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Impact of Medical Scribes in Healthcare: A Systematic Review

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Impact of Medical Scribes in Healthcare: A Systematic Review

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Abstract

Background: The utilization of medical scribes has increased significantly in healthcare facilities over the last ten years. Medical scribes are hired to assist providers with documentation in the electronic health record (EHR). The purpose of this systematic review is to evaluate how scribes impact productivity/throughput, revenue, provider satisfaction, and patient satisfaction in healthcare.

Methods: A database search from January 2000 to May 2017 of PubMed, Google Scholar, and Academic Search Premier was done using the keywords medical scribe, scribes, and healthcare. Based on inclusion criteria, this review includes studies from 5 emergency departments, 2 primary care clinics, and 1 cardiology clinic. Also, an in-person interview was conducted with an Internal Medicine physician.

Results: Of the studies that evaluated productivity/throughput, all showed improvements with scribe intervention. Revenue was also generated by healthcare facilities using scribes. Provider satisfaction was overall positive, although documentation errors were noted. Patient surveys demonstrated predominantly positive remarks regarding medical scribes, as this allowed the provider to focus more on the patient versus a computer screen.

Conclusions: Evidence demonstrates medical scribes have improved the burdens of EHRs in emergency departments, primary care clinics, and a specialty clinic. Due to the limited number of peer-reviewed sources, further research should be done to justify the future of medical scribes. To further improve the role of scribes, recommendations have been made regarding training protocols, staffing models, patient education, and areas for future research.

Introduction

The medical record was first adapted in the 1920s to allow physicians to briefly document a patient's medical history.[1] While this helped physicians quickly remember why and how they were treating a patient, these records were handwritten, were often illegible, and lacked organization.[1] Overtime, the medical record has evolved into the electronic health record (EHR). As of 2015, 86.9% of healthcare providers are using EHRs to document with the intent to improve quality of care.[2] The EHR has been widely accepted as it allows for better organization of a patient's medical history and for quick communication between healthcare professionals.[1] The expansion of EHRs has also increased its purpose and is now used for scheduling, billing, and data tracking.

While there are many highlights to this advancement, providers have found digital documentation to be a time-consuming and burdensome process.[3,4] Emergency department (ED) physicians spend significantly more time entering data into EHRs than on actual patient care.[3] Increased documentation time has led to poor ED throughput, which measures how many patients can by cycled through a hospital's fixed resources. Some examples of throughput measurements include: time it takes for a patient to be roomed, time it takes to be seen by a provider, and time it takes to be discharged, which can all impact quality of care received by the patient.[5] Poor throughput has been linked with increased morbidity and mortality, delayed delivery of treatment, increased number of people leaving without being seen, and lower patient-provider satisfaction scores.[5, 6] In a general response to EHRs, providers have changed the way they interact with patients. Many will sit at the keyboard with their eyes on the computer screen versus on the patient.[1] To offset the burdens of EHRs, medical scribes are a proposed solution for many healthcare facilities.

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) defines scribes as, "an unlicensed person hired to enter information in the electronic medical record (EMR) or chart at the direction of a physician or practitioner."[7] Medical scribes mostly work in emergency departments, but clinics and specialties are becoming more prevalent. In general, scribes listen to and document the provider-patient interaction while noting pertinent positives and negatives in the patient's history and review of systems.[1] The specific duties of a medical scribe include updating record templates, gathering laboratory and radiographic results, and assisting to coordinate communication between consulting and referring physicians. There are three different types of staffing models, yet there is no national, state, or local regulations governing the scribe scope of practice.[7] See *Figure 1* for a complete description of the role of medical scribes.

Given increasing implications of EHRs, many healthcare facilities have implemented medical scribes. This systematic review will assess the contribution of scribes in healthcare and the future significance for their utilization in clinical practice. It is hypothesized that medical scribes will improve provider productivity, throughput, and satisfaction, while maintaining a positive patient experience. In addition, this paper will explore the benefits and risks to using different staffing models for hiring medical scribes.

Definitions
EHR: electronic health record; **ED:** emergency department; **JCAHO:** Joint Commission on Accreditation of Healthcare Organizations; **EMR:** electronic medical record; **ROI:** return on investment; **HCO:** healthcare organization; **HPI:** history of present illness; **ROS:** review of systems

Methods

This is a systematic review focusing on the utilization and impact of medical scribes in healthcare. The databases of PubMed, Google Scholar, and Academic Search Premier were

searched. A keyword search from January 2000 to May 2017 was performed using the words medical scribe, scribes, and healthcare. The year 2000 was the chosen start date as medical scribes were not using electronic records before this time. Additionally, the reference lists of each article were reviewed to find any other potential sources. The entire search was completed from 5/3/17 - 6/5/17.

After a complete search, each article was screened for inclusion into this systematic review. All articles that discussed the effects of medical scribes relating to productivity/throughput, revenue, provider satisfaction, and/or patient satisfaction were included. Based on the preceding criteria, eight studies were used for this systematic review.

To add a provider perspective into the review, an interview was conducted with Dr. Ghazi Qadri on 7/14/17. Dr. Qadri is an Internal Medicine Hospitalist at Abbott Northwestern Hospital in Minneapolis, Minnesota. He has been a practicing physician for more than ten years and has worked with medical scribes for the past three years. Refer to *Figure 2* for a list of specific questions asked during the interview.

Background

Of the eight studies used in this review, Table 1 summarizes each studies design, length, setting, and measured outcomes. Five are retrospective comparisons of pre and post-scribe intervention. The remaining three designs are prospective observational, prospective cohort design, and a qualitative research interview. One study was done in a cardiology clinic, two were performed in primary care clinics, and the remaining five were completed in emergency departments.

Results of the studies are summarized in Table 2 and further broken down into the categories of productivity/throughput, revenue, provider satisfaction, and patient satisfaction. In addition, the assumed staffing model if each study is noted.

Productivity/Throughput

Half of the studies measured the number of patients seen, and all showed increased productivity in the scribe intervention group. In one emergency department, the utilization of scribes allowed providers to see 13% more patients per hour.[8] Another ED determined that the group of providers who had a scribe saw a combined total of 88 more patients per day than the group without scribes.[9] In the cardiology clinic, physicians using scribes saw 9.6% more patients per hour than those without.[10] Earls et al. reported primary care providers were willing to schedule more patients in a given day when they knew a scribe was assigned to work with them. This additional scheduling led to a 28% increase in the number of patient visits per clinical session.[11]

ED throughput specifically measures time intervals relating to door to room, room to provider, provider to disposition, disposition to exit, and length of stay. Of the three studies measuring throughput, time intervals improved with the use of scribes. With scribes, one ED reported all throughput measurements decreased in time.[12] In Allen et al. the measurements between time to triage, time to room, time to provider, and time to disposition were all done faster with the scribe intervention group.[5] When comparing throughput based on time of day, Heaton et al. found scribes improved provider time in the room during the afternoon, but there was no change in the morning or evening. These results were still reassuring as there is traditionally a high volume of patients waiting to be seen in the afternoon.[13]

Revenue

Of the studies that directly measured change in revenue, all increased post-scribe intervention. The most impressive increase in revenue was seen in the cardiology clinic. Due to the increased productivity, there were 84 more new patients seen and 423 more follow-up patients seen annually.[10] This annual increase brought in additional revenue of $414,876 for new patients and $933,650 for follow-up patients. After deducting the cost of scribes ($98,588), the annual additional revenue was $1,249,849 for this cardiology clinic.[10]

Given the productivity seen in Earls et al., it was estimated 860 more patients would be seen annually in this primary care clinic. These additional visits were projected to generate $168,600 more annually.[11] This revenue was more than twice the cost of hiring two full time scribes, which yielded a 112% return on investment (ROI). In comparison, an ED predicted an increase in revenue by looking at number of patients who left before being seen by a provider. Over eleven months, the scribe group in Allen et al. had a slight decrease in the patients leaving before being seen (0.3%), but this small figure has the potential to increase revenue by $135,000. This was determined as it is estimated that there is a $450,000 loss for 1% of patients leaving without being seen.[5]

Provider Satisfaction

There were five studies that evaluated provider satisfaction. These results were measured using surveys administered to providers who had worked with medical scribes. All five of these studies showed providers were in favor of working with scribes. In Allen et al., 100% of providers indicated, "scribes are a valuable addition to the department and that they enjoy working with scribes." In addition, 90% of respondents felt scribes increased work satisfaction and quality of life.[5] Over 80% of providers indicated that when using scribes they were more focused at work and had a decreased stress level.[5]

Many providers reported increased satisfaction due to the estimated amount of time that was saved when working with medical scribes.[9, 11] In Bank et al., physicians estimated scribes saved them 2.5 hours per day. With scribes, many providers were able to finish their documentation during the allotted workday versus spending time documenting at home. In another study, time spent working at home decreased 38% over a 3- week average when using scribes.[11]

While the majority of respondents in Hess et al. were in favor of scribes, 25% reported that, "scribes negatively impacted the accuracy of the chart." Given this was a closed-ended survey, no rationale was given for this statement. This data conflicts with Yan et al. where providers felt scribes improved documentation quality because notes appeared more, "up-to-date, thorough, useful, and comprehensible." A scribe's primary role is to accurately document and update the medical chart, whereas a physician's main role is to diagnose and treat patients. When physicians did not have a scribe, it was predictable that their notes consisted of brief phrases and lacked important details.[14]

Patient Satisfaction

The two primary care studies in this review evaluated patient satisfaction via patient surveys. Both studies asked closed-ended questions, but allowed for the patient to add an open-ended response. Overall, scribes were well accepted from the patient's perspective.

In Earls et al., patients were given a paper survey at the end of their clinic session. The survey consisted of questions regarding the patient's comfort level with having a scribe in the room. Of the 313 respondents, 67% rated their overall satisfaction as "excellent." From the open-ended responses, almost all patients reported they felt the provider could focus more on them

instead of the computer. Most importantly, respondents did not change what they chose to tell the provider due to a scribe being in the room.

In Yan et al., 36 patients were interviewed by phone or in-person on the day of their clinic visit. The interviews lasted an average of five minutes, and most patients were being seen for a follow-up visit. Patients in this study also felt that scribes helped remove the computer as a distraction. One patient commented that because the provider was able to look at her directly during the entire visit she felt, "more cared for."

Staffing Models

There are three staffing models that healthcare facilities use to hire medical scribes. Five of the studies in this review hired scribes using the commercial model. While none of these explicitly stated a "commercial" model, it was inferred given terms such as "contract corporation" or "outside vendor."[9,11] These studies relied on the staffing company to hire, train, manage, and schedule the scribe.[12]

In contrast, the ED in Heaton et al. directly hired pre-healthcare professional students to work as scribes. These scribes were trained through an in-house program. A physician that had previously started a scribe program developed the curriculum and organized the program.

The third staffing model was used in Yan et al. where certified medical assistants were trained as scribes. The scribes were interviewed on their opinions of the intervention and the comments were conflicting. Many felt their documentation was valued and allowed the provider to focus more on the patient. Although, there were concerns that the time demands of being a scribe interfered with their medical assistant responsibilities.

Provider Interview

Dr. Qadri is an Internal Medicine Hospitalist at Abbott Northwestern Hospital, a large urban hospital in Minneapolis, MN. He started this position in January 2014 and medical scribes were implemented into his practice six months after he started. Presently, Dr. Qadri works with scribes on the majority of his shifts, but there are days that he works without a scribe.

When working with a scribe, Dr. Qadri reports he is more efficient and productive throughout the day. By having a scribe prepare his notes, he is able to spend more time learning the pertinent history of a patient via the EHR, prior to seeing them. Also, when a scribe is documenting the patient interaction, he is able to be attentive to the patient instead of a computer screen. Most specifically, Dr. Qadri appreciates the tedious tasks a scribe completes as this allows him to better "multi-task." Some of these tasks include: copying laboratory and radiographic data, calling nurses, paging for consults, and organizational assistance.

In addition to increased productivity, Dr. Qadri believes medical scribes indirectly improve patient care. He states that, "before [scribes] many providers would get behind on completing and signing their notes. If a provider leaves the hospital for the night and something happens to one of his or her patients, it is helpful for the covering physician to have an updated note explaining the medical history." Occasionally Dr. Qadri covers the overnight shift. He reports an unstable patient can be treated much faster and more efficient if their medical chart is completely up to date.

Dr. Qadri genuinely enjoys working with medical scribes. In general, he feels scribes are very competent and know their limitations on what to document. When reviewing the notes to sign, he occasionally finds mistakes in the chart made by the scribe. Although he comments this happens rarely and is typically done by a newly employed scribe. He reports most of these scribes are receptive towards the errors and quickly learn from their mistakes.

Discussion

Given the increasing use of EHRs, healthcare facilities will need to implement strategies to maintain productivity and throughput. Medical scribes have proved to increase the number of patients providers see in an allotted time period as well as improved throughput time within the ED. Because providers are treating more patients by utilizing scribes, annual revenue is also increasing. Improved productivity not only positively impacts healthcare facilities, but also improves provider job satisfaction and quality of life.

Productivity/Throughput

As previously stated, studies from emergency departments, primary care clinics, and a cardiology clinic were included in this review. Medical scribes could potentially have different roles based on the setting they are working in. When looking at productivity, providers worked more efficiently when having a scribe, regardless of setting. Closely relating to productivity is throughput data, which was only measured in EDs. This was expected as EDs are arranged depending on patient volume versus a clinic setting, where patients make scheduled appointments. By decreasing throughput times, providers are seeing more patients per hour.

While the throughput data of these reviews did show decreased time with the scribe intervention groups, there was no comment on the complexity of patients that were seen. Based on these studies, time intervals for each individual patient were compared regardless of what they were being seen for. This makes the data difficult to interpret, because how long a patient stays in the ED does depend on what laboratory or imaging data, procedures, or consultations are done. For instance, a patient presenting with concerns of a myocardial infarction would be expected to stay in the ED longer than a patient with concerns for otitis media.

Revenue

As expected, improved productivity/throughput increased the amount of revenue generated. Since more patients were seen each day, there was likely an increase in amount of insurance coverage claims or self-payment from patients. When taking the cost of scribes into consideration, it should be noted that the number of scribes hired was relatively low (1 full time in Walker et al., 4 part-time in Earls et al.). If a healthcare facility were to hire enough scribes so that every provider had one, it would be significantly more expensive. Also, many of the studies used staffing companies to hire their scribes, but did not report how much it cost to use a third party group.

To better assess how medical scribes influence revenue, there should be further documentation and research on how much healthcare facilities are paying to hire scribes. In this review, the studies specifically measuring revenue did take into consideration the cost of scribes, yet there is limited data on this elsewhere. Future research could look at what a large urban hospital like Abbott Northwestern spends on scribes compared to Walker et al. In the cardiology clinic, the cost of scribes was similar to that of a medical transcription service.[10] Comparing productivity and revenue using medical scribes versus transcription services poses an opportunity for further research into the future of healthcare documentation.

Provider Satisfaction

As healthcare keeps evolving, providers will continue to spend more time documenting in the EHR. Medical scribes have proven to improve provider satisfaction by relieving the burdens of the EHR. This was supported, first hand, through the interview with Dr. Ghazi Qadri. Spending less time documenting positively impacts provider's quality of life. Hess et al. reported that 25% of providers feel that at times scribes can negatively affect a patient's chart. This article did not discuss the specifics of what errors have been made or indicate the experience level of

the scribe. Dr. Qadri had also found documentation errors made by the scribe, but attributed it towards inexperience. To him, the improvements in provider quality of life outweigh the errors that scribes rarely make.

To improve scribe documentation, adequate and consistent training is necessary. While there are currently no state or federal regulations governing scribes, the future may indicate need for them. Based on Bank et al., the company Emergency Care Consultants requires 184 hours of scribe training. These hours include review of medical terminology, classroom lecture on major diagnoses, on-floor training, supervised scribing, and review of notes with a supervisor.[10] To specifically work in the cardiology clinic, there is additional training relating to the specialty as well. While this appears to be an appropriate training model, none of the other studies specifically discussed their training protocols. Given the concerns of documentation error, scribes should also be trained on their limitations. It is important that scribes only document what they are confident in and what is designated by their role. Scribes work alongside providers, so asking for clarification when unsure is essential.

Patient Satisfaction

It is profoundly reassuring that the majority of patients are comfortable with medical scribes. This satisfaction stems from the fact that providers are able to put their full attention on the patient. As stated by Dr. Qadri, scribes allow him to spend more time researching the patient's medical history prior to meeting them. Patients appreciate it when their provider is up-to-date on their medical history and understands their current condition or complaint.

Specifically in the ED, patient satisfaction is predominantly impacted on timing. Patients presenting to the ED are commonly in distress and want to be seen as soon as possible. In some scenarios, the efficiency of the provider can even be the difference between life and death for a

patient. Medical scribes have shown to improve ED throughput, which allows patients to wait less and be evaluated faster. Patients may not realize scribes impact their progression through the ED system, yet it is shown that improved throughput leads to gratified patients.

In Yan et al., the majority of patients were being seen for a follow-up appointment and already had an established relationship with their provider. Due to this known affiliation, adding a scribe into the room has the potential to worry or confuse the patient. To avoid making the patient feel uncomfortable a proper introduction and brief explanation of the scribe's role is important. For example, Dr. Qadri enters every patient room by first introducing himself and then the medical scribe. Next he tells the patient, "The scribe's role is to document what we are saying, so that I can better focus my attention on you." Additionally, Dr. Qadri reports there are certain scenarios, such as sensitive physical exams, when he asks the scribe to wait outside of the room.

Staffing Model

Each staffing model poses risks and benefits that may influence productivity, revenue, and provider and patient satisfaction. The majority of studies in this review hired scribes based on a commercial model, which is a common practice for large healthcare facilities. Theses staffing companies often have set training protocols in place to assure each scribe is competent at their role before working with a provider. While training may be more protocol based, the costs of using a staffing company are likely to be higher, which could negatively affect revenue.

In the student model, scribes are typically intrinsically motivated to learn and be engaged in the profession. Scribing has a significant educational benefit for undergraduates wishing to become medical providers. This position equips pre-healthcare professional students with valuable knowledge and skills, such as medical terminology, history taking, observing physical

assessment, and how to handle stressful situations. The risk to using the student model is that there is a high turnover rate. Many students choose to scribe during their "gap year" while applying to higher education.

In the licensed healthcare model, documentation may be more thorough as the scribe has efficient training and background in healthcare. The downside to this model was directly stated by a scribe in Yan et al. Scribes who are also medical assistants do not have enough time to complete both roles effectively, so one of their jobs has the potential to become compromised.

Based on these studies, all three of these staffing models have proven to be successful. The commercial model was most inclusive as it positively impacted productivity, revenue, provider satisfaction, and patient satisfaction. While using a staffing model was indicated, the reviews did not comment on the demographics of the hired scribes. Without knowing this knowledge, the medical scribe could potentially fall under the student model too. When speaking with Dr. Qadri, he commented that almost every scribe he works with is planning on applying to medical or physician assistant school. With the assumption that many staffing companies hire pre-healthcare professional students, it is recommended that this be the hiring protocol for healthcare facilities.

Limitations

The limitations to this review are in large part due to the low quantity of peer-reviewed studies. Medical scribes are relatively new interventions to the EHR, and most of the data is in the setting of the emergency department. Additional studies of medical scribes in primary care or specialty clinics would better compare how setting impacts productivity.

There are also limitations given the qualitative methods to evaluate provider and patient satisfaction. Specifically in Yan et al., there is the potential for survey bias as patients

participated in phone or in-person interviews. Additionally, there are limitations related to non-inclusive survey response rates. In Allen et al., there was a 60% provider respondent rate, and in Hess et al., the post- scribe intervention survey response rate was 69%. Depending on the opinions of those non-respondents, there is potential for provider satisfaction rates to be significantly different.

Throughout the studies included in this review, there was minimal documentation on how the scribes were trained prior to being implemented in the relating studies. The timing and curriculum of scribe training could have influenced the quality of the scribes documentation and efficiency.

Conclusion

Based on this systematic review, medical scribes have improved the burdens of EHRs in emergency departments, primary care clinics, and a specialty clinic. Despite limitations in the quantity of peer-reviewed studies, scribes positively impacted productivity/throughput, revenue, provider satisfaction, and patient satisfaction. With technology advancing, the EHR will only become more complex and require additional documentation from providers. Providers and patients are the producers and consumers of healthcare, so it is imperative their satisfaction be maintained or even better improved.

Evidence has proven medical scribes are a beneficial solution to EHRs in the present day, yet there are ways to improve as medicine continues to evolve. In summary, the following recommendations have been proposed to benefit the future of medical scribes.

1. Identify and implement effective medical scribe training methods.

There is limited data on how commercial staffing companies and/or healthcare facilities specifically train their medical scribes. A retrospective study comparing staffing companies

training methods to productivity/throughput and provider satisfaction is warranted. Results of this type of study could give guidance to the fundamental components of scribe training. It is recommended there be evidence-based proposals for the pre-requisites, length of training, and curriculum of a scribe training program.

2. Utilization of the commercial staffing model by healthcare facilities.

The commercial model is recommended because training is likely more consistent and protocol based. Before a staffing company allows a scribe to work with a provider, they must meet certain training milestones. It is assumed that once a scribe has mastered each aspect of the training curriculum, they are adequately prepared for the position. Additionally, by using a staffing company the student model is essentially being utilized as well. Many pre-health professional students seek out scribe positions to gain healthcare experience. Pre-healthcare students are the providers of the future, so it is valuable to expose them to medical documentation early in their career training.

3. Improve patient education on the role of medical scribes.

Given medical scribes are a new advancement over the past ten years, many patients may be unfamiliar with the role. It should be the provider's responsibility to formally introduce and explain the role of the scribe to each patient. Furthermore, a provider should be mindful of scenarios where having a scribe in the room may make the patient uncomfortable. There are certain physical exams, procedures, and private conversations where it may be better for the scribe to step outside the room.

4. Consider complexity of patients when measuring ED throughput data.

The existing throughput data would be more credible if it included the complexity of patients. This could be accomplished by indicating triage level when comparing pre and post-

scribe intervention groups. When a patient first arrives to the ED, a triage employee strategically places the patient in a triage level based on the severity of their complaint. Typically a Level 1 is considered very urgent and Level 5 is least urgent.[15] By comparing pre and post-scribe intervention groups based on triage level, the time intervals will more closely correlate to their expected ED length of stay.

5. Further analysis of the utilization of medical scribes versus transcription services.

A direct comparison of scribes and transcription services on productivity and return on investment could provide healthcare facilities with justification for hiring medical scribes. It is hypothesized that because medical scribes perform additional tasks beyond documentation, providers would prefer to work with medical scribes.

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Appendix

Figure 1: Role of Medial Scribes [1, 3, 7, 9, 14]

Staffing Model
1. **Licensed Model**: healthcare professional performs scribe duties
   - Ex) Certified Medical Assistant, Certified Nursing Assistant, Licensed Practical Nurse
2. **Commercial Model**: Scribe staffing companies provide scribes to HCO
3. **Student Model**: Pre-Medical, Pre-Nursing, Pre-Physician Assistant students

Training
- Dependent on staffing company
- No National, State, or Local regulations governing training procedures
- Average training is 80-100 hours prior to working on own

Assignment
- Placement in emergency department, hospital, clinic, and/or specialty clinic
- May work with one provider or work in a structure with many different providers

General Duties
- Completes a chart review on next patient and prepares note template
- Enters room with provider and stations self at computer
- Listens to provider-patient interaction and documents pertinent positives and negatives of HPI and ROS
- Uses template to update past medical, social, and family history
- Leave room and provider dictates physical exam findings
- Gather and enter lab and radiographic results into EHR
- Assist with coordination between consulting and referring providers
- Forward chart to provider for review, amendment, and signature

HCO: Healthcare Organization; **HPI:** History of Present Illness; **ROS:** Review of Systems; **EHR:** Electronic Health record
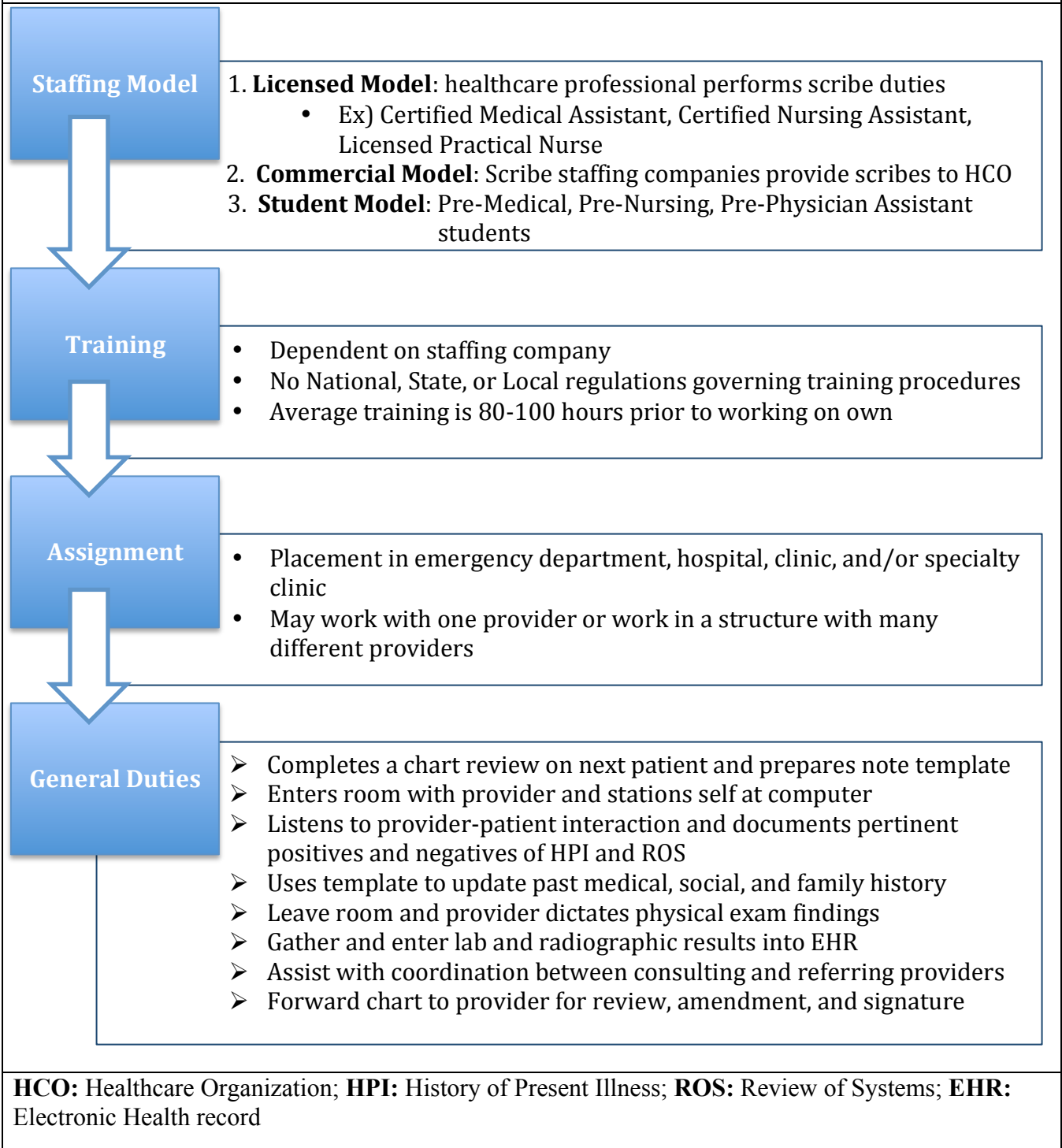
Figure 2: Provider Interview Questions

1. How long have you worked at as a physician? How many of those years at Abbott Northwestern Hospital?

2. How many years have you worked with medical scribes?

3. On shifts you don't work with a scribe, how are things different?

4. Do you think scribes are valuable to the Hospitalist department?

5. What is the most valuable part?

6. Does the use of a scribe increase the amount of time you spend with patients?

7. Do you enjoy working with scribes?

8. Have your hours spent charting changed due to scribes (Both in the hospital and at home)?

9. Do you have any reservations about medical scribes?

10. Do you note errors in the medical record made by scribes?

Table 1: Components of Peer-Reviewed Studies Evaluating Utilization of Medical Scribes in Healthcare

Article	Study Design	Sample Size	Study Length	Setting	Outcomes Measured
Allen et al.[5]	- Retrospect analysis comparing pre and post scribe intervention - Survey and administration data	- 30 providers	- 10 months for each pre and post period	- Emergency department	- Throughput: door to triage, door to room, door to provider, door to disposition, door to exit time, provider to disposition time, disposition to exit time - Provider satisfaction via self survey
Walker et al.[8]	- Prospective Observational	- 5 physicians	- 5 months total	- Emergency department	- Physician productivity - Time of day or week when scribe was most effective
Hess et al.[9]	- Comparing Pre and Post scribe intervention - Surveys and administration data	- 56 pre-scribe providers - 49 post-scribe providers	- 4 months for each pre and post period	- Emergency department	- ED length of say - RVU/hr - Self report of: time spent teaching, time spent documenting, and job satisfaction
Bank et al.[10]	- Retrospective study - Comparison of physicians using scribes and those not using scribes - Survey and time-tracking data	- 10 physicians with scribe - 15 physicians without scribe	- 1 year total	- Cardiology Clinic	- Physician productivity - Revenue generation
Earls et al.[11]	- Retrospective review comparing pre and post scribe intervention	- 7 physicians	- 6 months total	- Primary Care Clinic	- Physician and patient satisfaction - Hours physicians spent on administrative tasks
Bastani et al.[12]	- Before-and-after scribe study	- 11,729 pre-scribe patient encounters - 12,609 post-scribe patient encounters	- 60 days for each before and after period	- Emergency Department	- Throughput: door to room, room to physician, door to physician, physician to disposition, and length of stay
Heaton et al.[13]	- Prospective cohort design	- 3070 non-scribe patient encounters - 3049 scribed patient encounters	- 3 months total	- Emergency department	- Throughput: length of stay, door to provider, treatment room time, provider to disposition
Yan et al.[14]	- Qualitative research interview - Individual audio-recorded, telephone, and in-person interviews with physicians, scribes, and patients	- 18 physicians - 17 scribes - 36 patients	- 11 months total	- Primary Care Clinic	- Documentation - Patient care - Teamwork

Table 2: Impact of Medical Scribes on Productivity/Throughput, Revenue, Provider and Patient Satisfaction, and Staffing Model

Article	Productivity/Throughput	Revenue	Provider Satisfaction	Patient Satisfaction	Staffing Model
Allen et al.[5]	- Implementation of scribe group led to statistically significant decreases in time among patients with time to triage, time to room, time to provider, and time to disposition	- Estimated $135,000 in revenue	- 100% of providers indicated scribes are a valuable addition to the department		- Unknown
Walker et al.[8]	- Scribe group saw 13% more patients per hour	- No change in income per scribed hour			- Commercial
Hess et al.[9]	- ED volume increased by 88 patients per day (P=0.04)		- 73% reported overall positive attitude toward scribe intervention - 25% reported scribes negatively impacted chart accuracy - Statistically significant decrease in percent of time documenting	- Provider time spent with patients increased 11% (absolute)	- Commercial
Bank et al.[10]	- Physicians with scribes saw 9.6 % more patients/hour	- Estimated increased revenue of $1,348,437 daily - Patient visits with a scribe were coded and billed higher	- Physicians with scribes were estimated to save 2.5 +/- 9 hours daily		- Commercial
Earls et al.[11]	- Scribe group had a 28.8% increase in visits per clinical session	- Estimated 112% ROI	- Post-scribe showed 13% decrease in time spent in clinic and 38% decrease in time spent working at home	- Patients reported high level of comfort with the scribe	- Commercial
Bastani et al.[12]	- All throughput metrics improved in post-scribe cohort				- Commercial
Heaton et al.[13]	- Scribes decreased patient time in the room during afternoon, but not in morning or evening				- Student
Yan et al.[14]			- Provider notes appeared to be more up-to-date, thorough, useful, and comprehensible	- Reported scribes allowed for better physician attention to patients	- Licensed

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