacted and required meaningful use of health information technology.[2] These acts created a large demand for electronic data entry by health care clinicians as well as an increase in documentation requirements for billing and reporting initiatives.[2]

EMRs provide important advantages, such as structural and process-related benefits[6] and enhanced patient care.[7] However, EMRs increase the burden of clinical documentation, disrupt face-to-face encounters with patients,[8] and reduce time available for resident and student training.[9] Additionally, efficiency measures required by the quality reporting program enacted by the Centers for Medicare & Medicaid Services (CMS), such as door-to-doctor time or length of stay, have increased pressure on clinicians and health systems to meet these quality metrics.[10]

While formal training, accreditation, and recertification are not required for all scribe positions, there are 2 scribe accreditation programs in the United States from the American College of Medical Scribe Specialist and the American Healthcare Documentation Professional Group. Both accreditation programs test aspiring scribes on competencies related to care and require completed pre-clinical training as well as clinical training hours.[18,19] The American College of Medical Scribe Specialists is also certified by CMS and emphasizes CMS reporting in the training.[20] Both programs require re-training and licensing every 12-24 months.

Scribes are typically hourly employees with wages ranging from $10 to $21 per hour.[21] Costs to consider before implementing a scribe program may include salary, taxes, and benefits. Although some larger scribe vendors may provide health insurance, many individual clinicians and health institutions do not.[22] When implementing scribes though in-house hiring and training programs, previous studies have put internal recruitment costs of scribes around $3,117 per scribe and additional training costs around $1,200.[23]

Alternatively, contracting scribes through external vendors is also an option. Companies can be hired by health care systems or individual clinical groups to train, accredit, place, and conduct performance evaluations of scribes through contracting mechanisms to health care systems. These companies can reduce administrative hiring, training, and oversight burden to health care facilities and serve as a resource to replace scribes due to relatively high turnover. Additionally, these companies can also contract for "virtual scribes" whereby the scribes are located "off-site" and conduct their duties through video teleconferencing.[11] To date there is little non-industry evidence comparing benefits, harms, and costs of contract (*ie*, vendor-supplied) scribes to those which are employees of the institution.

Within the Department of Veterans Affairs, the 2018 MISSION Act aimed to increase Veterans access to health care in VA facilities and the community. Section 507 of the MISSION Act[12] mandates a 2-year pilot of in-clinic medical scribes in VA specialty clinics and emergency departments across the United States. The pilot will evaluate clinician efficiency, patient volume, and patient satisfaction.

We conducted a systematic review of the effects of medical scribes. With insight from our operational partners and technical expert panel members, our scope focused on outpatient emergency, cardiology, and orthopedic departments. The Section 507 Committee will use the findings of this review alongside findings from the medical scribe pilot to inform the use of medical scribes in VA including considerations of budgeting, resource utilization, and services where medical scribes may be most beneficial.

METHODS

TOPIC DEVELOPMENT

Section 507 of the 2018 VA MISSION Act has mandated a 2-year medical scribes pilot in specialty and emergency departments within VA. This pilot will evaluate the impact of medical scribes on clinician efficiency, patient volume, and patient satisfaction within cardiology, orthopedic, and emergency department clinics. This review was convened to supplement findings from this pilot to inform future use of medical scribes in VA. Key Questions (KQ) were developed in collaboration with stakeholders from the VA Office of Nursing Services, along with our technical expert panel.

1. What is the effect of medical scribes in cardiology, orthopedic, or emergency department clinics?

2. How do the effects of medical scribes vary based on differences in compensation structure (*ie*, contracted through vendor or employees of the institution), qualifications (*ie*, training, accreditation, experience), types of entries (*ie*, medical orders, medical history, coding [billing, diagnoses, complexity/comorbidities]), or setting (*ie*, rural, urban, access-challenged)?

A protocol was developed with input from stakeholders and our Technical Expert Panel and registered in PROSPERO (CRD42020169079).

DATA SOURCES & SEARCHES

We searched MEDLINE, EMBASE, and CINAHL from 2010 through December 2019 using Medical Subject Headings (MeSH) and keywords for medical scribes and outcomes of interest (Appendix 1). We supplemented these results with additional searches of bibliographies from recent systematic reviews, and references from our technical expert panel.

STUDY SELECTION

Eligible citations were screened independently by 2 reviewers using Distiller SR (Distiller SR, Evidence Partners, Ottawa, Canada) with prespecified criteria. Citations moved to full-text review if either reviewer considered the citation eligible. At full-text review, agreement of 2 reviewers was needed for study inclusion or exclusion; disputes were resolved by discussion with input from a third reviewer, if needed.

We included English-language intervention studies, interrupted time series or other pre-post studies, and observational studies comparing participation in a medical scribe intervention to usual care or no intervention. Only adult patients and/or practitioners in cardiology, orthopedic, or emergency departments were considered eligible for inclusion. Eligible interventions consisted of a “medical scribe” or “document assistant” program that involved navigation of an electronic health record system and provided some information about scribe responsibilities/duties. Eligible studies reported outcomes related to clinic efficiency (*eg,* patients seen per hour, length of stay), clinician and/or patient satisfaction, financial impacts (*eg,*

revenues, cost of scribes), quality of documentation, medical errors, or scribe training (*eg,* time to train, turnover). A full list of inclusion/exclusion criteria can be found in Appendix 2.

DATA ABSTRACTION & STUDY QUALITY ASSESSMENT

We formally assessed risk of bias (ROB) of each individual study by assessing critical elements using the ROBINS-I tool[13] for observational studies and a modified Cochrane tool[14] for randomized controlled trials (RCTs), as described in Appendix 3. Two reviewers independently rated each non-randomized eligible study as low, moderate, serious, or critical ROB, and randomized studies were rated as low, moderate, or high ROB. Consensus was reached through discussion, if necessary. Studies rated as critical or high ROB were not included for analysis. Ratings for each study can be found in Appendix 4.

We abstracted data from all eligible studies with low, moderate, or serious ROB on: design and description of study; health care setting (rural, urban, access-challenged); scribe duties (types of entries); clinician and scribe experience; scribe training and/or accreditation (hours of training and whether training was in-house or contracted by a vendor); quality of documentation and/or medical errors; baseline characteristics including age, gender; number of patients admitted (for emergency department studies); funding source; and all data related to outcomes of interest (*ie*, clinic efficiency, patient/clinician satisfaction, and financial impacts). For clinic efficiency, we abstracted number of patients seen per hour or shift, door-to-room time, door-to-provider time, length of appointments, length of stay/door-to-disposition time, and number of patients who left without being seen (for emergency room studies). For financial productivity we abstracted revenues and costs related to scribe training.

We also abstracted relative value units (RVUs), which are a measure of physician and health system productivity and used by Medicare for reimbursement. Each medical procedure has a number of RVUs associated with it, and payment per RVU can vary depending on a number of factors, such as the local price level and the local malpractice environment. In 2020, the monetary value to be reimbursed per RVU was $36.0896.[24]

DATA SYNTHESIS & ANALYSIS

Due to heterogeneity of populations and interventions, data were not pooled but narratively synthesized. Tables were developed by outcome and stratified by clinical setting (*ie,* cardiology or emergency department). For Key Question 2, our subgroups of interest included: compensation structure (*ie*, contracted through a vendor or employee of the institution), qualifications, duties and type of entry required, and setting.

Overall quality of evidence for the primary outcomes considered ‘critical’ (important for decision making) within each comparison was evaluated using a modified Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach on 5 assessed domains.[25] The quality of evidence levels range from high to very low (Table 1). The 5 domains include: (1) study limitations (risk of bias); (2) directness (single, direct link between intervention and outcome); (3) consistency (similarity of effect direction and size among studies); (4) precision (degree of certainty around an estimate [*ie*, width of confidence intervals]); and (5) publication bias. In the GRADE approach, the initial quality of evidence is considered high for RCTs and low for observational studies.[26,27] Our summary of assessment of

"effectiveness" is based on statistical significance of the effects rather than an established or derived clinical magnitude of importance or estimates of precision derived from confidence intervals.

We graded certainty of evidence for the following outcomes that we deemed critical to decision making: patients seen per hour, length of stay, patient satisfaction, clinician satisfaction, and RVUs.

Table 1. GRADE Quality of Evidence

GRADE Quality of Evidence Levels	
Quality Level	**Definition**
High	We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that is substantially different.
Low	Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.
Very Low	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of the effect.

PEER REVIEW

A draft version of this report was reviewed by 4 technical experts and VA operational partners. Their comments and our responses are presented in Appendix 5.

RESULTS

After removing duplicates, we identified 621 citations for title and abstract triage. A hand-search of systematic review bibliographies yielded 2 additional references. We reviewed the full text of 45 articles and identified 22 which met our inclusion criteria (Figure 1).

Of the eligible articles, we identified 2 observational studies from cardiology departments, both from the same group at a Minneapolis, MN-based health care system. No eligible articles were identified from orthopedic departments. (Table 2)

All but 2 eligible articles (20/22, 91%) were from emergency departments. Of these, 6 publications (all observational) came from the same group at a Rochester, MN-based health care system and 6 publications (1 RCT, 1 secondary analysis of the RCT data, 4 observational) came from a group based in Australia. The remaining 8 publications consisted of 1 RCT and 7 observational studies. One of these observational studies was conducted in Canada, and the remaining observational studies and RCT were conducted in the US. Summary characteristics of eligible publications can be found in Table 2.

Eighteen studies reported clinic efficiency, 5 patient satisfaction, 5 clinician satisfaction, 8 for financial productivity, 10 on relative value units (RVUs), 3 for quality of documentation, and 3 for cost/time of training. Only 4 reports noted 4 out of our 5 outcomes of interest and only 2 reported on 3 outcomes of interest. (Table 3) Our summary of assessment of “effectiveness” is based on statistical significance of the effects rather than an established or derived clinical magnitude of importance or estimates of precision derived from confidence intervals.

Most authors (8/12) reported using a vendor service which supplied, trained, and managed scribes. One Australian group used a vendor service for a pilot study (1 publication) and then implemented an in-house scribe program (4 publications). Two US-based groups implemented an in-house scribe program (6 publications from one group and 1 publication from another). One publication did not report any information on scribe training. The remaining 9 publications used a vendor service. While most publications (18/22) reported on components of how scribes were trained (*eg,* on-site training or classroom lecture), very few provided details about training programs or costs associated with training. Few studies reported scribe experience at baseline. No studies reported associated and peripheral costs with employing scribes (administration or management) or elements such as scribe turnover. All programs utilized “in person” rather than virtual or tele-scribes.

Five studies (including both RCTs) were rated as moderate ROB and 15 studies were rated as serious ROB. Two studies were rated as critical risk of bias and not analyzed further.

Figure 1. Literature Flow

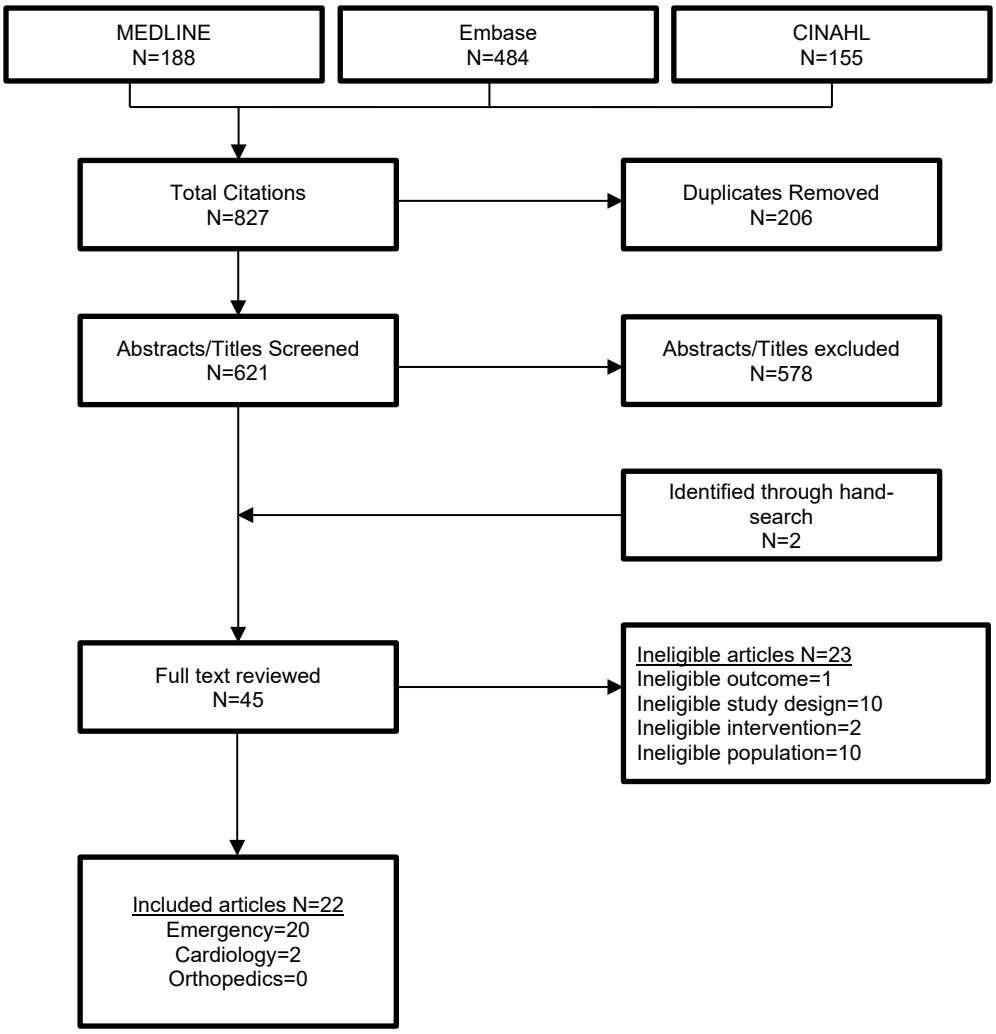

Table 2. Summary characteristics of all eligible publications

Author, Year	Risk of Bias	Location	Outcomes Reported						
			Clinic Efficiency (k=18)	Patient Satisfaction (k=5)	Clinician Satisfaction (k=5)	Financial productivity (k=8)	Relative Value Units (k=10)	Quality of Documentation (k=3)	Cost/Time of Training (k=3)
Orthopedics									
No eligible studies identified									
Cardiology									
Bank, 2013[28]	Critical	United States	X	X		X	X		
Bank, 2015[29]	Serious	United States	X			X	X	X	X
Emergency Departments									
Walker, 2014[30]	Critical	Australia	X			X			X
Walker, 2016a[31]	Serious	Australia	X	X	X	X			
Walker, 2016b[32]	Serious	Australia				X			
Walker, 2017[33]	Moderate	Australia						X	
Dunlop 2018[34]	Serious	Australia	X	X					
Walker, 2019*[35]	Moderate	Australia	X			X		X	X
Heaton, 2016[36]	Serious	United States	X				X		
Heaton, 2017a[37]	Serious	United States	X				X		
Heaton, 2017b[38]	Moderate	United States					X		
Heaton, 2018[39]	Serious	United States	X						
Heaton, 2019a[40]	Serious	United States					X		
Heaton, 2019b[41]	Serious	United States	X			X			
Allen, 2014[42]	Serious	United States	X		X				
Arya, 2010[43]	Moderate	United States	X				X		
Bastani, 2014[44]	Serious	United States	X	X					
Friedson, 2018*[45]	Moderate	United States	X				X		
Graves, 2018[46]	Serious	Canada	X			X			
Hess, 2015[47]	Serious	United States	X		X		X		
Ou, 2017[48]	Serious	United States	X		X				
Shuaib, 2017[49]	Serious	United States	X	X	X		X		

*Randomized controlled trial

Table 3. Summary of results for emergency department publications*

Author, Year Risk of Bias	Outcomes									
	Patients per hour per clinician	**Door-to-Room/ Waiting Time (minutes)**	**Door-to-Provider (minutes)**	**Appointment Length/ Time-to-disposition**	**Door-to-Discharge/ LOS (minutes)**	**LWBS**	**Patient Satisfaction**	**Clinician Satisfaction**	**Financial Productivity**	**Relative Value Units (RVU)**
Walker, 2016a[31] Serious	↑ 1.13 vs 1.02	NR	↔	NR	↔	NR	↔	↔	↔[h]	NR
Walker, 2019[35] Moderate	↑ 1.31 vs 1.13	NR	↔	NR	↓ 173 vs 192	NR	NR	NR	↑[i] -$26.15/hr	NR
Dunlop 2018[34] Serious	NR	NR	↔	NR	NR	NR	↔	NR	NR	NR
Heaton 2016[36] Serious	↔	NR	↔	↔	↑ 265 vs 255	NR	NR	NR	NR	NR
Heaton 2017a[37] Serious	NR	NR	↔	↔	↔	NR	NR	NR	NR	NR
Heaton 2017b[38] Moderate	NR	NR	NR	NR	NR	NR	NR	NR	NR	↑[k] 4.04 vs 3.84
Heaton 2018[39] Serious	NR	NR	NR	↔	NR	NR	NR	NR	NR	NR
Heaton 2019a[41] Serious	NR	NR	↔	↔	↔	NR	NR	NR	NR	↔[k]
Heaton, 2019b[40] Serious	NR	NR	NR	NR	NR	NR	NR	NR	↑[j] $488 vs $600	NR
Allen, 2014[42] Serious	↔	↔	↔	↓ 157 vs 169	↓ 233 vs 249	↔	NR	+[c]	NR	NR
Arya, 2010[43] Moderate	↑ +1.63[a]	NR	NR	NR	↔	NR	NR	NR	NR	↑[l] +0.24
Bastani, 2013[44]	NR	↓ 34 vs 35	↓ 61 vs 74	↓ 185 vs 237	↓ 269 vs 289	NR	↑[b] 58% vs 75%	↑[d] 62% vs 92%	NR	NR

Serious										
Friedson, 2018[45] Moderate	↑ 2.33 vs 2.23	NR	NR	↓ 228 vs 258	NR	NR	NR	NR	NR	↔[m] ↑[n] 72 vs 77
Graves, 2018[46] Serious	↑ 2.81 vs 2.49	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hess, 2015[47] Serious	↔	NR	NR	NR	↔	↑	NR	+[e]	NR	↔/↑[o]
Ou, 2017[48] Serious	NR	NR	NR	NR	NR	NR	NR	+[f]	NR	NR
Shuaib, 2017[49] Serious	↑ 3.2 vs 2.3	↓ 41 vs 37	↓ 56 vs 61	↓ 228 vs 237	↓ 287 vs 303	NR	↔	↑[g] 66% vs 81%	NR	↔[p] ↑[q] 241 vs 336

↔=no significant difference; ↑=increase in outcome compared to control group; ↓=decrease in outcome compared to control group; +=satisfaction reported, but no comparison group; LOS=length of stay; LWBS=left without being seen; NR=not reported; RVU=relative value units

*Numerical data only presented when deemed statistically significant

[a] Calculated by ESP team, unable to calculate for comparison group

[b] Press Ganey Survey: Overall patient satisfaction percentiles

[c] 100% clinicians reported "scribes are a valuable addition"; 77% clinicians reported "scribes increase workplace satisfaction; 90% clinicians reported "scribes increase quality of life"

[d] Press Ganey Survey: Overall physician satisfaction percentiles

[e] 62% clinicians "liked or loved working with scribes", 74% clinicians "positive or very positive attitude towards scribes", 82% clinicians "positive or very positive changes in efficiency"

[f] 85% residents "my interactions with attendings have improved with scribes", 79% "scribes have improved my overall education as a resident in the emergency department"

[g] "Physician satisfaction increased 15% from pre- to post-scribe" (p=NR)

[h] Billing per patient

[i] "Cost saving to the hospital per scribed hour of $26.15 when hospital absorbs the cost of training"

[j] estimated costs of charting per shift

[k] mean RVUs per patient

[l] RVUs per hour increased by 0.24 units for every 10% increment in scribe usage during a shift

[m] total RVUs per shift

[n] trimmed RVUs per shift (lowest and highest 10% removed from analysis)

[o] Pre-post differences in seasonally-matched productivity metrics; mean differences in RVU per patient and RVU per hour were mixed

[p] mean RVUs per patient

[q] mean total RVUs per hour

KEY QUESTION 1A: WHAT IS THE EFFECT OF MEDICAL SCRIBES IN ORTHOPEDIC CLINICS?

We identified no eligible studies that examined the effect of medical scribes in orthopedic clinics.

KEY QUESTION 1B: WHAT IS THE EFFECT OF MEDICAL SCRIBES IN CARDIOLOGY CLINICS?

Key Messages

- In cardiology clinics, the effect of medical scribes on efficiency and financial productivity is uncertain.
- There are no data on medical errors or scribe training (*eg*, time to train, turnover).
- Resources required to train, staff, maintain, and monitor scribes are substantial and rarely reported.
- There are no data on the role of scribes in VA cardiology clinics.

We identified 2 eligible studies that examined the effect of medical scribes in cardiology clinics.[28,29] Both studies were conducted by the same group at a single center in St. Paul, Minnesota. One of these studies was rated critical ROB and not analyzed further.[28] Detailed ROB assessments can be found in Appendix 4.

Bank et al[29] performed a retrospective study comparing routine clinic visits of 10 cardiologists with scribes to 15 cardiologists without scribes. For physicians without scribes, patients were scheduled 20 minutes for follow-up and 40 minutes for new patient visits. Every 4 hours, one follow-up slot was left unscheduled for physicians to "catch up" with dictation/documentation. For physicians using scribes, the open 20-minute slot every 4 hours was eliminated; resulting in 22 and 24 scheduled patients per 8-hour day, in routine and scribe clinics respectively.

Scribes received approximately 184 hours of total training, including classroom lecture, supervised on-floor training, and cardiology-specific terminology and clinic processes from an outside "scribe vendor" hired to perform these services and provide ongoing monitoring and retention. Scribe duties included medical documentation services and clerical support.

Summary results are presented in Table 4. Detailed study characteristics and results can be found in Appendix Table 6-1 and Appendix Table 6-2, respectively. Certainty of evidence tables can be found in Appendix 7.

Table 4. Summary results for cardiology studies

Author, Year Risk of Bias	Study Characteristics (Sample size)	Outcomes				
		Patients/hour per clinician	Patient Satisfaction	Clinician Satisfaction	Financial productivity	Relative Value Units
Bank, 2015[29] Serious	Retrospective observational N=25 providers	↑ 2.5 vs 2.3	NR	NR	↑	↑[a]

↑=increase in outcome compared to control group; ↓=decrease in outcome compared to control group; **NR**=not reported
[a] work based on Relative Value Units

Clinic Efficiency

Bank et al[29] reported that physicians who had a scribe, and were thus scheduled for more patients per day (24 vs 22), saw more new (84) and returning (423) patients annually, but did not report any tests of statistical significance. Physicians with scribes saw 9.6% more patients per hour (2.5 vs 2.3) when compared to physicians without scribes (P=.01); however, by design scheduling templates for physicians with scribes allowed for more appointments.

Patient/Clinician Satisfaction

No studies assessed patient or clinician satisfaction.

Health Care and System Outcomes

Financial Productivity and Relative Value Units

Bank et al[29] reported the use of scribes was associated with more patients seen annually, and an increase in work RVUs. Scribes' clinic notes were coded and billed at a higher level. The study estimated an "additional annual revenue of $1,372,694 at a cost [for the scribes' salary] of $98,588." No data were provided on the costs paid to the vendor or other administrative or operating costs. The lead author was noted to be a paid consultant to 2 different scribe vendors, though not the vendor used for this study.

Quality of Documentation

While Bank et al[29] did not formally evaluate the quality of documentation, they stated "the higher level of service associated with visits using a scribe suggests that documentation may be better during those visits."

KEY QUESTION 1C: WHAT IS THE EFFECT OF MEDICAL SCRIBES IN EMERGENCY DEPARTMENTS?

Key Messages

- The quality, quantity, completeness, and applicability of findings is limited.
- Medical scribes may improve efficiency by increasing number of patients seen per hour (low certainty of evidence [COE]) and decreasing length of stay (moderate COE). The magnitude of effect is likely small; efficiency may vary based on the setting and outcomes assessed.
- Medical scribes may increase revenues or RVUs due to more patients seen per hour (low COE); however, resources required to train, staff, maintain, and monitor scribes are substantial and rarely accounted for in these estimations.
    - Financial impacts varied based on how outcomes were measured.
- In emergency departments, medical scribes may make little to no difference in door-to-room or door-to-provider time, number of patients who left without being seen, and patient or clinician satisfaction, though results were mixed.

- No comparative reliable data on quality of documentation or medical errors was identified.
- There are no data on the role of scribes in VA emergency departments.

Twenty eligible studies were identified that reported on the effect of medical scribes in emergency departments.[30-49] Six were from one group in Australia,[30-35] 6 from one group in the US,[36-41] and the remaining 8 were from different areas around the US[42-45,47-49] and Canada.[46]

Two RCTs were identified[35,45] and rated as moderate ROB. From the remaining observational studies, 3 were rated moderate ROB,[33,38,43] 15 were rated serious ROB,[29,31-34,36,37,39-42,44,46,48,49] and 2 were rated critical ROB and not analyzed further.[28,30] Outcome reporting was incomplete and varied across studies. For example, no study reported on all our outcomes of interest and few reported on 3 or more. The most commonly reported outcomes were measures of clinic efficiency (16/20 studies), financial productivity (6/20) and RVU (8/20).

Walker et al Group (Victoria, Australia)

Six studies, conducted by the Walker group, were included that assessed outcomes of interest in emergency department clinics. All studies were conducted at a private emergency department (ED) setting in Australia. Cabrini Hospital is a tertiary, non-profit, Catholic private hospital in southeast Melbourne. Therefore, results from this group are likely to be highly correlated across the studies, though are not considered duplicate reporting of results. The emergency department sees approximately 24,000 adult and pediatric patients annually and has a 48% admission rate.

One prospective observational pilot study was conducted in 2013,[30] which was rated critical ROB and omitted for further analysis. An additional prospective pilot study was conducted in 2014,[31] which was rated serious ROB. This study used a single American scribe provided by a scribe company that required 2 years of experience. The third study in this series was an economic evaluation describing the cost to implement an in-house training program, and train Australian scribes, which was rated serious ROB and did not provide any comparison data.[32] A multi-center RCT was then conducted from 2015-2018, using the trained Australian scribes from the economic evaluation discussed previously; it was rated moderate ROB.[35] The RCT was conducted at the same private emergency department, as well as other facilities within the same health care system. During the RCT period, a qualitative interview study was done to assess patient satisfaction, which was rated serious ROB.[34] Using data from the RCT, a secondary analysis was conducted to assess note quality, which was rated moderate ROB.[33]

Detailed ROB assessments can be found in Appendix 4. Summary results for the 3 Walker studies that reported outcomes of interest are presented in Table 5. Detailed study characteristics can be found in Appendix Table 6-3 and detailed results for clinic efficiency, patient and clinician satisfaction, and health care systems outcomes can be found in Appendix Table 6-4, Appendix Table 6-5, and Appendix Table 6-6, respectively. Certainty of evidence tables can be found in Appendix 7.

Table 5. Summary results for emergency department studies (Walker group, Australia)*

Author, Year Risk of Bias Study Characteristics (sample size)	Outcomes									
	Patients per hour per clinician	**Door-to-Room/ Waiting Time (minutes)**	**Door-to-Provider (minutes)**	**Appointment Length/ Time-to-disposition**	**Door-to-Discharge/ LOS (minutes)**	**LWBS**	**Patient Satisfaction**	**Clinician Satisfaction**	**Financial Productivity**	**Relative Value Units**
Walker, 2016a[31] Serious Prospective observational, single center N=5 physicians N=799 shifts N=6344 patients	↑ 1.13 vs 1.02	NR	↔	NR	↔	NR	↔	↔	↔[a]	NR
Walker, 2019[35] Moderate RCT, multi-center N=88 physicians N=3885 shifts N=28936 patients	↑ 1.31 vs 1.13	NR	↔	NR	↓ 173 vs 192	NR	NR	NR	↑[b] -$26.15/hour	NR
Dunlop 2018[34] Serious Semi-structured interview N=215 patients	NR	NR	↔	NR	NR	NR	↔	NR	NR	NR

↔=no significant difference; ↑=increase in outcome compared to control group; ↓=decrease in outcome compared to control group; LOS=length of stay; LWBS=left without being seen; NR=not reported; RCT=randomized controlled trial

*Numerical data only presented when deemed statistically significant

[a] Billing per patient
[b] "Cost saving to the hospital per scribed hour of $26.15 when hospital absorbs the cost of training"

Clinic Efficiency

Patients seen per day

Two studies reported on the number of patients seen per day. One was a single center prospective cohort, rated serious ROB,[31] and the other was a multicenter randomized controlled trial, rated moderate ROB.[35] Both studies reported an increase in the total number of patients seen per hour in the scribe group when compared to the non-scribe group. However, the observational study did not report any tests of statistical significance. The RCT reported that scribes increased the number of patients seen per hour per clinician from 1.13 (95% CI 1.11 to 1.17) to 1.31 (95% CI 1.25 to 1.38), representing a 15.9 percent relative increase (P<0.001).

Door-to-provider time

Three studies reported on door-to-provider time. One was a single center prospective cohort, rated serious ROB,[31] another was a multicenter randomized controlled trial, rated moderate ROB,[35] and the third was a qualitative interview study conducted during the same time period as the RCT.[34] None of these studies reported any significant difference in door-to-provider time in the scribe group compared to the non-scribe group.

Appointment length

None of the Walker et al studies reported on outcomes related to appointment length.

Time-to-disposition

None of the Walker et al studies reported on outcomes related to time-to-disposition.

Length of stay/Door-to-discharge time

Two studies reported on length of stay, though results were mixed. One was a single center prospective cohort, rated serious ROB,[31] and the other was a multicenter randomized controlled trial, rated moderate ROB.[35] The prospective cohort study reported no significant difference in length of stay between the scribe and non-scribe groups. Conversely, the RCT found that the length of stay in the scribe group was reduced by 19 minutes (absolute reduction) when compared to the non-scribe group (P<.001).

Patients left without being seen

None of the Walker et al studies reported on the number of patients who left the emergency department without being seen.

Patient/Clinician Satisfaction

Two studies reported on patient and/or clinician satisfaction. Both were conducted at the same private ED and rated serious ROB. One was a prospective cohort study which reported "*no patients asked the scribe to leave or complained about the scribe's presence*" and "*all physicians were satisfied with the initial history/physical exam capture into the chart and would like a scribe permanently*." However, no formal data collection measures were described.[31]

The second study was a qualitative, semi-structured interview study which reported no differences in patient satisfaction between the scribe and non-scribe groups. This study was conducted during the same time as the aforementioned RCT and consisted of interviewing patients while they were in the waiting room using previously validated questionnaires.[34]

Health Care and System Outcomes

Financial productivity and relative value units

Three studies reported on the financial impacts of implementing a scribe program. Two were single center prospective cohort studies both rated serious ROB,[31,32] and the third was a multi-center RCT rated moderate ROB.[35]

Walker et al 2016a[31] was a pilot study which reported no significant differences in amount billed per patient between the scribe group and the non-scribe group. The scribe group reported an average of billing $150 per patient, while the non-scribe group reported an average of billing $149 per patient. These estimates did not include the cost of the scribe.

Walker et al 2016b[32] was an economic evaluation study conducted to determine the cost of implementing a scribe program. The medical center hired and trained scribes with no previous experience and measured recruitment costs, start-up costs, cost of training materials/courses, and administration costs of their scribe program. They found that scribes required 68-118 hours of training to become competent, and medical students achieved competency faster (after 7 shifts) than premedical students (after 8-16 shifts), and individuals from other disciplines did not achieve competency. The program took 7 months to implement (not including initial stakeholder buy-in time). Out of 79 applicants, 22 were invited to interview, and 10 had successful interviews. From those 10, only 5 (2 medical students and 3 pre-medical students) successfully completed training and became competent scribes.

Costs were reported based solely on a salary for the scribes ($15.91/hour), which included a 25% "on-cost" or "fringe". Costs were reported for the total time it took to implement the scribe program (7 months) and does not include or report the amount of time for initial stakeholder buy-in or cost to replace departing scribes. (Table 6) The study also compared physicians' productivity (based on patients seen per hour) with and without scribe trainees, and found that the productivity of physician trainers was unaffected while training scribes.

Table 6. Reported costs of implementing a scribe program from Walker et al[32]

Component	Total cost (US$)	Total cost per competent scribe[a] (US$)
Recruitment and start-up	15,555	3,111
Education program	6,283	1,257
Administration	4,326	866
Clinical training	5,686	1,137
Total	31,853	6,371

[a] at the end of the implementation, the institution had 5 competent scribes

Walker et al (2019)[35] was a multi-center RCT that used the scribes trained in the previously described economic evaluation[32] and estimated costs during the RCT period. The authors reported that scribes earned $20.51/hour and physicians earned $165/hour; estimating a 15% gain in productivity when a scribe was working generated a savings of $24.75/hour in physician time. The study also reported "training the scribe cost $5015 per scribe, and scribes worked 1000 hours once trained, generating a cost per hour worked of US$5 after completion of training."

Quality of documentation

No study directly reported on quality of documentation.

However, 1 multicenter moderate ROB RCT[35] reported 16 "incidents" (possibly attributed to the scribe) where the scribe was present and recorded. The majority of incidents related to patient identification and selecting the incorrect patient from the medical record. In all instances the error was corrected without further incident. The study also reported that "the presence of scribes at times worked as a protective factor in reducing medical error." The rate of incidents reported where a scribe was present was one in every 300 encounters.

Analysis of notes taken during the above RCT[33] found that the Physician Documentation Quality Instrument[50] used to evaluate the quality of notes did not demonstrate reliability or validity. Authors also described difficulty is assessing note quality for accuracy considering evaluators weren't in the room when the consultation took place. Additional information indicated that notes were longer in the scribe group (357 words) compared to the non-scribe group (237 words; P<.0001) but that there was no difference in their rate of omissions (42% vs 43%) or sufficiency of information to manage the patient (92% vs 93%).

Heaton et al Group (Mayo, Rochester, MN)

Six studies, conducted by the Heaton group, were included that assessed outcomes of interest in emergency department clinics. Because they were all conducted at the same medical center and authored by the same group their findings are likely to be highly correlated across reports within this group (though not considered duplicate results reporting). All studies were prospective cohort studies conducted in the United States. Five studies were rated as serious risk of bias[36,37,39-41] and 1 as moderate.[38] The studies recruited and trained scribes using an in-house training program that was developed by a physician with prior experience with scribes. Detailed ROB ratings can be found in Appendix 4.

Two of the studies reported grant[39] or hospital funding.[41] The studies varied by study period as well as the primary objectives. Scribes were recruited and trained through an in-house training program with a defined curriculum developed by a physician with prior experience implementing scribe programs. Individuals who agreed to participate in the studies included attending physicians,[36-41] residents,[37,38] senior resident physicians,[36-38,41] nurse practitioners,[36-38] physician assistants,[36-38] and interns.[41]

In all studies scribe duties included medical documentation services and clerical support. Most scribes were college students or recent graduates with an interest in health science careers. A summary of reported outcomes is presented in Table 7. Detailed study characteristics can be found in Appendix Table 6-7 and detailed results clinic efficiency and health care system

outcomes can be found in Appendix Table 6-8 and Appendix Table 6-9, respectively. Certainty of evidence tables can be found in Appendix 7.

Table 7. Summary results for emergency department studies (Heaton group, MN)*

Author, Year Risk of Bias Study Characteristics (sample size)	Outcomes									
	Patients per hour per clinician	Door-to-Room/ Waiting Time (minutes)	Door-to-Provider (minutes)	Appointment Length/ Time-to-disposition	Door-to-Discharge/ LOS (minutes)	LWBS	Patient Satisfaction	Clinician Satisfaction	Financial Productivity	Relative Value Units (RVU)
Heaton 2016[36] Serious Prospective Cohort N=8015 patients	↔	NR	↔	↔	↑ 265 vs 255	NR	NR	NR	NR	NR
Heaton 2017a[37] Serious Prospective Cohort N=6119 patients	NR	NR	↔	↔	↔	NR	NR	NR	NR	NR
Heaton 2017b[38] Moderate Prospective Cohort N=39926 visits	NR	NR	NR	NR	NR	NR	NR	NR	NR	↑[a] 4.04 vs 3.84
Heaton 2018[39] Serious Prospective Cohort N=48 shifts	NR	NR	NR	↔	NR	NR	NR	NR	NR	NR
Heaton 2019a[41] Serious Prospective Cohort N=4629 patients	NR	NR	↔	↔	↔	NR	NR	NR	↔[a]	NR
Heaton 2019b[40] Serious Prospective Cohort N=8 shifts	NR	NR	NR	NR	NR	NR	NR	NR	NR	↑[b] $488 vs $600

↔=no significant difference; ↑=increase in outcome compared to control group; ↓=decrease in outcome compared to control group; LOS=length of stay; LWBS=left without being seen; NR=not reported

*Numerical data only presented when deemed statistically significant

[a] mean RVUs per patient
[b] estimated costs of charting per shift

Clinic Efficiency

Patients seen per day

One report from this group, rated as serious risk of bias, reported outcomes related to patients seen per day.[36] The study reported no difference in patients seen per hour among attending physicians with a scribe compared with no scribe; however, no data was provided.

Door-to-provider time

Three reports from this group reported outcomes related to door-to-provider time in the emergency department.[36,37,41] All studies were rated as serious risk of bias.

All studies found median door-to-provider time to be similar in scribe and non-scribe groups, with time ranging from 20 to 25 minutes in the scribe group and 19 to 27 minutes in the non-scribe group. Heaton 2017a[37] and Heaton 2016[36] also found similar times between groups among attending physicians, second- and third-year residents, nurse practitioners, and physician assistants. Additionally, Heaton 2019[41] also compared door-to-provider times in morning, afternoon, and overnight shifts. The study found door-to-provider time to be shorter in the scribe group (21 minutes) compared to the non-scribe group (28 minutes) during overnights shifts (P=.01) but similar during morning and afternoon shifts.

Appointment length

Four reports from this group reported outcomes related to appointment length.[36,37,39,41] All studies were rated as serious risk of bias. Three studies found time in treatment room to be similar in scribe and non-scribe groups, with time ranging from 176 to 222 minutes in the scribe group and 181 to 221 in the non-scribe group.[36,37,41] Heaton 2017[37] and Heaton 2016[36] also found similar times between groups in attendings, second- and third-year residents, nurse practitioners, and physician assistants, while Heaton 2019b[41] found similar treatment room times in morning, afternoon, and overnight shifts.

Heaton 2018[39] reported time spent at patient bedside. Based on 24 shifts, the average time was found to be similar between scribe and non-scribe groups (138 versus 140 minutes, P=.88).

Time to disposition

Three reports from this group, rated as serious risk of bias, reported outcomes related to disposition time.[36,37,41] None found a difference between scribe and non-scribe groups. Two studies reported that the median provider-to-disposition time among patients were similar between scribe and non-scribe groups (P=.51 and P=.32).[37,41] The third study also found median provider-to-disposition times among providers were similar between groups (P=.15).[36]

Length of stay/Door-to-discharge time

Three studies, rated as serious risk of bias, reported outcomes related to length of stay.[36,37,41] Outcomes were mixed. Two studies reported median length of stay among patients and found it to be similar between scribe and non-scribe groups, 215 versus 214 minutes (P=.34) and 267 versus 272 minutes (P=.34).[37,41] In comparison, the third study found median length of stay among clinician s to be greater in the scribe group, 265 versus 255 minutes (P=.03).[36]

Patients left without being seen

The Heaton group did not report on outcomes related to the number of patients who left without being seen.

Patient/Clinician Satisfaction

None of the Heaton group's eligible articles reported patient or clinician satisfaction regarding the use of medical scribes in the emergency department.

Health Care and System Outcomes

Financial productivity and relative value units

Three studies reported outcomes related to cost or revenue. One study was rated as moderate risk of bias[38] and the other 2 as serious risk of bias.[40,41] Results were mixed.

Heaton 2017[38] estimated the mean RVUs per patient to be higher in the scribe group compared to the non-scribe group (4.04 vs 3.84 per patient [mean difference [MD] 0.20, P<.001]). In post hoc analyses they also found RVUs to be higher in the scribe group among patients with emergency severity levels of 2 and 3 (P<.001) but similar among severity levels of 1, 4, and 5 (P value ranges from .10 to 0.63). RVUs were also higher in chest pain, heart, and respiratory emergencies (P<.001); ear, throat, and nose emergencies (P=.04); leg fractures (P=0.027); and psychiatric emergencies (P=.002). In comparison, patients in the scribe group had lower RVUs in vision emergencies (P=.027).

Heaton 2019[41] estimated the mean RVUs were similar between scribe and non-scribe groups, 4.79 versus 4.72 (P=.76).

One study reported the cost of charting per shift.[40] The cost of a physician per clinical hour was estimated to be $200 and the cost of a scribe was $11. For every 3 hours, the study estimated costs to be $488 in the scribe group (accounting for 2 hours of clinical work and 1 hour of scribe work) compared to $600 in the non-scribe group.

Other health care and systems outcomes

The Heaton group did not report any outcomes related to time to train scribes, turnover of scribes, medical errors, or quality of documentation.

Other Publications (United States and Canada)

Eight additional studies were included that assessed outcomes of interest in emergency department clinics.[42-49] Seven studies were pre-post design and 1 was a randomized controlled trial.[45] One study instituted an in-house 60-hour training program and required 2 years of clerical experience.[43] Six additional studies used outside vendors to employ and train scribes, One company considered scribes to be proficient after 15 shifts and skilled after 45 shifts[47] while another company considered scribes to be proficient after 20 shifts and skilled after 40 shifts.[49] Six of the 7 pre-post studies were rated as serious risk of bias and 1 was rated as moderate risk of bias.[43] The single randomized controlled trial was rated as moderate risk of bias.

Seven studies were conducted in the United States[42-45,47-49] and 1 in Canada.[46] Of the 2 studies that reported funding, 1 was funded by hospital and foundation,[46] the other by foundation and industry.[45]

Six studies employed scribes using independent scribe companies responsible for hiring and training.[44-49] One trial instituted a 60-hour training program and required scribes to have 2 years of experience.[43] One study considered scribes skilled after 45 shifts[47] and another after 40 shifts.[49]

In all studies scribe duties included medical documentation services and clerical support. Most scribes were college students or recent graduates with an interest in health science careers. The number of clinicians included in the studies ranged from 26 to 103, and scribe to doctor ratio was typically 1 to 1.

Detailed ROB assessments can be found in Appendix 4. A summary of reported outcomes is presented in Table 8. Detailed study characteristics can be found in Appendix Table 6-10 and detailed results for clinic efficiency, patient and clinician satisfaction, and health care system outcomes can be found in Appendix Table 6-11, Appendix Table 6-12 and Appendix Table 6-13, respectively. Certainty of evidence tables can be found in Appendix 7.

Table 8. Summary results for emergency department studies (US and Canada)*

Author, Year Risk of Bias	Outcomes									
	Patients per hour per clinician	**Door-to-Room/ Waiting Time (minutes)**	**Door-to-Provider (minutes)**	**Appointment Length/ Time-to-disposition**	**Door-to-Discharge/ LOS (minutes)**	**LWBS**	**Patient Satisfaction**	**Clinician Satisfaction**	**Financial Productivity**	**Relative Value Units**
Allen, 2014[42] Serious Retrospective Cohort (pre-post) N=NR	↔	↔	↔	↓ 157 vs 169	↓ 233 vs 249	↔	NR	+	NR	NR
Arya, 2010[43] Moderate Retrospective Cohort (pre-post) N=243 shifts	↑ +1.63[a]	NR	NR	NR	↔	NR	NR	NR		↑[a] +0.24
Bastani, 2013[44] Serious Prospective Cohort (pre-post) N=24,338 patients	NR	↓ 34 vs 35	↓ 61 vs 74	↓ 185 vs 237	↓ 269 vs 289	NR	↑[b] 58% vs 75%	↑[c] 62% vs 92%	NR	NR
Friedson, 2018[45] Moderate RCT N=905 shifts	↑ 2.33 vs 2.23	NR	NR	↓ 228 vs 258	NR	NR	NR	NR	NR	↔[d] ↑[e] 72 vs 77
Graves, 2018[46] Serious Prospective Cohort (pre-post) N=158 shifts	↑ 2.81 vs 2.49	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hess, 2015[47] Serious Prospective Cohort (pre-post) N=103 providers	↔	NR	NR	NR	↔	↑	NR	+[f]	NR	↔/↑[g]

Ou, 2017[48] Serious Qualitative survey N=47 residents	NR	NR	NR	NR	NR	NR	NR	+[h]	NR	NR
Shuaib, 2017[49] Serious Prospective Cohort (pre-post) N=23,319 encounters	↑ 3.2 vs 2.3	↓ 41 vs 37	↓ 56 vs 61	↓ 228 vs 237	↓ 287 vs 303	NR	↔	↑[i] 66% vs 81%	NR	↔[j] ↑[k] 241 vs 336

↔=no significant difference; ↑=increase in outcome compared to control group; ↓=decrease in outcome compared to control group; +=satisfaction reported, but no comparison group; LOS=length of stay; LWBS=left without being seen; NR=not reported; RCT=randomized controlled trial

*Numerical data only presented when deemed statistically significant

[a] RVUs per hour increased by 0.24 units for every 10% increment in scribe usage during a shift
[b] Press Ganey Survey: Overall patient satisfaction percentiles
[c] Press Ganey Survey: Overall physician satisfaction percentiles
[d] total RVUs per shift
[e] trimmed RVUs per shift (lowest and highest 10% removed from analysis)
[f] 62% clinicians "liked or loved working with scribes", 74% clinicians "positive or very positive attitude towards scribes", 82% clinicians "positive or very positive changes in efficiency"
[g] Pre-post differences in seasonally-matched productivity metrics; mean differences in RVU per patient and RVU per hour were mixed
[h] 85% residents "my interactions with attendings have improved with scribes", 79% "scribes have improved my overall education as a resident in the emergency department"
[i] "Physician satisfaction increased 15% from pre- to post-scribe" (p=NR)
[j] mean RVUs per patient
[k] mean total RVUs per hour

Clinic Efficiency

Patients seen per day/hour/shift

Six studies reported outcomes related to patients seen per day, per hour or per shift. Five studies were pre-post[42,43,46,47,49] and 1 was a randomized controlled trial.[45] Four of the studies were rated as serious risk of bias, and 2 were rated as moderate.[43,45] Results generally suggested that scribes were associated with an increase in the number of patients seen per day, per hour or per shift.

One RCT[45] found that the number of patients per shift increased with scribes compared to non-scribed shifts, 18.6 per clinician per shift versus 17.8 (MD=0.8, P<.05). Four pre-post studies also found an increase in patients seen per provider shift or per day[43,46,47,49] One study found no difference in the number of registered visits seen with and without a scribe (MD=-0.99, P=.47).[42]

Additionally, 1 study conducted a post-only survey in which 77% of residents stated that scribes allow them to see more patients.[48]

Door-to-room time/waiting time

Three pre-post studies reported on outcomes related to emergency department waiting time. Results were mixed. All studies were rated as serious risk of bias.[42,44,49] One study found door-to-room waiting time to be less in scribed cohorts compared to non-scribed cohorts, 37 versus 41 minutes (P<.0001).[49] A second study found door-to-room waiting time to be similar between scribe and non-scribe cohorts in the total cohort (MD=-0.01; P=.65). However, the study found door-to-room waiting time to be lower with scribes among admitted patients (MD=0.02; P=.001).[42] A third study also found waiting time to be similar between groups, 34 versus 35 minutes.[44]

Two studies reported room-to-provider times.[44,49] One study found room-to-provider time to be less in the scribe cohort compared to the non-scribe cohort, 24 versus 26 minutes (P<.0001).[49] The second reported room-to-provider waiting time to 31 minutes in the scribe group and 39 minutes in the non-scribe group.[44]

Additionally, 1 study reported door-to-triage waiting time and found it to be less with a scribe (MD=-0.01; P=.008).[42] Door-to-triage waiting time was also found to be less with a scribe among admitted patients (MD=0.02; P<.001) but not among discharged patients (MD=0; P=.20).

Door-to-provider time

Three pre-post studies, rated as serious risk of bias, reported mean door-to-provider time in the emergency department.[42,44,49] Door-to-provider time is defined as the time elapsed from when the patient arrives in the ED until the physician signs on to the patient's chart. Results were mixed.

Two studies found door-to-provider time to be significantly lower in the scribe group compared to the non-scribe group. Bastani et al[44] reported door-to-provider time to be 61 minutes with a scribe versus 74 minutes without a scribe (P<.0001). Shuaib et al[49] reported 56 minutes with a scribe versus 61 minutes without a scribe (P<.0001).

However, the third study did not find a significant difference between the scribe and non-scribe groups, reporting 1.28 mean hours (76.8 minutes) with a scribe versus 1.34 (80.4 minutes) mean hours without a scribe (P=.07).[42]

Appointment length/Time-to-disposition

Four studies reported mean provider-to-disposition time, defined as the time elapsed from when the physician signs on to the patient's chart to the time the patient is discharged or admitted.[42,44,45,49] All 4 studies reported lower mean provider-to-disposition time in the scribe group compared to the non-scribe group. Three of these studies were pre-post prospective cohort studies and rated as serious ROB.

The first study reported provider-to-disposition time to be shorter with a scribe compared to without a scribe, 228 versus 237 minutes (P<.0001).[49] The second study also found provider-to-disposition time to be shorter in the scribe cohort, 2.61 versus 2.82 minutes (MD=-0.21; P<.001). This difference was found in both admitted (MD=-0.38; P<.0001) and discharged patients (MD-0.09; P=.021).[42] The third study reported the average provider-to-disposition time to be 185 minutes in the scribe cohort and 237 minutes in the non-scribe cohort (P<.0001).[44] The fourth study was a randomized controlled trial, rated as moderate risk of bias.[45] The trial found provider-to-disposition time was shorter in the scribe group compared to the non-scribe group, 3.8 mean hours (228 minutes) versus 4.3 (258 minutes) (P<.01).

Shuaib et al[49] conducted a time-motion analysis of provider activities, breaking down different parts of a patient visit. Chart prep, chart review, and post-visit documentation were all found to be significantly lower in the post-scribe group (P<.01), while physical examination time was similar between groups. The study found doctor-patient interaction time to be greater in the scribe cohort compared to the non-scribe cohort, 7.8 mean minutes versus 4.0 (P<.01).

Length of stay/Door-to-discharge time

Five pre-post studies reported outcomes related to time spent in the emergency department and length of stay. Four studies were rated serious ROB[42,44,47,49] and 1 was rated moderate.[43] Results were mixed.

One study defined "length of stay" as the time between arrival of the patient and departure from ED.[47] Two other studies used the term "length of stay", but did not define it further.[44,49] One study referred to this as "turn-around-time", defined as the difference between electronically generated arrival and discharge times.[43] Of these 4 studies, 2 reported length of stay to be significantly lower in the post-scribe group, while the other 2 reported the pre-and-post mean length of stay to be similar between groups. Shuaib et al[49] found the length of stay, on average, to be shorter in the scribe cohort among both admitted patients, 473 minutes versus 507 minutes (P<.0001) and discharged patients, 287 minutes versus 303 (P<.0001). Bastani et al[44] also reported length of stay, on average, to be shorter in the post-scribe cohort in both admitted, 442 minutes versus 448 (P<.0001), and discharged patients, 269 minutes versus 289 (P<.0001). Comparatively, the Hess et al[47] found length of stay to be similar between scribe and non-scribe cohorts (MD=0.14 [95% CI -0.05, 0.33; P=.15]). Arya et al[43] reported turn-around-times (in minutes) were not significantly affected by scribe usage, when scribes were utilized in 10% increments during a shift (0.4 [95% CI -5.3, 6.1; P=.88]). The fifth study reported average door-to-exit time, defined as the time elapsed from when a patient arrives in the ED to the time the

patient exits the ED, was greater in the pre-scribe cohort compared to the post-scribe cohort, 5.76 hours (345.6 minutes) versus 5.62 (337.2 minutes) (P=.021).[42] The study found the average door-to-exit time to be greater among admitted patients in the post-scribe group, 8.27 mean hours(496.2 minutes) versus 7.61 (456.6 minutes; MD=0.65, P<.0001); however the time was shorter among discharged patients (4.89 hours/293.4 minutes versus 5.07 hours/304.2 minutes; MD=-0.18; P=.01). This study also reported door-to-disposition time, defined as the time elapsed from when the patient arrived in the ED until the clinician decided a patient's disposition. Allen et al reported, on average, a shorter door-to-disposition time with scribes compared to without scribes, 3.89 (233.4 minutes) versus 4.16 (249.6 minutes) hours (MD=-0.27; P<.0001). The difference was also found among discharged (MD=-0.16; P=.03) and admitted (MD=-0.38; P<.0001) patients.

Patients left without being seen

Two pre-post studies reported on the number of patients that left without being seen. Both studies were rated as serious risk of bias.[42,47] Results were mixed.

Hess 2015 reported a greater number of patients left without being seen in the scribe cohort compared to non-scribe cohort, 4.41 versus 2.94 (1.47 [95% CI 0.83, 2.11; P<.01]), while Allen 2014 found no difference in scribe and non-scribe cohorts, 5% versus 5% (P=.38).

Patient Satisfaction

Two pre-post studies, rated as serious risk of bias, reported patient satisfaction with mixed results. Using a Likert scale (1=poor to 5=excellent), Shuaib et al[49] asked 6 questions: 1) the doctor carefully listened to concerns; 2) the doctor explained things in a way you can understand; 3) meticulousness of examination; 4) doctors instructions concerning follow-up care; 5) the doctor was courteous; and 6) the doctor provided satisfactory feedback to questions. Results were similar for questions 1-5 for the pre-and-post scribe groups. However, the sixth question had higher scores in the post-scribe group compared to the pre-scribe group, 4.7 versus 3.9 (P<.01).[49]

Using the Press Ganey Survey, the second pre-post study found 'patient satisfaction' increased from the 58th percentile in the pre-scribe group to the 75th percentile in the post-scribe group.[44]

Clinician Satisfaction

Five studies reported on clinician satisfaction. All studies were rated as serious risk of bias. Two studies conducted surveys pre-and-post scribes,[44,49] 1 conducted pre-and-post surveys with additional post-only questions[48] and 2 conducted post-only surveys to measure clinician satisfaction.[42,47] Of the 3 that conducted pre-and-post surveys, 1 reported an increase in clinician satisfaction using the Press Ganey Survey from the 62nd percentile to the 92nd percentile in the pre-and-post scribe groups, respectively.[44] Another reported that physician satisfaction increased from 66% to 81% in the pre-and-post scribe groups, respectively, but did not provide further information about how it was measured.[49] The third study was a survey study measuring resident perceptions of their educational experience before and after a scribe program implementation.[48] Ou et al[48] conducted a pre-and-post survey, and additional questions post survey. Only 1 question from the pre-and-post survey was significantly different between groups, "I have enough fact-to-face teaching with the attendings during my shift". Of the 47 residents surveyed,

17% agreed to this statement during the pre-scribe survey and 55% agreed during the post-scribe survey (p<.001). Among the 47 resident clinicians, 85% reported "my interaction with attendings have improved with the implementation of scribes" and 79% reported "scribes have improved my overall education as a resident in the emergency department" in the post-only survey.

Among the 2 studies that provided post-only data, both reported clinicians were satisfied with the implementation of a scribe program. Hess et al[47] reported that among 71 providers, 62% "liked or loved working with scribes"; 74% had an "overall positive or very positive attitude toward scribes"; and 82% experienced "positive or very positive changes in efficiency". Allen et al[42] reported that among 20 providers, 100% agreed with the statement, "scribes are a valuable addition", 67% agreed with "scribes increase workplace satisfaction", and 89% agreed with "scribes increase quality of life".

Health Care and System Outcomes

Financial productivity and relative value units

One randomized controlled trial[45] and 4 pre-post studies[43,46,47,49] reported outcomes related to financial impacts. The randomized controlled trial was rated as moderate risk of bias, 3 studies as serious risk, and 1 study as moderate risk.[43] In general, scribes were associated with a positive financial impact, though none of the studies reported on the cost of the contracted services required to hire, train, maintain, and supervise scribes.

The randomized controlled trial reported total RVUs between scribe and non-scribe groups. Total RVUs were similar between scribe and non-scribe groups, 76.5 versus 7.3 (MD=2.14; P=non-significant; no numerical value reported). However, after excluding shifts with the highest and lowest 10% of RVUs from analysis, total RVUs were greater in the scribe group, 76.9 versus 72.0 (MD=4.87; P<.01).[45]

In the first pre-post study, the average costs of a clinician amounted to $1200 per shift ($150 per hour) and the average costs of scribes were estimated to be $216 per shift ($27 per hour). The study assessed that "given a scribe may be associated with a mean increase of 13% in productivity 'costs' to a physician using a scribe would be about $60 relative to what their earning without a scribe would be". The study suggested a greater income with scribes even after accounting for associated scribing costs.[46]

The second study found RVUs per patient to be similar between scribe and non-scribe groups, 2.74 versus 2.57 (P=.88). However, the study found RVUs per hour to be greater in the scribe group compared to the non-scribe group, 336 versus 241 (P<.001).[49]

The third study compared a 4-month period (September-December 2011) before scribe implementation to the same 4-month period (September-December 2012) after the scribe implementation. The study found mean RVUs per hour to be greater in the scribe group, though small in magnitude in September (MD=0.00008; P=.03), October (MD=0.00016; P<.01), and November (MD=0.0001; P=.03), but similar in December (MD=0.00003,P=.57). Mean RVUs per patient were also assessed between scribe and non-scribe groups. RVUs per patient were greater in the scribe group in October (MD=0.00007; P<.01) but similar in September (MD=0.00001; P=.39), November (MD=0.0; P=.98), and December (MD=-0.00003; P=.08).[47]

The fourth pre-post study reported an additional 24 RVUs per 10-hour shift with the use of scribes (P=.00011).[43]

KEY QUESTION 2: HOW DO THE EFFECTS OF MEDICAL SCRIBES VARY BASED ON DIFFERENCES IN COMPENSATION STRUCTURE, QUALIFICATIONS, TYPES OF ENTRIES, OR SETTING?

Summary of Findings

Key Messages

- No eligible studies were identified that reported if the effects of medical scribes varied based on differences in compensation structure, qualifications, types of entries, or other scribe-permitted tasks or scribe-specific qualifications, or setting within orthopedic or cardiology clinics.

- No eligible studies were identified that reported if the effects of medical scribes varied based on differences in compensation structure, types of entries, or other scribe-permitted tasks or scribe specific qualifications within emergency departments.

- Evidence was insufficient to determine whether the effect of medical scribes on emergency department efficiency varied based on clinician training, experience, or area of service within the emergency department.

Very few articles were identified (k=5) that addressed how the effects of medical scribes vary based on provider qualifications and setting. Additionally, no studies compared scribes employed and contracted by outside vendors to those trained and employed by medical institutions. Summary characteristics of the scribe training programs for each eligible study can be found in Table 9. All studies required additional on-the-job training regardless of the hiring mechanism.

Table 9. Summary characteristics of scribe training programs

Author, Year	Risk of Bias	Location	Training Supplied by:		Total Training	Experience	Training Characteristics			
			In-house	Vendor			Classroom lecture	On-line/ training manual	On-floor training	Supervised scribing
Orthopedics										
No eligible studies identified										
Cardiology										
Bank, 2015[29]	Serious	United States		X	184 hours	6 years	X		X	X
Emergency Department										
Walker, 2016a[31]	Serious	Australia		X	NR	2 years	NR			
Walker, 2016b[32]	Serious		X		68-118	None		X	X	X
Walker, 2017[33]	Moderate									
Dunlop 2018[34]	Serious									
Walker, 2019*[35]	Moderate									
Heaton, 2016[36]	Serious	United States	X		NR	NR		X	X	X
Heaton, 2017a[37]	Serious									
Heaton, 2017b[38]	Moderate									
Heaton, 2018[39]	Serious									
Heaton, 2019a[40]	Serious									
Heaton, 2019b[41]	Serious									
Allen, 2014[42]	Serious	United States	NR		NR	NR	NR			
Arya, 2010[43]	Moderate	United States	X		60 hours	NR				X
Bastani, 2014[44]	Serious	United States		X	NR	NR	NR			
Friedson, 2018*[45]	Moderate	United States		X	NR	NR	NR			
Graves, 2018[46]	Serious	Canada		X	NR	NR			X	X
Hess, 2015[47]	Serious	United States		X	NR	NR			X	X
Ou, 2017[48]	Serious	United States		X	6-8 weeks	NR	X		X	X
Shuaib, 2017[49]	Serious	United States		X	NR	NR			X	X

NR=not reported

Emergency Department: Walker et al Group (Victoria, Australia)

Clinic Efficiency

Patients seen per hour

Walker 2016a[31] assessed the number of patients seen per hour for 5 individual doctors with and without a scribe. A 9-15% relative increase was reported, varying by doctor, but did not provide any further detail about specific physicians' qualifications or experience that may account for these varying effects. The article concluded it would be more cost-effective to allocate scribes to faster doctors.

Walker et al (2019)[35] assessed the number of patients seen per hour per doctor by different regions of the emergency department. No significant differences were found during sub-acute, fast-track, or observation ward shifts. A small but statistically significant increase was reported for "acute" shifts, (increase of 0.09 (0.03 to 0.15) patients per hour per doctor), and larger increase for "senior doctor at triage" shifts, (increase of 0.53 (0.14 to 0.93) patients per hour per doctor).

Emergency Department: Heaton et al Group (Mayo, Rochester, MN)

Clinic Efficiency

Provider-to-disposition

Heaton 2016[36] assessed provider-to-disposition time by training experience and found no difference between scribe and non-scribe groups among attending physicians, year-2 residents, year-3 residents, and nurse practitioners or physician assistants. Heaton 2017 also assessed provider to disposition time by clinic area and found no difference between scribe and non-scribe groups in areas seen by attending physicians with residents (P=.21) or attending physicians with nurse practitioners or physician assistants (P=.42).

Heaton 2019[41] also assessed provider-to-disposition time among patients by time of shift. They study found median disposition times were similar between groups in morning (189 minutes in non-scribe group vs 179) and afternoon (223 minutes in non-scribe group vs 224) shifts but higher in the scribe group in overnight shifts (146 minutes in non-scribe group vs 156) (P=.01).

Length of stay

Heaton 2016[36] assessed length of stay by training experience and found no difference between scribe and non-scribe groups among attending physicians (P=.06), year-2 residents (P=.55), and nurse practitioners or physician assistants (P=.39). However, length of stay was shorter among patients seen by year-3 residents, 244 versus 262 minutes (P=.02).

Heaton 2017[37] assessed length of stay by clinic area and found no difference between scribe and non-scribe groups in areas seen by attending physicians with residents (P=.18) or attending physicians with nurse practitioners or physicians assistants (P=.80).

Heaton 2019[41] assessed length of stay among patients by time of shift. They study found median disposition times were similar between groups in morning (P=.13), afternoon (P=.86), and overnight (P=.86) shifts.

SUMMARY AND DISCUSSION

Findings from our systematic review on the effects of medical scribes in orthopedic, cardiology, and emergency departments are limited by the quantity, quality, completeness, and applicability of information. Available information is based on studies mostly rated as having serious risk of bias and of limited applicability to widespread implementation. There are no data in VA health care settings or among Veterans. Much of the information from emergency departments is from 2 single-site centers (one from Australia and another from the US). Thus, findings across multiple reports from these groups are likely to be highly correlated even though they are not considered duplicate outcomes reporting. Studies typically recruited interested clinician participants and began data collection following scribe and clinician training run-in periods. Studies did not report all outcomes of interest and rarely provided adequate information on resources required to hire, train, maintain, and supervise scribes.

No data were identified on medical scribes in orthopedic clinics. In cardiology clinics the efficiency and financial productivity of scribe programs is uncertain, with findings based on a single, serious risk of bias study from a cardiology group in Minneapolis, MN that evaluated medical scribes provided by a vendor. No data are available on the effect of medical scribes on patient and provider satisfaction in cardiology clinics.

Most of our findings are from studies conducted in emergency departments, much of them limited to 2 groups publishing multiple results of various measures of scribe related outcomes. In emergency departments, medical scribes may improve efficiency (low certainty of evidence [COE]) and financial productivity (low COE). The magnitude of effect on efficiency is likely small to moderate. Efficiency varies based on the setting, outcomes assessed, and methods for evaluating financial productivity. The effect on costs is difficult to ascertain as complete cost reporting was not provided. Resources to identify, hire, train, staff, maintain, and monitor a scribe program are expected to be substantial, rarely reported in the literature, and not readily available through online searches. Thus, net financial impact is not known and likely varies by key assumptions and methods for scribe program development, implementation, and maintenance. All the studies that reported on financial productivity reported estimations based on a typical scribe salary and average billings, and none of the identified studies were true economic evaluations incorporating all costs attributed to the scribe intervention, including administrative or supervisory cost; the cost of identifying, hiring, training, supervising, maintaining, or replacing scribes; documentation verification costs; or costs related to contracting through outside vendors. Medical scribes may make little to no difference in door-to-room or door-to-provider time, number of patients who left without being seen, and patient or clinician satisfaction, though results were mixed. There are no direct comparative data on quality of documentation, medical errors, or scribe training (*eg,* time to train, turnover), and no data comparing these outcomes in contracted (*ie*, vendor supplied) scribes versus scribes trained in-house or using virtual scribes.

We identified only 1 study that provided a detailed analysis of the implementation of a scribe training program, which was implemented in Australia. Few US studies provided any details about scribe training, and no studies described the time it takes to orient a contracted scribe to the health care facility in which they are working.

The data identified from the emergency departments are not necessarily generalizable to other clinics, as these departments function differently, have variation in measured metrics (*ie*, panel size vs number of patients seen per day) and have a different financial model. Outcomes of interest to emergency departments are not necessarily the same as other specialty clinics. For example, an emergency department may be able to alter staffing schedules if 1 doctor can see more patients in a shift, where the only way to alter the number of patients seen in a shift in the cardiology clinic is to alter the clinicians schedule. The single cardiology study we identified reported that the clinicians with scribes allocated to them had altered schedules which allowed them to see more patients per day. No emergency department studies discussed altering staffing ratios.

Though we did not identify any studies assessing virtual scribes, many vendors offer the service. Virtual scribes may be of increasing interest as they may allow for increased accessibility, especially in rural areas or in cases of a pandemic, as well as potentially save money as they can be used on-demand.[51]

Additional information on the role of medical scribes in primary care and other specialty settings was beyond the scope of our report and not included. However, these studies are typically of similar methodological quality to those identified in our report – that is, single-site reports with clinician volunteers, vendor supplied scribes, and limited outcome (including financial) reporting. Their results suggest modest effects for improving documentation time and patient satisfaction.[15] It is not known how the results from these settings can be applied to future implementation in orthopedic, cardiology, and emergency departments. A prior systematic review identified 5 studies published through 2014 and noted limited quality and quantity of information.[16]

LIMITATIONS

This review had several limitations. Evidence evaluating the effect of medical scribes was very limited and of poor methodological quality. Only 2 RCTs were identified, 1 conducted in Australia. Also, the bulk of the available evidence comes from 2 distinct groups, using the same general population in several studies and from single-site settings. There also was no reliable evidence available to address different aspects of a scribe program, such as quality of documentation and medical errors. Data on financial impacts was difficult to interpret, as most studies did not report the cost of initiation, implementation, or sustainability. Studies that used vendor services did not include the cost of these vendor services in their estimates of revenues. Variation in training programs and requirements put forth by scribe vendors was not well described. Measures used to quantify outcomes also varied widely across studies. There were also no data on the organizational structures and resources needed to develop and maintain scribe programs as well as barriers and facilitators to implementation.

Applicability of Findings to the VA Population

Current findings have limited applicability and raise important questions about implementation, research gaps and future research. Despite information that there may be 100,000 medical scribes in the US in 2020,[17] there is a paucity of data on the effectiveness, harms, costs, and quality of scribes, or on best methods for implementation and evaluation. No studies were conducted in Veterans Affairs Medical Centers and the effectiveness and financial productivity for widespread

implementation across a national health care system are not known. Several reports were not from the US, and many evaluated programs after training had been completed and limited inclusion to clinicians volunteering for scribe services. Additionally, a large amount of information was reported from 2 emergency department groups, 1 in Australia. The only report from a cardiology department was limited to a single clinic in the US that assigned scribes to clinician volunteers and altered the daily schedule of clinicians working with scribes to permit more clinic visits. Scribes in the cardiology report were hired by an outside vendor and had extensive experience. Charges and costs for the services provided by the vendor were not described. None of the programs described the possible role of allocating scribe services to employees currently assigned other clinic duties, including administrative, nursing or "clinician extenders". The effect of scribes on improving efficiency, patient access, and throughput likely also requires additional programmatic factors including reducing clinic appointment times and increasing the number of patients scheduled per day.

RESEARCH GAPS/FUTURE RESEARCH

Our principal finding is that there are large gaps in evidence that require future research. Despite the marked increase in the use of medical scribes in the United States, there is no high-quality information evaluating their effects on clinic efficiency, health care access, patient or clinician satisfaction, or financial investment and productivity in cardiology, orthopedic and emergency departments. There are no data on the use of virtual scribes. Additionally, there are limited data on other important aspects of a medical scribe program, including documentation quality, the comparative effects of in-house versus contracted hiring, training, maintaining, and/or supervising, large-scale implementation of medical scribes, and other components to medical scribe programs required to enhance care quality, including productivity. Future research should be more transparent about costs related to contracting scribes through a vendor, as well as any administrative oversight costs that must exist even when using a vendor for scribes. Data from other clinical settings (primary care and other specialty clinics) is of limited applicability, quality, and quantity.

POLICY IMPLICATIONS

Our results have policy implications and suggest that prior to widespread implementation, more information is needed on the effectiveness, harms, and costs of scribe programs. If information is deemed sufficient for programmatic rollout, then clear identification and evaluation of programmatic goals (improving access and patient/provider satisfaction, enhancing documentation quality, increasing clinical throughput), resources, programmatic models, and personnel required, as well as implementation barriers and facilitators, are needed.

CONCLUSIONS

Based on mostly serious risk of bias reports, in-person medical scribes may improve clinic efficiency and improve financial productivity and revenue as measured by relative value units in emergency departments. The effects on clinic efficiency appear to be small in magnitude and dependent on the type and method of outcome assessment. Cost and financial productivity data do not include the cost of hiring, training, maintaining, and supervising scribes. Generalizability of findings outside the reported settings is limited. The effect of medical scribes in cardiology departments is uncertain. There is no information from orthopedic departments or VA Medical

Centers, or on virtual scribes. There is little information on patient or clinician satisfaction, scribe documentation quality, or whether results vary by in-house versus contracted hiring and training.

REFERENCES

1. American Healthcare Documentation Professionals Group. Medical Scribe - The Job Description. https://ahdpg.com/medical-scribe-the-job-description/. Accessed 07/01/2020.

2. Oregon Health and Science University. Medical Scribes History. https://www.ohsu.edu/medical-scribes/history-and-results. Accessed 07/01/2020.

3. Heaton HA, Castaneda-Guarderas A, Trotter ER, Bellolio MF, Erwin PJ. Impact of scribes: A systematic review and meta-analysis. *Academic Emergency Medicine.* 2016;23:S62.

4. Cabilan CJ, Eley RM. Review article: Potential of medical scribes to allay the burden of documentation and enhance efficiency in Australian emergency departments. *Emerg Med Australas.* 2015;27(6):507-511.

5. Shultz CG, Holmstrom HL. The use of medical scribes in health care settings: A systematic review and future directions. *Journal of the American Board of Family Medicine.* 2015;28(3):371-381.

6. Holroyd-Leduc JM, Lorenzetti D, Straus SE, Sykes L, Quan H. The impact of the electronic medical record on structure, process, and outcomes within primary care: a systematic review of the evidence. *Journal of the American Medical Informatics Association.* 2011;18(6):732-737.

7. King J, Patel V, Jamoom EW, Furukawa MF. Clinical benefits of electronic health record use: national findings. *Health services research.* 2014;49(1pt2):392-404.

8. Boonstra A, Broekhuis M. Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. *BMC Health Serv Res.* 2010;10:231.

9. McLean SA, Feldman JA. The impact of changes in HCFA documentation requirements on academic emergency medicine: results of a physician survey. *Acad Emerg Med.* 2001;8(9):880-885.

10. Finkelstein J, Lifton J, Capone C. Redesigning physician compensation and improving ED performance. *Healthc Financ Manage.* 2011;65(6):114-117.

11. Brady K, Shariff A. Virtual medical scribes: making electronic medical records work for you. *J Med Pract Manage.* 2013;29(2):133-136.

12. U.S. Congress. VA MISSION Act of 2018.https://www.congress.gov/115/bills/s2372/BILLS-115s2372enr.pdf.

13. Sterne JA, Hernan MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. *BMJ.* 2016;355:i4919.

14. Higgins JP, Altman DG, Gotzsche PC, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ.* 2011;343:d5928.

15. Mishra P, Kiang JC, Grant RW. Association of Medical Scribes in Primary Care With Physician Workflow and Patient Experience. *JAMA Intern Med.* 2018;178(11):1467-1472.

16. Shultz CG, Holmstrom HL. The use of medical scribes in health care settings: a systematic review and future directions. *The Journal of the American Board of Family Medicine.* 2015;28(3):371-381.

17. George A, Gellert M. The Rise of the Medical Scribe Industry Implications for the Advancement of Electronic Health Records. 2014.

18. American College of Medical Scribe Specialists. Becoming Licensed – Certified Medical Scribe Specialist. https://acmss.org/become-cmss-licensed/. Accessed 7/01/2020.

19. American Healthcare Documentation Professionals Group. The MSCE. https://ahdpg.com/scribe-certification/. Accessed 07/01/2020.

20. Centers for Medicare and Medicaid and Services. Recommended Core Measures. https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Recommended_Core_Set. Accessed 07/01/2020.

21. Glassdoor. Medical Scribe Salary. https://www.glassdoor.com/Salaries/minneapolis-medical-scribe-salary-SRCH_IL.0,11_IM567_KO12,26.htm

Accessed 06/22/2020.

22. ScribeAmerica. FAQs. https://www.scribeamerica.com/faq/. Accessed 06/22/2020.

23. Medical Scribes Training Institute. Medical Scribe Program Implementation: 8 Key Decisions When Hiring Scribes. https://medicalscribes.org/medical-scribe-program-implementation-8-key-decisions-when-hiring-scribes/ 06/22/2020.

24. Centers for Medicare and Medicaid and Services. Finalized Policy, Payment, and Quality Provisions Changes to the Medicare Physician Fee Schedule for Calendar Year 2020. https://www.cms.gov/newsroom/fact-sheets/finalized-policy-payment-and-quality-provisions-changes-medicare-physician-fee-schedule-calendar. Accessed 07/01/2020.

25. Murad MH, Mustafa RA, Schunemann HJ, Sultan S, Santesso N. Rating the certainty in evidence in the absence of a single estimate of effect. *Evid Based Med.* 2017;22(3):85-87.

26. Malmivaara A. Methodological considerations of the GRADE method. In: Taylor & Francis; 2015

27. Balshem H, Helfand M, Schunemann HJ, et al. GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol.* 2011;64(4):401-406.

28. 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(1):399-406.

29. Bank AJ, Gage RM. Annual impact of scribes on physician productivity and revenue in a cardiology clinic. *Clinicoecon Outcomes Res.* 2015;7:489-495.

30. Walker K, Ben-Meir M, O'Mullane P, Phillips D, Staples M. Scribes in an Australian private emergency department: A description of physician productivity. *Emerg Med Australas.* 2014;26(6):543-548.

31. Walker KJ, Ben-Meir M, Phillips D, Staples M. Medical scribes in emergency medicine produce financially significant productivity gains for some, but not all emergency physicians. *EMA - Emergency Medicine Australasia.* 2016;28(3):262-267.

32. 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(12):865-869.

33. Walker KJ, Wang A, Dunlop W, Rodda H, Ben-Meir M, Staples M. The 9-Item Physician Documentation Quality Instrument (PDQI-9) score is not useful in evaluating EMR (scribe) note quality in Emergency Medicine. *Applied clinical informatics.* 2017;8(3):981-993.

34. Dunlop W, Hegarty L, Staples M, Levinson M, Ben-Meir M, Walker K. Medical scribes have no impact on the patient experience of an emergency department. *EMA - Emergency Medicine Australasia.* 2018;30(1):61-66.

35. 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.

36. Heaton HA, Nestler DM, Jones DD, et al. Impact of scribes on patient throughput in adult and pediatric academic EDs. *Am J Emerg Med.* 2016;34(10):1982-1985.

37. Heaton HA, Nestler DM, Lohse CM, Sadosty AT. Impact of scribes on emergency department patient throughput one year after implementation. *Am J Emerg Med.* 2017;35(2):311-314.

38. Heaton HA, Nestler DM, Jones DD, et al. Impact of Scribes on Billed Relative Value Units in an Academic Emergency Department. *J Emerg Med.* 2017;52(3):370-376.

39. Heaton HA, Wang R, Farrell KJ, et al. Time Motion Analysis: Impact of Scribes on Provider Time Management. *J Emerg Med.* 2018;55(1):135-140.

40. Heaton HA, Nestler DM, Barry WJ, et al. A Time-Driven Activity-Based Costing Analysis of Emergency Department Scribes. *Mayo Clin Proc Innov Qual Outcomes.* 2019;3(1):30-34.

41. Heaton HA, Schwartz EJ, Gifford WJ, et al. Impact of scribes on throughput metrics and billing during an electronic medical record transition. *Am J Emerg Med.* 2019;(no pagination).

42. Allen B, Banapoor B, Weeks EC, Payton T. An assessment of emergency department throughput and provider satisfaction after the implementation of a scribe program. *Advances in Emergency Medicine.* 2014;2014.

43. Arya R, Salovich DM, Ohman-Strickland P, Merlin MA. Impact of scribes on performance indicators in the emergency department. *Acad Emerg Med.* 2010;17(5):490-494.

44. Bastani A, Shaqiri B, Palomba K, Bananno D, Anderson W. An ED scribe program is able to improve throughput time and patient satisfaction. *American Journal of Emergency Medicine.* 2014;32(5):399-402.

45. Friedson AI. Medical Scribes as an Input in Health-Care Production: Evidence from a Randomized Experiment. *American Journal of Health Economics.* 2018;4(4):479-503.

46. Graves PS, Graves SR, Minhas T, Lewinson RE, Vallerand IA, Lewinson RT. Effects of medical scribes on physician productivity in a Canadian emergency department: a pilot study. *CMAJ Open.* 2018;6(3):E360-E364.

47. Hess JJ, Wallenstein J, Ackerman JD, et al. Scribe Impacts on Provider Experience, Operations, and Teaching in an Academic Emergency Medicine Practice. *West J Emerg Med.* 2015;16(5):602-610.

48. Ou E, Mulcare M, Clark S, Sharma R. Implementation of Scribes in an Academic Emergency Department: The Resident Perspective. *J Grad Med Educ.* 2017;9(4):518-522.

49. Shuaib W, Hilmi J, Caballero J, et al. Impact of a scribe program on patient throughput, physician productivity, and patient satisfaction in a community-based emergency department. *Health Informatics J.* 2017:1460458217692930.

50. Stetson PD, Morrison FP, Bakken S, Johnson SB, eNote Research T. Preliminary development of the physician documentation quality instrument. *J Am Med Inform Assoc.* 2008;15(4):534-541.

51. ScribeKick. Virtual Scribe. https://www.scribekick.com/virtual-scribe/. Accessed 07/01/2020.