1. **Title Page**

Title of Project: **Creation and validation of a training toolkit to ensure safe and proficient use of EHR by medical scribes**

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2. Structured Abstract:

Purpose: To create a toolkit to allow institutions to establish and monitor safe and effective use of medical scribes.

Scope: Due to a combination of provider burnout and poor EHR design, providers have gravitated toward the use of intermediaries to untether them from the EHR for documentation. Medical scribes are the most currently employed modality. Scribes are typical pre-professional students with no medical training who are either supplied by independent, for-profit companies or are trained directly by their providers, with no established guidelines for training content, certification, or monitoring of the quality of their documentation.Our preliminary data suggest that scribes, in a controlled setting, make numerous errors of omission and commission in documentation. Furthermore, survey results suggest that providers are potentially rapidly, and in an uncontrolled manner, expanding the scope of scribe duties beyond pure documentation to include numerous other EHR activities, including chart navigation and order entry.

Methods: This was a mixed method study, using a combination of EHR audit log data, ethnographic evaluation and qualitative analysis, to determine the current role for scribes *in situ*, including identifying barriers and facilitators toward successful implementation. All these results were then used to create and validate a training toolkit to allow for dissemination of best practices and training materials for other providers and institutions.

Results: Qualitative and ethnographic data highlight a few important themes: 1) Scribes are widely employed with a wide range of EHR responsibilities beyond pure documentation. 2) There is little oversight of scribe output, 3) There is little to no standard training for scribes, and what training exists does not encompass the growing EHR responsibilities beyond documentation. 4) Scribes have highly variable impact on provider productivity, which is likely driven by the aforementioned factors. All these data were used to create a first-in-kind corpus of Knowledge Skills and Attitudes (KSAs) for medical scribes, subdivided in to those which can be taught asynchronously vs. those to be taught through simulation-based practice. We subsequently created content for both of these domains and assembled into a fully annotated curriculum/toolkit.

Key Words: Scribes, EHR, Simulation, clinical documentation

3. Purpose

With the widespread adoption of Electronic Health Records (EHRs), there has been a growing appreciation of the unintended consequences associated with their adoption and specifically the negative impacts on productivity and workflow. Consequently, there has been dramatic growth in the use of medical scribes to aid providers by, in essence, “untethering the provider from the EHR.” In spite of this rapid growth and the purported benefits on improving physician efficiency and improved billing, there is little to no regulation on standardization of scribe training, nor any assessment of their ability to safely interface with the EHR. To better understand the role and functionality of scribes, we undertook a national survey of healthcare providers. We found that scribes comprise a wide range of personnel, from college students to Medical Assistants. There is wide variability in their training, with the majority of scribes receiving job-specific training by the hiring practice. In terms of scribe function, again there was wide variability in scribe activities with relation to the EHR, from simple encounter note creation to finding information in the EHR for the physicians to entering orders and responding to patient messages. We directly assessed scribe function at OHSU in a novel, video-based virtual simulation. We found that there is tremendous intra-scribe variability in note creation and structure. This corresponds to significant errors of omission and commission (incorrect information entered into the system). Specifically, the average scribe captured only 40% of the diagnoses or plans mentioned in the simulation, with less than 40% overlap in documentation between scribes. Furthermore, every scribe documented a number of incorrect plan and diagnosis items. Combined, these data suggest a new and potentially significant safety issue with scribe use of the EHR. Therefore, the goal of this proposal is to fully assess the scope of scribe use with respect to the EHR and use this information in conjunction with national experts in EHR safety and medical documentation to establish a series, Entrustable Professional Activities (KSAs), for medical scribes. We will use these as basis to create and validate a toolkit to allow for organizations to assess the ability of scribe to complete these KSAs. In **Aim #1**, we used a combination of surveys and site visits to assess the landscape of scribe functionality. This information will then serve as the basis for a consensus conference to define scribe Entrustable Professional Activities (KSAs) with respect to the EHR. In **Aim #2**, we mapped these KSAs to a set of competencies and will create a curriculum to assess these competencies. This curriculum will contain a series of online EHR didactics and video-based simulation exercises, with corresponding simulated EHR records to asses real-world performance of scribes. In **Aim #3**, we calibrated and validated this curriculum across a variety of specialties and EHR use expectations with current scribes. In lieu of consensus conference in **Aim #4** as planned, due to the constraint of the pandemic, we used a modified Delphi approach, incorporating the members from the consensus conference to allow for refinement of the KSAs and member checking of all components of the curriculum. Furthermore, based on extensive feedback from the members of the consensus conference in Aim #1 as well as from site visits, it was apparent that methodology mustbe established to measure the impact of scribe adoption on providers to allow for better assessment of the impact of the curriculum. This was achieved through evaluation of EHR audit logs. Finally, the entire curriculum is now assembled and available for distribution.

4.Scope

The electronic health record (EHR) is a ubiquitous tool in the delivery of clinical care. EHR adoption rates have grown rapidly in large part due to programs such as HITECH.[1,2] With increasing use of EHRs, there has been an increased realization of the fact that clinical information systems can foster errors in ways that paper charting did not, a term described as "e-iatrogenesis." [3] A number of different EHR factors contribute to this, including data overload, over-completeness with numerous data screens, problems with information retrieval, and alert fatigue.[4] As a result, a number of studies by our group and others suggest that providers across multiple professions have difficulty in using EHRs, as manifest by issues with data finding, recognition of patient safety issues, and impairment in clinical decision making.[5-8] The clinical significance of this is highlighted by a recent study in which problems with either selective data gathering or selective data interpretation are associated with increased patient mortality.[9] Recent work from our group, using high-fidelity interprofessional EHR-based simulations, suggests that these issues affect multiple professional groups at all levels of training, implying a global problem related to the use of EHRs in healthcare.[10-13]

Aside from these direct impacts on patient care, the widespread adoption of EHRs has uncovered a multitude of sociotechnical issues associated with the integration of EHRs into existing workflows. Studies suggest that physicians are generally dissatisfied with their EHRs.[14-16] This is in part driven by negative impacts on workflow and efficiency and the consequent increase in time required for information retrieval and documentation. To combat this, a number of sociotechnical solutions have been developed, including the use of macros/templates and copy/paste. However, these have not fully addressed efficiency issues, have resulted in additional errors, and have created a number of potential "ethical" concerns.[11,17,18] As a result, there has been the rapid adoption of "Medical Scribes" to serve as a human interface between the EHR and provider. Scribes are not a new profession in medicine, with studies lauding their benefits on efficiency for over 30 years.[19] However, with widespread EHR adoption, scribe growth has exploded. According to one survey, nearly 20% of physicians utilize scribes, with 10% planning on hiring in the near future. [16] Current estimates suggest that the number of scribes will grow almost five-fold by 2020 to over 100,000, with one scribe for every nine physicians.[20]

Scribes serve in almost every practice setting and across a wide variety of disciplines.[21-23] Although scribes are considered a distinct professional group, their composition is quite varied. The role of a scribe may be filled by personnel with a wide variety of backgrounds, from premedical students to certified Medical Assistants (MAs).[20] The rapid growth of scribe use has been accompanied by the increased commercialization of scribes, with the development of a new industry: dedicated scribe organizations, which serve as staffing solutions and provide scribes for individual practices and healthcare organizations.[20] Some scribes may be trained by the scribe agency or the organization, usually on topics pertaining to basic medical terminology, note structure, documentation, and EHR basics. Others may receive on-the-job training from the provider for whom they scribe. With respect to scribes used within healthcare organizations, it typically is up to that organization to setup site-specific training that is specific to local clinical workflows, dependent on the level of scribe functionality deemed appropriate by the organization. Once embedded in the organization, scribes may perform a variety of functions, ranging from pure transcription of the encounter to using templates or macros within notes, to placing orders, finding information in the EHR for the provider, or even responding to patient messages.[21] Unfortunately, there currently are few rules or standards that designate appropriate scribe activities. Recently, The Joint Commission stated that, at a minimum, all scribe-generated orders must be signed by a provider prior to implementation, and, more importantly and relevant to this proposal, organizations must document the competency of the scribes for the functions the organization deems appropriate.[24] Given that the performance of these EHR-based actions is associated with numerous patient safety issues amongst every medical profession investigated **AND** training of scribes is often conducted in part by providers who themselves require scribes because of their difficulties with EHR use, it is likely that scribes, with their varied backgrounds and lack of standardized EHR training, suffer from these issues as well. In essence, the current paradigm represents a solution that promotes EHR utilization errors, because suboptimal EHR use patterns have been transferred from one professional group to another.

In terms of the impact of scribes on delivery of care, studies suggest that scribes enhance physician efficiency, improve physician satisfaction, and increase billing in a variety of clinical settings.[21,23,25,26] In addition, reports describe more benefits related to patient satisfaction, purportedly from improved physician-patient interactions during the actual visit.[25] However, in spite of these benefits, very little information exists on the quality of documentation generated by scribes. Specifically, though one study suggests that scribe notes (with MAs as scribes) may be more thorough, no study has looked at the accuracy of these notes or the ability of scribes to effectively interface with the EHR.[27] Consequently, there has been a growing awareness of the potential unintended consequences with the widespread adoption of scribes.[20] Aside from the wide variance in scribe activities, concern exists for the concept of "functional creep" with scribe activities; the granting of scribes the authority to perform more complex functions in the EHR over time.

In other words, scribes will slowly assume more and more complex EHR tasks, such as order entry, data finding, data interpretation, and entering of other data elements besides general notes.[20] Given the already large number of negative safety issues associated with these complex EHR functions with other professional groups, it is imperative that appropriate Entrustable Professional Activities (KSAs) be defined for scribes with respect to EHR use and a series of assessable competencies be established for each of these KSAs.

EHR-specific training and the establishment of a standardized evaluation paradigm to assess effective EHR use will be central components to designing and testing these competencies. Unfortunately, basic EHR training is often considered suboptimal and fails to prepare providers for optimal use of the system.[28] This type of training usually focuses the acquisition of rudimentary EHR skills, as opposed to teaching users to integrate the EHR into the delivery of care for their specific discipline and care environment effectively and safely. For scribes, the training modalities are even more nebulous in nature. Large numbers of scribes receive their basic training through national scribe organizations; this typically includes modules on note writing, medical terminology, and basics of general EHR use. However, given the over 350 EHR systems in the US and their customization by the organizations that implement them and the clinicians who use them, end-user training for scribes is typically coordinated by the physician, practice, or institution that hires them.

Recently, our group has published a set of basic EHR competencies and demonstrated that high-fidelity simulation can serve as a means to assess and improve EHR use.[13] **Our hypothesis is that there is wide variance in the scope and complexity of EHR use by scribes and that we can assess the ability of scribes to achieve the appropriate EHR-based competencies through the use of simulated provider-patient encounters. These simulations and assessment tools will form the basis of a toolkit to allow for practices and healthcare organizations to perform similar assessments of their own.**

Settings: Observations and multiple scribe using facilities and all analyses taking place at OHSU.
Participants: Medical Scribes, providers who use medical scribes and hospital/clinic administrators.

5. Methods:

The methods for this protocol are subcatagorized into three Specific Aims, each with their own independent methods and findings.

Aim #1: To Describe the Role of Scribes in the Clinical Environment and Determine the Entrustable Professional Activities (KSAs) that Allow Scribes to Perform their Duties in a Safe and Proficient Manner

Aim #1A: To Identify Characteristics of Scribe Demographics and Utilization by Conducting a Comprehensive Survey

We will develop and deploy a comprehensive online survey that will be sent to physicians, risk managers, billing and coding experts, and hospital administrators nationally. We subsequently deployed a more specialized version of the survey locally, at OHSU, to understand the changes to use of scribes with the changes in workflow introduced by the COVID-19 pandemic.

Aim #1B: To Refine Scribe Use Characteristics and Validate Survey Results by Conducting Site Visits

Methods: We leveraged our partnership with TDC to identify five sites that represent different spectra of scribe use within healthcare. We conducted in-person visits to these identified sites and utilized qualitative methodology anchored in observations and interviews, and a grounded theory approach, to generate data that will be analyzed. We used a validated ethnographic methodology to conduct assessments that have been adapted from anthropology, the Rapid Assessment Process (RAP) model.[29] This model streamlines traditional ethnographic data collection

and analysis and relies on multiperspective triangulation to generate robust results; it has been used successfully by our team in the generation of the SAFER guides for EHR use.[30-32]

Once sites were selected, informants were selected according to role and relevant knowledge regarding scribe utilization within the organization. Data were gathered using a mixed-method approach, utilizing purposefully created data collection guides. After preparation for fieldwork, we conducted an inventory of organizational profile and site characteristics, followed by a series of interviews and observations of scribe use in the field. Data collection took place over 3 days. For formal interviews, an interview guide outlining questions was developed for each interviewee. Fieldwork was followed by an evaluation and revision of the guides for future use. Recorded interviews were professionally transcribed. Field notes were expanded and converted into electronic form by the researchers, and all files were entered into QSR NVivo (QSR International). Finally, to understand an iterative change to scribe workflow introduced by the pandemic, we revisited three sites, using a virtual adoption of RAP to understand significant differences introduced by telemedicine and remote patient monitoring.

We conducted analyses as a series of sweeps through the data; as we examined the data in greater detail, we developed a preliminary list of named codes. Each researcher coded data separately into these codes and had the ability to create new codes. We approached the data in a series of iterative sweeps, utilizing a modified constant comparison method for content analysis. The first sweep served to tag and code the data; the second sweep, to pull together similar codes to identify patterns and themes. The third sweep was calibrated to identify lessons learned about barriers and facilitators. The fourth sweep discovered ways to operationalize themes identified during analysis. After the coding of the text data was done by each researcher for each site, a team of two to three researchers met to discuss codes and agree on them. Finally, the above methods incorporated all five strategies for ensuring trustworthiness: *Reflexivity*, the acknowledgement of natural biases, is maintained by requiring the researchers to note their personal biases in their field notes and during analysis discussions. *Triangulation*, the weaving together of different data gathering techniques, data elements and/or investigators, is accomplished by using different methods and researchers with different perspectives. *Member checking* is accomplished by going back to key informants to confirm that the study findings are reasonable. Data *saturation* was continuously monitored.[31]

Aim #1C: Conduct Consensus Conference to Establish the Optimal Role of Scribes and Identify KSAs

We convened a first-in-kind, multiprofessional, multidisciplinary subject matter expert group, including representatives of clinicians, scribes, hospital administrators, risk managers, coders, compliance experts, EHR trainers, and informatics workforce developers. This group was presented with results of our preliminary survey as well as results and analysis of Aims #1A and #1B, and they deliberated the optimal role of scribes in healthcare. All conversations were audio recorded, transcribed, and analyzed from a qualitative perspective. The end product of this conference was a list of KSAs that would be utilized to build a scribe training curriculum with respect to EHR use. They will determine the span of acceptable activities allowable to scribes with respect to the EHR and develop and fine tune an *a priori* construct for gradation of these activities (Functional Levels of Activity).

Aim #2: To Develop Competencies, Curriculum, and Learning Activities to Assess Performance of KSAs by Scribes

Aim #2A: To Develop Competencies That Will Define the Scope of Scribe Activities

Note, based on feedback from the consensus conference, the term EPA was replaced with KSA (Knowledge, Skills, and Attitudes) and will be the term used throughout the remainder of this report. Each KSA defined in Aim #1C was deconstructed into EHR-specific competency axes based on the ACGME's Six Core Competencies (i.e., patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice).

EHR competencies linked to ACGME Core Competencies were further defined in the context of the clinical workflows under which scribes operate as one or more task-related learning objectives (TRLOs), which in turn specified a circumscribed series of actions that allow the KSA to be successfully completed by the scribe. Once defined, TRLOs will be utilized to build both dedicated **W**eb-based **E**HR **L**earning **L**essons (WELLs) and **S**imulation-based **L**earning and **A**ssessment **M**odules (SLAMs) that will form the core of scribe training activities.

Aim #2B: To Develop Curricula and Associated Learning Activities for Scribe Training in the Context of Scribe KSAs

Because the EHR is ubiquitous in scribe workflows, we used EHR-related tasks as the fulcrum for scribe learning activities. Learning activities were calibrated and graduated along two axes: first, the functional level of EHR complexity associated with the KSA; second, the socioclinical complexity of the clinical scenario utilized to frame the learning activities. Utilizing a validated six-step approach that addresses the needs of both scribes and their supervising physicians, curricular goals and objectives will be written using a funnel-refinement method that first defines broad goals and then narrows them to specific measurable goals that are aligned to TRLOs.[33] Attention to both cognitive (knowledge skills) and affective (attitudinal skills) skills, as well as an emphasis on educational strategies for both WELLs and SLAMs that employs an iterative approach with both formative and summative evaluation, will be maintained throughout the curriculum development process.

Creation of WELLs: For the creation of WELLs (which we renamed didactic learning activities in the final curriculum), development was modular. We used the KSAs created in Aim #1 to subdivide activities between those to be trained with simulation (used for SLAMS) and those that could be taught asynchronously (WELLS). For the WELLS, we also described each as one of three Functional Levels of Activity (FLAs): Level 1 (low), comprising the least independent scribe activities (e.g., transcribing verbatim reports of physician documentation or creating a clinical note entirely utilizing templates); Level 2 (intermediate), which adds additional responsibilities for the scribe within the clinical workflow (e.g., entering basic patient demographics, updating an allergy list, or entering patient vitals into the medical chart); and Level 3 (high), which adds elements such as order entry or complex information retrieval tasks, such as finding and reporting laboratory tests from the EHR. We then used these to create a series of PowerPoint presentations with professional voiceover narration. This and the entire transcript for the voiceover are now available in the consolidated curricula.

Creation of SLAMs (renamed hands-on learning activities for curriculum): For KSAs that could be taught via simulation, we created a series of simulation scenarios to allow for assessment. Each simulation contained three basic components. First is a corresponding EHR chart. Second is a gold-standard video of the patient-provider encounter. For these, we used professional standardized patients from the OHSU simulation program. Third is a gold-standard rubric for evaluation of scribe-related output. Furthermore, we created simulations to represent multiple specialties (OB, Family Medicine, Surgery, Pediatrics, Emergency Medicine, and General Medicine) as well as both simplex and complex levels of communication. For the establishment of each scenario, initial transcripts and core curricula concepts were created to ensure that they encompassed simulation-trainable KSAs. These were then embedded into a clinical scenario specific to a given specialty/ specialties. After creation of the script, the scenario was vetted by two members of the study team to ensure that it would meet curricular goals. After vetting, each scenario was reviewed with a Standardized Patient Senior trainer and the standardized patient. After a dry run of the scenario, each scenario was run at the OHSU simulation center with professional AV capture. After completion, the AV files were sent for professional transcription to allow for creation of a gold-standard checklist.

Specific Aim #3: Validation of Simulation Based Scribe Curriculum and Evaluation Paradigm

For validation of the didactic learning activities, we distributed them to leaders of the OHSU scribe program for feedback. All feedback was incorporated, and appropriate adjustments were made.

After year 4, these modules were updated with information from subsequent site visits to incorporate additional KSAs related to the integration of telemedicine and new workflows observed with the COVID-19 pandemic.

For simulation videos, each scenario underwent AV validation with members of scribe training program at OHSU. This resulted in a number of edits to both pace and timing of the video to allow for adequate documentation time. For creation of a gold-standard grading rubric, each video was assessed in dyads to created a series of reportable elements for each case.

Specific Aim #4. **Creation of Toolkit to Assess Safe and Effective EHR Use by Medical Scribes**

The learning toolkit had three major components. First, an instructor guide provided detailed instructions on setting up and deploying a training program, intended for use by healthcare organizations and supervising providers. The guide also described how to set up and deploy simulation videos, provide instructions for EHR case creation, and enumerate assessment tools. Second, KSA and EHR skill levels were delineated and itemized. This section of the toolkit also included an enumeration of the competencies defined in Aim #1. Third, the toolkit included the actual assessment tools that can be utilized by clinicians or healthcare organizations as well as the library of virtual video-based simulations, including data to generate a corresponding EHR patient chart for each simulation. The toolkit also included a gold-standard outline for a note and the scoreable elements contained within each case. The entire toolkit will be loaded onto a dedicated server for open and public dissemination. Because of the COVID pandemic, the second consensus conference was unable to be held as originally proposed in Aim #4B. Instead, we used frequent email collaborations with the members and used them, as part of a modified Delphi approach to validate the entirety of the KSAs, to form the foundation for the entire curricula.

Additional Methods and Work not outlined above:

Based on feedback from the consensus conference and site visits, it became apparent that organizations would require the ability to triangulate the success of the training curriculum on scribe performance with independent assessment of real-world impact of scribe use by providers. This included two domains: first, the degree and frequency of edits to scribe generated notes by providers; second, the impact of scribes on provider workflow. To accomplish this, we extracted from EHR audit logs all scribe-associated encounters from 2014 to 2021. With this, notes were extracted into a Python algorithm developed by collaborators to assess timing and extent of edits. For provider workflow, timestamps were used to determine effect on chart closure and after-hours activity.

6. Results

Note: For this section, we have broken down major results by Aim.

Aim #1

This aim overall produced a number of manuscripts related to both site visits and the consensus conference. Globally, we conducted site visits at 12 clinics and emergency departments within five organizations in the US between 2017 and 2019. We did 76 interviews with 81 people and spent 80 person-hours observing scribes working with providers. Interviewee comments and observations indicate that they believe that scribes decrease patient safety risks. Analysis of the data yielded 12 themes within a four-dimension sociotechnical framework. Results about the “technical” dimension indicated that the EHR is not considered overly problematic by either scribes or providers. The “environmental” dimension included the changing scribe industry and need for standards. Within the “personal” dimension, themes included the need for provider diligence and training when using scribes. Finally, the “organizational” dimension highlighted the positive effect scribes have on documentation efficiency, quality, and safety. These data were published in JAMIA and established, for the first time, the global sociotechnical barriers and facilitators toward scribe adoption.

As offshoots from this dataset, we have a number of themes that were delved into with greater detail. Given the importance of the provider-scribe relationship, we explicitly explored this theme.

Analysis of the scribe-provider interaction data generated six subthemes: characteristics of an ideal scribe, characteristics of a good provider, provider variability, quality of the scribe-provider relationship, negative side of the scribe-provider relationship, and evaluation and supervision of scribes. These data were published in JAMIA and established, for the first time, the critical components to this key factor for scribe success.

Another theme that we explored in greater depth was the question of scribes and burnout. In theme analysis from the site visits and data from the consensus conference, we demonstrated that providers reported that medical scribes improve provider job satisfaction and reduce burnout, because they reduce the documentation burden. Medical scribes extend providers' careers and may prevent early retirement. However, and in surprising fashion, we found that medical scribes themselves may experience similar forms of burnout, likely representing the difficulties with current documentation workflow. These findings, which are presented in JAMIA Open This, have significant impact on the future of medical scribing.

All these findings formed the basis for a first-in-kind, 2-day interprofessional consensus conference on the role of medical scribes and specifically what is required to ensure safe and effective adoption of them. The primary output was the description of the KSAs required for the training and evaluation of medical scribes, which will be discussed in the Aim #2 section of this report. However, one additional publication originating from this conference was specifically related to the future of the medical scribe industry. Threats facing the medical scribe industry were related to changes in the documentation model, EHR usability, different payment structures, the need to acquire disparate data during clinical encounters, and workforce-related changes relevant to the scribing model. Simultaneously, opportunities for medical scribing in the future included extension of their role to include workflow analysis, acting as EHR-related subject matter experts, and becoming integrated more effectively into the clinical care delivery team. Experts thought that, if EHR usability increases, the need for medical scribes might decrease. Additionally, the scribe role could be expanded to allow scribes to document more or take on more informatics-related tasks. The experts also anticipated an increased use of alternative models of scribing, like telescribing and the adoption of digital scribes. These data are being published in JAMIA.

The anticipated future of medical scribes became relevant with the COVID-19 pandemic. With this, we were able to reassess the how the transition to telemedicine impacted scribe workflow. We surveyed 74 scribes working in ambulatory practices within OHSU to assess their workflow since the beginning of COVID-19 restrictions. Fifty-seven scribes completed the survey. Overall, 42% of scribes have transitioned to remote scribing, and 97% served as remote scribes for remote visits. This workflow is conducted at home and with personal equipment. Of those not working as scribes, 46% serve in pre-clinic support, with a wide range of reported EHR-related activities. The remaining scribes have been either redeployed or furloughed. We were able to conclude that the rapid transition to virtual care brought about by COVID-19 has resulted in a dramatic shift in scribe workflow with the adoption of a previously unreported workflow of remote scribing for virtual care. These findings were subsequently published in ACI.

Aims #2 and #3

The primary output from this aim was the establishment of the KSAs for a scribe training curriculum. Our analysis generated preliminary KSA-related themes, which were further refined during a consensus conference of subject matter experts. This was followed by a modified Delphi study to finalize the KSA lists. The team identified 90 descriptions of scribe-related KSAs and subsequently refined, categorized, and prioritized them for training development purposes. Three lists were ultimately defined as follows: (1) Hands-On Learning KSA list with 47 items amenable to simulation training, (2) Didactic KSA list consisting of 32 items appropriate for didactic lecture teaching, and (3) Prerequisite KSA list consisting of 11 items centered around items scribes should learn prior to being hired or soon after being hired. All three lists were then stratified for which KSAs were foundational, intermediate, or aspirational in nature for scribes, allowing for organizations to tailor the KSAs for the anticipated scribe scope of activity and their background experience. This first in-kind description of KSAs was published in JAMIA.

We used these KSAs to then create a multimedia-based curriculum. For didactic KSAs, we organized material into five macro categories that subsequently were transformed into a PowerPoint presentation. For each slide, we created a dedicated script with professional voice actor to narrate, creating a fully multimedia experience for these KSAs.

For the hands-on KSAs, we created 15 simulations (bringing the total library to 18) to specifically allow for assessment of the quality of scribe-facilitated EHR documentation. Scenarios were divided into two basic groups of those with standard and those with complex levels of communication to allow for graduated evaluation of scribe competency. For each scenario, we first mapped to a specialty and ensured the general disease and visit-contained elements were represented in the KSA list. After outlining the general components, a storyboard was created and reviewed with OHSU Standardized Patient (SP) senior trainers for modification. Once the storyboard was finalized, SPs were selected and dry runs were performed to confirm adequate content and veracity. Once complete, each scenario was run at the OHSU simulation center with 1080 video and digital audio capture.

Each video subsequently was edited for content and then given to OHSU scribe leadership for an additional round of feedback. When necessary, scenarios were reshot and/or edited to achieve the desired goal. After the final alpha validation of the video, team members worked in dyads to create a gold-standard note outline (with critical reportable elements) for each case. This will be complementary to the parent transcript from the audio file for grading. Finally, videos are now integrated into OHSU operations for scribe training, where they have undergone additional validation of content and veracity.

Aim #4

There were two main outputs from Aim #4: The first was re-engagement of the members from the consensus conference to participate in a modified Delphi process for the creation of the KSAs, which was a critical component for the creation of the entire curriculum. The entire annotated scribe curriculum, including KSAs, scribe videos, gold-standard notes/assessment tools, and didactics, is now fully assembled and freely available for dissemination. We are in the process of hosting on a dedicated website that will be working and hosting from OHSU servers in the near future.

The second main output from this aim was an extension from the consensus conference and site visits, when it became apparent that one of the main barriers to fully assessing the safety and efficacy of medical scribes was to have more automated means of assessing the content and quality of scribe-generated notes and to determine the impact of scribes on provider workflow. For this first element, we collaborated with Dr. Michelle Hribar and Dr. Adam Rule to develop a Python algorithm to automatically compare versions of the note (pre- and post-provider edits). In this work, published in JAMIA, we examined over 50,000 outpatient progress notes written with and without scribe assistance by 70 providers across 27 specialties in 2017-2018. We found that scribed notes were consistently longer than those written without scribe assistance, with most additional text coming from note templates. Scribed notes were also more likely to contain certain templated lists, such as the patient's medications or past medical history. However, there was significant variation in how working with scribes affected a provider's mix of typed, templated, and copied note text, suggesting that providers adapt their documentation workflows to varying degrees when working with scribes. These results suggest that working with scribes may contribute to note bloat and that providers' individual documentation workflows, including their note templates, may have a large impact on scribed note contents.

For the second domain, impact on provider workflow, we used EHR audit logs to look longitudinally at impact of scribes on provider note completion time, after-hours charting, and delinquent charts; 395 physicians (23% scribe users) across 29 medical subspecialties, encompassing nearly 1.2 million encounters, were included in the analysis. At baseline, scribe users had higher chart closure time, delinquent charts, and after-hours documentation than did physicians who never used scribes. Among scribe users, the difference in outcome measures post-scribe compared with baseline varied, and using a scribe rarely resulted in outcome measures approaching a range similar to the performance levels of non-using physicians. Additionally, there was variability in outcome measures across medical specialties and within similar subspecialties.

These data were published in JAMIA, JAMA, and JAMBFM. Together, this corpus of data is the largest studies of impact of scribes on provider behavior reported and the scripts used for extracting and analyzing EHR audit log data to be made available to any who wishes.

In total, the funding afforded by this grant has resulted in the largest, most comprehensive, objective description of scribe use and has, for the first time, not only identified risk and benefits to their use but also established a novel, comprehensive set of Knowledge Skills and Attitudes (KSAs) to guide subsequent training and evaluation. This, when combined with the associated curriculum, will create a true turn-key solution for the training of medical scribes.

7. List of Publications and Products (To Date)

1. Corby S, **Gold JA**, Mohan V, Solberg N, Becton J, Bergstrom R, Orwoll B, Hoekstra C, Ash JS. A Sociotechnical Multiple Perspectives Approach to the Use of Medical Scribes: A Deeper Dive into the Scribe-Provider Interaction. AMIA Annu Symp Proc. 2019;2019:333-342
2. Ash JS, Corby S, Mohan V, Solberg N, Becton J, Bergstrom R, Orwall B, Hoekstra C, **Gold JA**. Safe Use o of the EHR by Medical Scribes: A Qualitative Study. J Am Med Inform Assoc. 2020; 28:294-302. doi.org/10.1093/jamia/ocaa199
3. **Gold JA**, Becton J, Ash JS, Corby S, Mohan V. Do You Know What Your Scribe Did Last Spring? The Impact of COVID-19 on Medical Scribe Workflow**.** Appl Clin Inform. 2020 11 (5): 807-11. DOI: 10.1055/s-0040-1721396
4. Corby S, Ash JS, Mohan V, Becton J, Solberg N, Bergstrom R, Orwoll B, Hoekstra C, **Gold JA**. A Qualitative Study of Provider Burnout: Do Medical Scribes Hinder or Help? JAMIA Open 2021; 4(3): ooab047. doi: 10.1093/jamiaopen/ooab047
5. Corby S, Whittaker K, Ash JS, Mohan V, Becton J, Solberg N, Bergstrom R, Orwoll B, Hoekstra C, **Gold JA**. The Future of Medical Scribes Documenting in the Electronic Health Record: Results of an Expert Consensus Conference. BMC Med Inf Decision Making 2021; 21: 204 (2021). doi.org/10.1186/s12911-021-01560-4
6. Rule A, Florig ST, Bedrick S, Mohan V**, Gold JA**, Hribar MR. Comparing Scribed and Non-scribed Outpatient Progress Notes. AMIA Annu Symp Proc. 2022:1059-1068.
7. Florig ST, Corby S, Rosson NT, Devara T, Weiskopf NG, **Gold, JA**, Mohan V. Chart Completion Time of Attending Physicians While Using Medical Scribes. AMIA Annu Symp Proc. 2022:457-465
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9. Florig ST, Corby S, Devara T, Weiskopf NG, Mohan V, **Gold JA**. Chart Closure Practices of Physicians Before and After the Use of Medical Scribes. *JAMA* 2022; 328:1350-2. doi:10.1001/jama.2022.13558
10. Corby S, Ash JS, Florig S, Mohan V, Becton J, Solberg N, Bergstrom R, Orwoll B, Hoekstra C, **Gold JA**. How Providers Can Optimize Effective and Safe Scribe Use: A Qualitative Study. J. Gen Int Med 2022; Nov 16;:1-7. doi: 10.1007/s11606-022-07942-2
11. Florig ST, Corby S, Devara T, Weiskopf NG, Gold JA, Mohan V. Variable Impact of Medical Scribes on Physician Electronic Health Record Documentation Practices: A Quantitative Analysis Across a Large Integrated Health-System. Journal of American Board of Family Medicine 2023;In Press.
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