Provider Preference in Exam Room Layout Design and Computing

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Abstract

Background The introduction of the electronic health record (EHR) has had a significant impact on provider–patient interactions, particularly revolving around patient-centeredness. More research is needed to understand the provider perspective of this interaction.

Objectives Our objective was to obtain provider feedback on a new exam room design compared with the one already in use with respect to the computing layout, which included a wall-mounted monitor for ease of (re)-positioning. An additional objective was to understand elements of exam room design and computing that were highly valued.

Methods Semistructured interviews were conducted with 28 providers from several health care organizations. Interviews were audio recorded and transcribed for analysis. We used an inductive coding approach to abstract recurrent themes from the data.

Results Our analysis revealed several themes organized around exam room layout, exam room computing, and provider workflow. We report frequency of occurrence of the coded data for computer accessories, computing usefulness, computer mobility, documentation habits, form factor, layout preference, patient interaction, screen sharing, and work habits.

Conclusion Providers in our study preferred exam room design to promote flexibility, mobility, and body orientation directed toward the patient. Providers also expressed the need for exam room design to support varying work habits and preferences, including whether to share the computer screen or not.

Keywords
- human–computer interaction
- computer workstations
- exam room design
- exam room computing
- patient centeredness

Background and Significance

The impact of computers and the electronic health record (EHR) on provider–patient interaction has been a long-standing issue and challenges persist on how to effectively integrate these tools into health care environments, while maintaining patient-centered care. These challenges include the integration of EHRs into clinical workflow, specifically surrounding the patient visit.[1,2] Current viewpoints suggest that patient-centeredness is negatively impacted by the integration of the EHR.[2] Moreover, patient-centeredness can be impacted by the exam room layout, interactions with the EHR, and the provider–patient interaction.[1] With

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this perspective, more effective integration of EHRs into the exam room layout and the interactions within the patient visit may facilitate patient-centeredness, thereby enhancing the provider–patient relationship. Previous studies demonstrate that active screen sharing with the patient may enhance patient engagement,[3] provider–patient communication,[4,5] and patient trust in the provider.[6] Additionally, recent studies encourage the use of screen sharing to increase patient-centeredness by minimizing patient alienation due to the provider's focus on the computer screen and to improve patient understanding of care.[4,7]

Prior research has provided insights on the impacts of EHR placement in the exam room, interactions with the EHR, and provider–patient interactions on overall patient-centeredness during a patient visit. Initial placement and positioning of the EHR within the exam room is based upon wherever proper wiring is available.[8] In fact, placement of the EHR on a desk in the corner of the room is common in practice, especially when the EHR was first introduced to the exam room.[9,10] Furthermore, McGrath et al[11] categorized spatial designs of rooms with the provider, patient, and EHR into three concepts: "open," "closed," and "blocked." The categorizations were dependent upon the provider's orientation toward the patient even while using the EHR, where "open" indicated the provider's body orientation was toward the patient, "closed" indicated the provider's back was toward the patient, and "blocked" indicated the provider was oriented toward the patient, but the EHR is between the provider and patient.[11] Further research is needed to gather a provider perspective on the exam room layout regarding EHR positioning to better understand how patient visits can become more patient-centered.

Interactions with the EHR can also impact the patient-centeredness of a patient visit. Once the EHR is introduced and used in the patient visit, the provider–patient relationship is affected by the patient's behaviors with the computer.[3] A systematic review of prior literature found that patients felt that EHR use facilitated communication and offered opportunities for clarification and discussion.[12] Specific patient behaviors have been categorized as "screen watching," "screen ignoring," and "screen excluding."[13] Screen watching is a behavior used by the patient when they focus their attention on the screen, whereas screen ignoring is when the patient deliberately disregards the screen, and screen excluding is the use of the screen to challenge the provider. Prior research has indicated that the patient looks at the screen twice as much when the EHR is positioned within their eye gaze compared with when the patient needs to adjust their body posture to see the screen, which can then cause the EHR to become a more consistent element of the interaction.[13,14] To maintain patient-centeredness, one view is that the computer and EHR should be conceptualized as a "third party" or a mediator between provider and patient.[2] While research exploring the patient's perspective of the influence of the EHR on the patient visit is widely explored, the provider's perspective remains to be further explored.

Provider–patient interactions are key to the patient-centeredness of a patient visit. However, with the introduction and use of EHRs into patient encounters, the provider's body orientation can change, which influences these interactions.[15,16] The positioning of the EHR can impact the body orientation of the provider. When the lower pole of the provider's body is predominantly oriented toward the computer, the orientation can be classified as "unipolar." In the unipolar orientation, the providers often ask the patient questions that are prompted or motivated by the EHR. In contrast, "bipolar" orientation is when the lower pole of the provider's body fluctuates between the patient and the computer.[16] These lower body shifts seem to indicate "computer time" versus "patient time." Another orientation, whereby the computer and patient are triangulated, is more consistent with the "bipolar" orientation, during times when the provider's orientation fluctuates between the computer and patient. During this fluctuation, the patient may also have an opportunity to orient on the provider or computer. This type of triangulation is explored by our study. In addition to body orientation, the provider–patient interaction can also be influenced by the behaviors of the provider. With the introduction of the EHR to the exam room, providers may utilize the EHR to accomplish a multitude of tasks. Multitasking can negatively impact communication and the rapport between the provider and patient, even if multitasking is less intrusive due to the experience of the provider.[17] Finally, the provider can look to use the EHR to facilitate the communication and overall interaction with the patient. This can be achieved by inviting the patient to share the screen, using the EHR to answer questions from the patient, and asking the patient open-ended questions while using the EHR.[2,11,17–19]

With the introduction of the EHR into the exam room, patient-centeredness of the patient visit has been impacted. However, there are multiple strategies that can be implemented to optimize the integration of EHRs into these visits to promote patient-centeredness, such as: utilization of the EHR in screen sharing activities, enhancing verbal and nonverbal communication, and adjusting the room design.[1] Moreover, this study hopes to explore the provider perspective of using the EHR in different configurations during a patient visit.

Objectives

Our objective was to obtain provider feedback when using a more tangible and interchangeable exam room layout, based on the Department of Veterans Affairs (VA) new exam room design standard. An additional objective was to support the notion that a redesigned exam room layout has various benefits for the provider–patient relationship from the provider perspective. To do this, we analyzed the debrief interview data collected from a larger parent study.[20] The parent study reports the result of a laboratory simulation experiment that compared two exam room layouts (current layout "A" vs. new layout "B"). Layout A represents the historical placement of a desk and computer fixed to the wall in a way that encouraged the provider to turn their back to the patient when using the EHR. Layout B represents a new exam room design that would minimize the dependency of a built-in

desk which encourages a "move-in and occupy" mindset that allows the provider to move from one room to another.[21] While there are other exam room layout configurations that do exist in the VA, for practical reasons we selected layout A as one of the variations of the exam room design for this study. Based upon the flexibility and maneuverability offered by the set-up in the new layout, we expected layout B to be the preferred layout, be more ergonomically appealing, and be better aligned with clinical workflow. Here, we report findings from a systematic, qualitative analysis of the debrief interviews that we conducted with each provider from the parent study on their views of the exam room layouts, as well as their views on exam room computing in general. While broad themes from the debrief interviews (such as: layout preference, elements of provider–patient interaction, and redesign recommendations) were summarized in Weiler et al,[20] a formal, in-depth qualitative analysis of the interviews was reserved for this follow-up study.

While the efforts described in this article focus on the provider perspective, another one of our concurrent studies under the same grant collected interview data from the patient perspective at a VA medical center that utilizes both the legacy (layout A) and new (layout B) exam room designs.[22] From that study, we found that not only did providers value the ability to easily swivel and share the screen with the patient in the new exam room design, patients expressed interest in viewing what was on the screen in the new exam rooms compared within the legacy exam rooms, where the screen was not easily viewable. Patient preference is critical to patient-centeredness; however, with simulated encounters using patient actors, it was not the focus of this study.

Methods

This study examines qualitative debrief interview data collected from a larger, parent study (see Weiler et al[20]). In the parent study, we had providers go through two different simulated patient encounters using the two different layouts described in the above "Objective" section and in the "Exam Room Layouts" subsection. Once both of the simulated patient encounters (and parent study-related surveys) were completed, a debrief interview lasting no longer than 30 minutes was conducted. We focus on presenting the methods relevant to the debrief interviews. A complete description of the parent study experimental design, procedure, simulation scenarios, and description of layouts can be found in Weiler et al.[20]

Participants

A total of 28 health care providers (17 males, 11 females) completed the institutional review board-approved study, with the mean age being 31 years (range: 26–59 years). Using convenience sampling, 4 attending physicians, 23 resident physicians, and 1 nurse practitioner were recruited. In total, 26 of the 28 providers used the Department of VA Computerized Patient Record System (CPRS) as their EHR often or occasionally; the majority of the providers were resident physicians who had previously rotated through the VA and had used CPRS, which was the EHR used in our study. CPRS is an integrated program with multiple software packages to support several functionalities, including the ability to view and update patient medical records, order prescription medications, laboratory tests and special procedures, and manage consultations.[23]

Procedure

Providers completed simulated patient encounters with an actor patient using two exam room designs at the Center for Ergonomics at the University of Louisville. Before each simulated patient encounter, providers were made aware of the purposes of the study and that they would be experiencing two different scenarios in two different exam room layouts. An in-depth description of this laboratory experiment is available in Weiler et al.[20] Following the simulated patient encounters, we conducted a debrief interview with each provider using a semistructured interview guide (►**Supplementary Appendix A**, available in the online version). The debrief interviews were audio and video recorded via Morae software (version 3.3.4, TechSmith Corporation, Okemos, Michigan, United States). Each of the providers received a $100 gift card as compensation for their time at the conclusion of the interview.

Semistructured Interview Guide

We used a semistructured interview guide (►**Supplementary Appendix A**, available in the online version) for debrief questions following the simulated patient encounters. The purpose of the debrief interview questions was intentionally meant to broaden our understanding of our participants' experiences beyond the scope of the specific objectives of the simulation study,[20] work habits, and preferences for exam room computing, and what their ideal exam room would contain in terms of computing, furniture, etc. The objective of the simulation was to understand the impact of redesigning the layout of a hospital exam room to include a mobile computing workstation. Specifically, the study looks to measure the improvements in efficiency, errors, workload, patient-centeredness, amount of screen sharing with patient, workflow integration of computer, and situation awareness. We developed these questions to focus on aspects regarding EHR use during the simulated patient visit and how to best design the exam room while considering exam room computing. Moreover, our understanding of existing literature aided question development. The semistructured interviews provided the flexibility to ask related, follow-up questions on topics of interest, while also asking the same set of core questions to each provider.

Exam Room Layouts

Two exam room layouts were used during the simulated patient encounters. Layout A had a traditional desktop computer and 19-inch monitor setup on a stationary desk at the nearest electric outlet with no respect to the locale of the patient, patient table, or other needed medical tools (►**Fig. 1**). Providers were free to move the patient and patient's chair as desired; the default location of the patient's

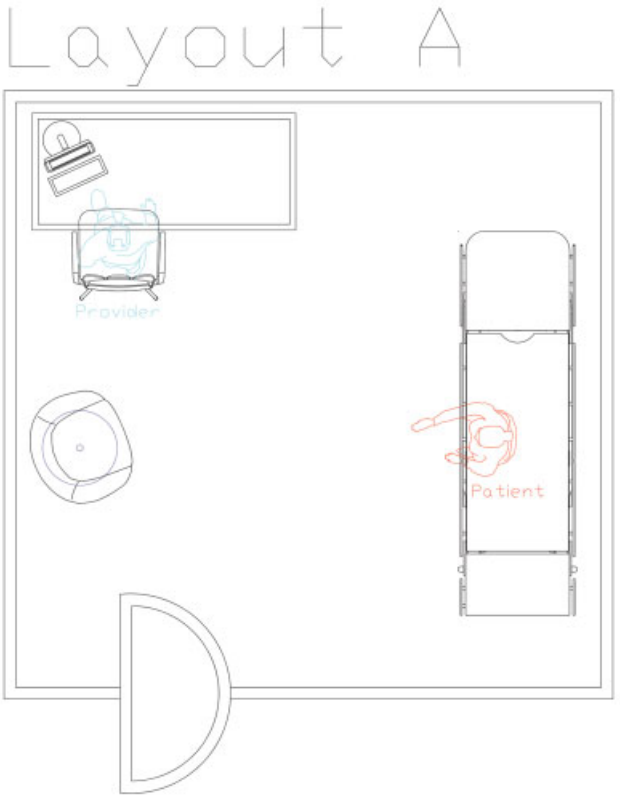

Fig. 1 Exam room layout A consists of a computer desk in the top-left corner, a patient table on the right-hand side, and a door near the bottom.

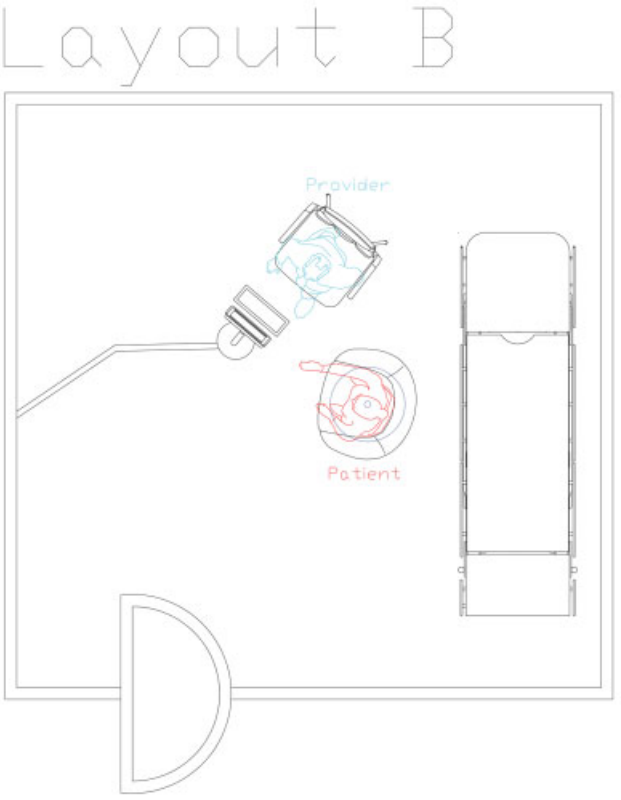

Fig. 2 Exam room layout B consists of a PC affixed to a mobile armature system extending from the left-hand side, a patient table on the right-hand side, and a door near the bottom.

chair is depicted in ►Fig. 1. Layout B had an all-in-one computer with 19.5-inch display attached to an armature device and mounted on the wall allowing for optimal screen positioning adjustments along three axes depending upon the scenario (►Fig. 2). Placement of the wall mount was determined to not limit the potential movement of the screen along any axis. This is consistent with the VA's new exam room design standard, which is the basis for layout B. Both simulated exam rooms were of high fidelity regarding the exam room computing device, room layout, and furniture pieces. However, we did not include many smaller items that are typically in exam rooms (e.g., blood pressure monitor, supply cart, and so on).

Analysis

The debrief interviews were first transcribed from Morae audio recordings. Transcripts then underwent a data segmentation process. Segmentation breaks were made when logical breaks or transition of topics occurred, with the break sometimes coming in the middle of one person talking. These logical breaks or transitions in the raw data transcripts were considered a unit and varied from partial to several sentences in length. Utilizing a bottom-up and inductive coding approach, we reviewed units from the transcripts to identify recurrent themes. Then, we developed an initial codebook by reconciling the themes into code names and definitions. This initial coding procedure reached saturation after the first four interview transcripts.

Then, we used the codebook developed from the first four transcripts to code the remaining transcripts. During this secondary coding exercise, a review team added three new codes and modified one existing code for additional clarification. The team reviewed and recoded the first four transcripts with the updated codebook. The final codebook can be found in ►Supplementary Appendix B available in the online version. The review team then independently coded the remaining transcripts and met periodically to reconcile their codes and assign final codes for each unit. For many units, more than one code was assigned.

Next, we conducted a secondary analysis, or further level of abstraction. We grouped together all units that shared a final code. Within these groupings, labels and sublabels were created to describe trends/patterns found in the units within each code. ►Fig. 3 shows a visual depiction of the coding process.

We then summarized the secondary labels for each final code. In these code summaries, we documented the total frequencies of each assigned label, as well as the number of providers who provided feedback related to each label.

Results

The most common recurring themes, those mentioned by at least half the providers, are shown in ►Table 1. The results in this section are reported as how many units were counted within a related code, followed by the number of providers

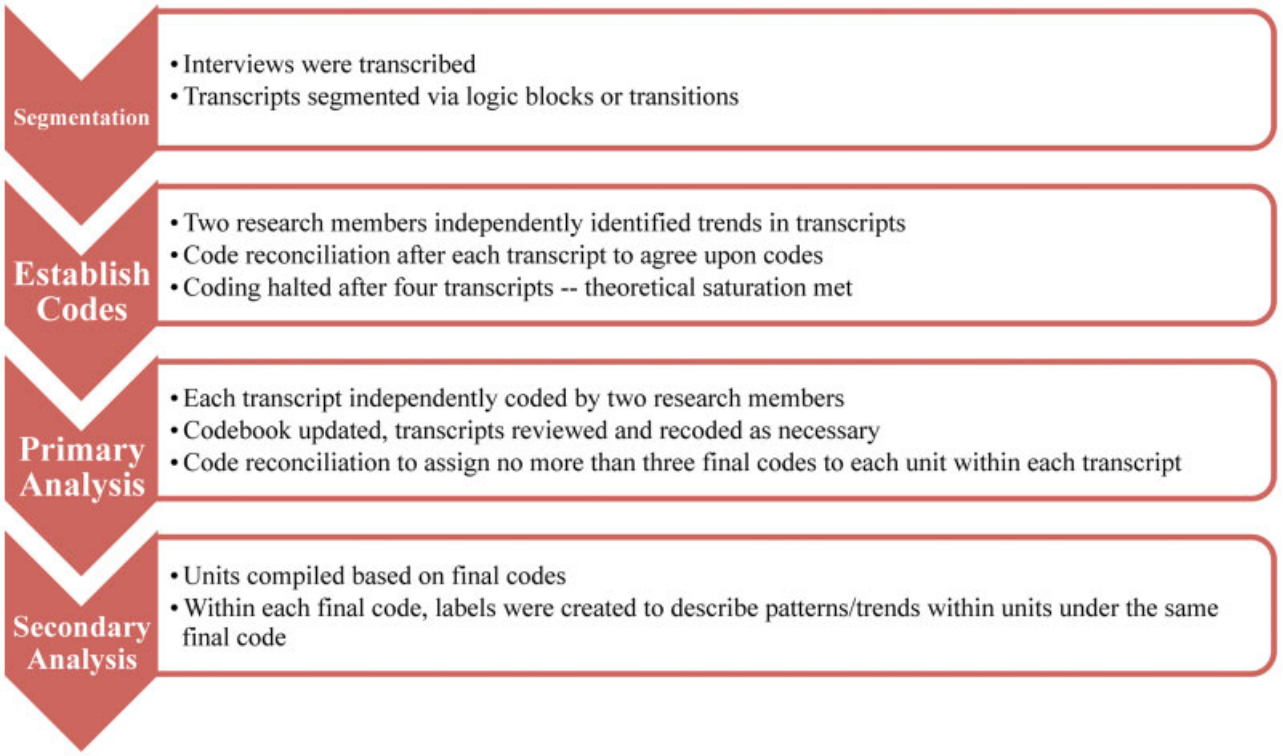

Fig. 3 Data segment coding process.

that made a statement supporting the result. For example, 27 out of 28 different providers expressed a preference for layout B over layout A in 76 out of 163 units coded as layout preference in the first sentence of the "Exam Room Layout" subsection.

Exam Room Layout

Most providers in some way preferred layout B over layout A (76/163 units; 27/28 providers), whether it was a general preference (23/163 units; 19/28 providers) or something more specific, such as better patient focus or ability to see the patient (17/163 units; 15/28 providers), promoting sharing of information with the patient (12/163 units; 10/28 providers), or better flexibility (of both the armature system and whether they wanted to engage in screen sharing; 6/163 units; 6/28 providers). When asked about their interaction with the patient in the simulation, one provider expressed their preference for layout B by saying "*I can look at both you and the computer and share the information when asked, but still have my own computer.*"

Consequently, the primary reason providers did not like layout A (35/163 units; 22/28 providers) stemmed from having their backs to the patient while using the exam room computing device (19/163 units; 16/28 providers). This made it nearly impossible to see the patient while computing and made it harder for most to share information from the exam room computing device with the patient. One provider clearly expressed their dislike for layout A by explaining "*I'd actually move the desk, or I'd just ignore the computer completely. I'd probably bring the patient in my office if he wanted to pull up his blood pressure, but I just wouldn't use that computer if that was the option.*" Interestingly, a few providers noted their preference would change to layout A if the orientation of provider and patient reflected layout B. One provider offers, "*The ideal combo would be [LA] with the patient next to me.*" This helps highlight how a difference in the layout, regardless of the computing device used, can affect the patient encounter.

Exam Room Computing Device

Most providers found a computing device to be useful in the exam room (17/63 units; 15/28 providers), mostly for note-taking, completing orders, and accessing and sharing information, which helped facilitate interaction with the patient. Providers also considered mobility for a computing device (a distinct feature of layout B) to be beneficial in that it promoted more engagement with the patient (15/80 units; 14/28 providers), particularly through eye contact and screen sharing. One provider commented, "*…if I needed to, I could turn it to us, but I could still move to the side and see you. So as long as I have a way to communicate with you, that lets you know that I'm still talking with you, I'm writing and charting but I'm here with you because this is your appointment…*" Furthermore, providers described how the ability to share information with the patient from the exam room computing device was affected by the mobility of said device (20/80 units; 16/28 providers). As one provider explained regarding a mobile computer, "*…it makes it more interactive, a tool you can use to involve the patient, whereas when it's stationary, it really will depend on where the patient is in the room if you can use it…*"

The mobility of the computing device also seems to be related to efficiency in the exam room, which was an

Table 1 Code summary results

Codes/Labels	Supporting providers ($N = 28$)	Total number of units ($N = 728$)
Accessories ($n = 52$)		
Mouse and keyboard	14	19
Computing usefulness ($n = 64$)		
Facilitate interaction	15	19
Level of importance	15	17
Computer mobility ($n = 80$)		
Mobility impact	16	21
Facilitated info/screen sharing	16	20
Facilitated patient engagement	14	15
Documentation habits ($n = 83$)		
Documentation done in room	24	52
Documentation done after visit	21	33
Documentation flexibility	17	24
Form factor ($n = 74$)		
Technology efficiency	16	28
Layout preference ($n = 163$)		
Prefer LB	27	76
Dislike LA	22	35
Physician preferences	15	23
Patient interaction ($n = 115$)		
Body orientation to patient	20	26
Communication flow with patient	15	23
Screen sharing ($n = 93$)		
Sharing difficulty	20	36
Screen sharing methods	18	30
Work habits ($n = 93$)		
During encounter	20	41
Preencounter preparation	21	28
Postencounter wrap-up	18	31

Abbreviations: LA, layout A; LB, layout B.
Note: Only labels with support from at least 50% of providers are shown.
The number of times each code was assigned is shown alongside each code, as well as the number of providers who expressed a sentiment that received each label, and the total number of times each label was assigned.
The distinction between codes and labels can be found in the "Analysis" subsection.
The grand total number of units ($N = 728$) is not the sum of the totals for each code because some units were multicoded.
Not all codes from the codebook are represented here.

important factor in providers' preferences. Aside from the armature device used in layout B, the most common device mentioned related to efficiency was a laptop (19/74 units; 13/28 providers), which provides superior mobility compared with a traditional desktop display. However, some providers had complaints about laptop usage, such as one providers comment, "*They're very awkward to use. You either balance them on your legs, you balance them somewhere. You can't use the mouse with them; you have to use the little cursor. I've found laptops harder to use.*" They did not prefer to sacrifice workspace to add mobility. Providers noted how mobility also aided efficiency through the ability to maneuver or customize the layout of the exam room to accommodate different patient types (those in wheelchairs, elderly, young adults, etc.; 10/80 units; 9/28 providers).

Providers also mentioned preferences for peripheral accessories related to the exam room computing device, particularly the mouse and keyboard setup as it related to usability (19/52 units; 14/28 providers). Despite an almost unanimous preference for layout B, providers did not like the confined nature of the limited desktop workspace that the armature system provided (not to be confused with the size of

the exam room, which remained the same between the two layouts). One provider offered their ideal setup, "…*as mobile of a computer that I can get, like the mobility of a laptop but the screen of a laptop and kind of a desktop keyboard and mouse*."

Provider Workflow

According to our providers, ideal clinical exam patient visits involve some previsit preparation, followed by the patient visit, and finally some postencounter wrap-up before preparing for the next patient. To prepare for a patient visit, providers noted reviewing previous visits and treatment plans, as well as laboratories, medications, etc. (23/93 units; 19/28 providers), starting a note or setting health reminders in the EHR (9/93 units; 9/28 providers), and preparing orders (3/93 units; 3/28 providers). During the encounter, providers take notes or leave reminders in the EHR (13/93 units; 10/28 providers), refill medications or order laboratories (12/93 units; 9/28 providers), take notes on paper (9/93 units; 7/28 providers), and review patient information with the patient (8/93 units; 7/28 providers). Once the visit is over, providers finish their notes either between patients (10/93 units; 9/28 providers) or wait to complete them at the end of the day (14/93 units; 11/28 providers).

However, there are deviations from the normative clinical exam workflow. During a patient visit, most providers noted only being able to start the note and leaving pieces of information for completion later (24/83 units; 17/28 providers), even though they recognized the benefits of completing the note during the exam such as increased accuracy, better patient focus, and lower time commitment outside of clinic work hours. A handful of providers even mention having to complete their notes at home, sometimes until late hours of the evening (5/93 units; 4/28 providers).

Interacting with the patient, specifically through screen sharing, during the encounter was another important issue. Screen sharing was engaged in to further educate the patient on their health care (13/93 units; 10/28 providers) but was avoided to prevent the patient from seeing sensitive or confidential information (16/93 units; 10/28 providers). Providers mostly described layout B as being easier for screen sharing compared with layout A (31/256 units; 17/28 providers). The level of difficulty stemmed from the methods used in either layout. Most providers with layout A said they would have the patient come over to the computing device while they moved out of their way (10/93 units; 9/28 providers). Meanwhile, in layout B, providers said they opted to turn the screen toward the patient to share information (19/93 units; 14/28 providers).

Discussion

From the providers' perspective, flexibility, mobility, and body orientation with respect to the location of the patient were highly valued when discussing physical aspects of exam room design. The flexibility of the wall-mounted armature system for screen repositioning is one clear example. However, while not part of the experiment, providers also discussed the flexibility and mobility afforded by a laptop computer. (Despite the flexibility and mobility afforded by other devices such as tablets or phones, providers generally did not share the same enthusiasm as they did for laptop computers.) Providers want to be easily and comfortably oriented toward the patient; computing devices and set-ups that allow for this are desired (e.g., wall-mounted armature system, laptop). Moreover, flexibility and mobility of the exam room furniture was valued, including the ability to easily reconfigure the spatial arrangement of a desk or chair based on the patient moving around during the physical exam. The key theme here is that providers do not want to be spatially constrained due to room arrangement during the patient encounter. Computing devices and furniture should facilitate customization of the exam room layout with an emphasis on flexibility, mobility, and orientation to the patient while accommodating various types of patients (those in wheelchairs, elderly, young adults, etc.). These provider preferences fall in line with the provisions listed in Patel et al[1] regarding practices that promote provider–patient interaction including adjusting room design, maintaining eye contact and talking with the patient while using the computer, and positioning oneself to be able to see the patient.

Customization also relates to provider work habits. Our data and analysis support the need to design for different work habits and preferences. There is quite a bit of variation in how providers work before, during, and after each patient encounter, including timing of EHR use. Some providers do a large amount of documentation in the EHR during the patient encounter, while others document almost exclusively after the patient encounter. Similarly, some providers spend time reviewing the patient's electric record prior to seeing the patient and others may not, especially if they are running behind schedule. Exam room computing should support this type of variation across providers as well as variation within each provider. In fact, a couple of providers mentioned their work habits might change depending on their work location. For example, if the clinic they were in saw a high volume of patients with low complexity issues, they could get away with computing during the patient encounter. However, patients with high complexity or needed emotional counseling limited their ability to do that. The key theme is that exam room computing should accommodate varying workflows. If a provider is assigned a stationary desktop for EHR use in the exam room, s/he should also have alternative options available, such as a laptop that can be carried from their office to the patient exam room.

Alternatively, work habits could be influenced by layout design to meet more desirable outcomes. This does not have to come at the cost of flexibility, however. For example, while it may become desirable for the provider to sometimes share the screen and other times not, the layout can be designed in such a way that both cases are possible while keeping the provider oriented toward facing the patient. In this way, variable provider work habit preferences are supported while simultaneously promoting patient-centeredness behaviors.

The design of the exam room should support provider–patient interaction, with or without the EHR/computer as a

mediator of that interaction. While some have argued that the computer and EHR can be used effectively to facilitate provider–patient interaction and communication,[2,7] not all of our providers agreed with that sentiment. Providers mentioned that high information density and the existence of sensitive information can prohibit (or hinder) screen sharing. Other providers expressed discomfort with screen sharing because it allows the patient to watch them while typing. Finally, other providers simply felt sharing the screen with the patient added no value to the patient encounter. Therefore, the exam room should be designed to accommodate both screen sharing and nonscreen sharing, rather than assuming that all providers will want to use the computer and EHR as a tool to enhance their interaction with the patient.

Limitations

Our study has limitations that should be considered. The study was conducted at a single institution (University of Louisville), with the majority of our participants being resident physicians. However, most of our participants had external clinical experience, such as rotations through the Veterans Health Administration and moonlighting at other local health care institutions. Because we had difficulty recruiting providers, convenience sampling was used and most of the providers were resident physicians, whose practices may not generalize to all primary care providers. Also, some of the providers had previous experience using a wall-mounted armature system, which may have introduced some learning bias. However, there was a good deal of variety in overall previous experiences with exam room computing set-ups across the providers. We did not measure for inter-rater reliability; however, coders met on codes until a consensus was reached.

Conclusion

Our analysis of the semistructured interviews revealed three interrelated themes for effective exam room design with respect to exam room computing. Providers highly value flexibility and mobility for the physical aspects of exam room design so that they can always be comfortably oriented toward the patient. Exam room design and computing should support the varying provider work habits and preferences, including the ability to easily document before, during, or after the patient encounter. Finally, the exam room should be designed to accommodate both screen sharing and nonscreen sharing activities, rather than assuming that all providers will view the computer and EHR as a tool to enhance their interaction with the patient.

Future Research

Future research may explore how to best balance and implement these interrelated themes through testing of different computer form factors (e.g., laptop vs. a wall-mounted armature system), furniture (e.g., desks that can be easily rotated out of the way or used with a laptop), and layout. Also, future research can look to modify the layouts used in this study to further explore impacts of exam room features, such as the mobility versus workspace size tradeoff. This study used two distinctly different layouts, and future research may benefit from using layouts that are not so different or introducing a layout that combines aspects of the two layouts used here. Finally, future research can look to have a more holistic approach to patient-centeredness by including the patient perspective with the provider perspective in the analysis.

Clinical Relevance Statement

Providers highly value flexibility and mobility for the physical aspects of exam room design so that they can always be comfortably oriented toward the patient. Exam room design and computing should support the varying provider work habits and preferences, including the ability to easily document before, during, or after the patient encounter. The exam room should be designed to accommodate both screen sharing and nonscreen sharing, rather than assuming that all providers will view the computer and EHR as a tool to enhance their interaction with the patient.

Multiple Choice Questions

1. What is one strategy that can be implemented to optimize the integration of electronic health records (EHRs) into provider–patient interaction?
   a. Ignoring the EHR.
   b. Waiting to use the EHR after the clinic has ended.
   c. Utilization of the EHR in screen sharing activities.
   d. Have the patient use the EHR instead of the clinician.

   Correct Answer: The correct answer is option c. There are multiple strategies that can be implemented to optimize the integration of EHRs into provider–patient interaction.[2,24] Prior research indicates that these strategies include: utilization of the EHR in screen sharing activities,[25] enhancing verbal and nonverbal communication, and adjusting the room.[1]

2. Which of the following are highly valued by providers in exam room design?
   a. Room size.
   b. Flexibility of positioning.
   c. More medical equipment.
   d. Lighting and temperature.

   Correct Answer: The correct answer is option b. The flexibility of the wall-mounted armature system for screen repositioning is one clear example that was valued by the providers. Providers also discussed the flexibility and mobility afforded by a laptop computer. While the other answers may be minor preferences of providers in exam room design, flexibility was a clear major issue among our participants.

Protection of Human and Animal Subjects

This study was reviewed and approved by the University of Louisville's Institutional Review Board (IRB), IRB study # 16.0749.

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Conflict of Interest
None declared.

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