Exploring the Use of Technology in Healthcare Spaces and its Impact on Empathic Communication

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ABSTRACT
As computing technologies in examination rooms become a more pervasive and dominant part of the healthcare experience, those technologies can disrupt the flow of information and empathic communication between a clinician and patient. We investigated how the design of healthcare spaces and the technologies inside affect doctor-patient interaction and communication. To identify clinicians' current practices and strategies of using technologies in the examination room, we interviewed clinicians from seven institutions and stakeholders involved in the design of healthcare spaces. We also documented the set-up of examination rooms from four clinics and hospitals. We interviewed and surveyed patients on their perception of clinicians using computers or other devices in the examination room during a medical consultation. Our findings show that clinicians and patients try to reach a common understanding about health priorities while facing the challenges of limited time and resources. We propose design recommendations that allow for efficient capturing and sharing of information between clinicians and patients while minimizing obstruction of empathic communication.

Categories and Subject Descriptors
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous, K4.2: Computers and Society: Social Issues, J.3 Computer Applications: Life and Medical Sciences

General Terms
Design, Human Factors

Keywords
Healthcare, communication, patient, doctors, clinicians, empathy, design, examination rooms, health informatics

1. INTRODUCTION
Patients are irritated when clinicians are insensitive to their experiences, treating them like "just a number," or when their interaction with a clinician is rushed [4]. Because of time and resource restraints, clinicians need to efficiently utilize the time they have with patients. Access to efficient, easy-to-use technologies such as electronic medical records (EMRs) allow clinicians to support proper patient care, information sharing, and communication. However, improper placement and use of these technologies in the physical space may interrupt clinicians' work flow and empathic dialogue with patients, making the consultation visit unpleasant and unproductive for the patient.

Our aim is to understand how the design of examination rooms and the technologies within affect the interaction between clinician and patient, in order to inform the design of new healthcare spaces and technologies. We conducted semi-structured, open-ended interviews with people involved in the design of healthcare spaces, clinicians who work in the space, and patients, and asked them to sketch examination rooms they use and the ideal room in which they would want to work. We also conducted a patient survey to incorporate their perspectives. These mixed methods allowed us to understand the stakeholders' perceptions and use of technologies in the healthcare space and prompted us to consider design opportunities that support the workflow of clinicians and doctor-patient interaction. We also discuss current practices and challenges clinicians face and workaround solutions they employ.

This work builds upon previous research across two main areas: doctor-patient interaction and human-centered design. Studies of doctor-patient interaction identified that heightened stress, inefficient use of clinical space, and inadequate delivery of medical information contributed to poor communication and understanding for patients [8]. Inadequate layout of facilities and improper deployment of communication technologies also decreased the amount of time clinicians have for patient care by increasing the time spent accessing and inputting data [7]. Our research investigates the design aspect of healthcare spaces, which is essential to understanding constraints and thus exploring new ideas. Evidence-Based Design, the concept that the design of healthcare spaces can directly impact the patient experience [3], originated from architecture and has been one source of inspiration for this work. Thus, by aiming to better incorporate computers and EMRs into the fabric of a healthcare space, we are contributing to the trend toward patient-centered spaces.

Our research findings fall into three areas:

1. **Space**: The space where the provider-patient interaction occurs has a great impact on the quality of the relationship. However, consultation rooms in use today are often designed for efficiency of resources, rather than successful communication.
2. **Tools**: Effective use of technologies, such as EMRs, is necessary for successful interaction. EMRs in use do not always support information sharing.
3. **Interaction:** How a provider shares information and interacts with a patient has an effect on the patient's outcome. A patient-centered approach with direct, face-to-face communication can encourage patient questions and ensure comprehension.

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2. METHOD

We used a mixed-methods approach to understand the examination room setting and the use of technologies inside. Semi-structured, open-ended interviews were conducted with clinicians and patients. We also interviewed stakeholders significantly involved in the decision-making and design process of the healthcare space, including an architect with 34 years experience designing hospital projects and a facility manager with 17 years of facility planning experience at 20 hospital facilities incorporating EMRs. While these participants do not represent the general population, we aimed to gather various perspectives, understand the varied needs of clinicians and patients, and the design constraints and rationales. Domain experts included seven clinicians, two facilities managers, and one architect (see Table 1). All the clinicians used computers or handheld devices while communicating with a patient in an examination room during a medical appointment. The two patients we interviewed have had experience going to medical appointments where the clinicians use a computer or handheld device during the appointment. All participants were recruited via word-of-mouth and directed email across several cities within the United States and received a $20 USD gift card. We conducted interviews either in person or over the phone and audio recorded and transcribed all interviews.

During interviews, we asked participants the following questions and modified the questions based on the role of the interviewee:

- Describe a typical appointment focusing on the clinician's use of technology and how information was shared.
- Describe a typical examination room setup and challenges that stakeholders face.
- Describe a situation during an appointment where the clinician's computer use was helpful/not so helpful to a patient.
- What would an ideal examination room look like?

For in-person interviews, we asked clinicians to sketch the current examination room, facility managers and architects to sketch the room they designed, and patients to sketch the rooms they visited as they talked through the issues they faced. They identified the arrangement of key objects, such as computer and monitor, furniture (e.g., sink, exam table, chairs, desk), and the way the door opens. At the end of the interview, they were asked to sketch an ideal examination room and envision future medical spaces. The sketching activities provided enormous benefits for the researchers by allowing us to situate ourselves in the healthcare spaces and provided insights for future design opportunities.

Table 1: Interview participants

ID	CATEGORY	YEARS OF EXPERIENCE	CHARACTERISTICS	FACILITY
F1	Architect	34	Specialization in design of medical facilities	B-1
F2	Facility Manager	17	Overseen the construction of medical facilities	B-1
F3	Nursing Manager	13	Overseeing the remodel of an outpatient center	B-3
D1	Doctor	19	Internist and clinical informaticist at a hospital	B-2
D2	Medical Director	10	Chair of the Internet Committee in an outpatient center	B-1
D3	Doctor	12	Obstetrics and Gynecology - Specialization in Technical Communications	B-4
D4	Doctor	23	Obstetrics and Gynecology	B-2
N1	Nurse	5	Burn unit	B-5
N2	ARNP	36	Primary Care Nurse Practitioner - Professor	B-6
N3	ARNP	9	Medical Rehab focusing on Multiple Sclerosis	B-7

We took photographs and drew floor plans of the facilities as examples of consultation rooms in use to identify problems and constraints. For example, Figure 1 shows that a patient sitting on the exam table has an oblique view of the clinician's back when the clinician is entering data on the computer.

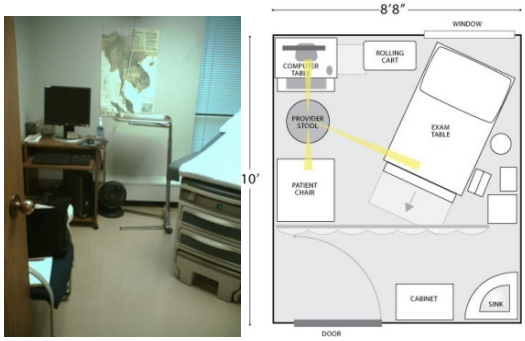


Figure 1. Photo (left) and floor plan (right) of a consultation room

We also conducted a short online patient survey to gather more of the patients' perspectives. The 24 respondents had experience with a variety of clinics and were asked to recall their most recent clinic visit where clinicians used a computer while they were in the examination room, their perceptions of the clinician's use of technologies, and their success interacting with the clinicians.

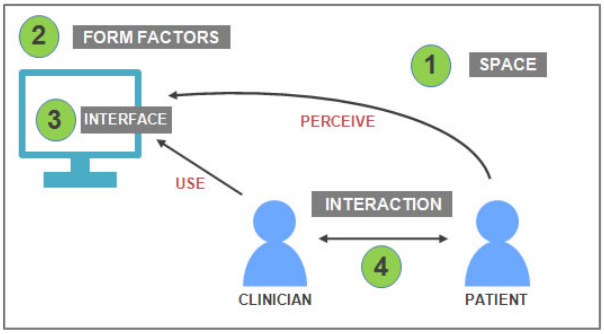
The qualitative data from the interviews and surveys was analyzed using grounded theory affinity analysis [2]. We chose affinity diagramming as a creative brainstorming tool to organize ideas and qualitative data, and we segmented direct quotes from the transcripts and surveys. Three researchers participated in bottom-up affinity diagramming by clustering related ideas and naming each category. Design opportunities were then brainstormed based on the themes that emerged from the data and the sketches of ideal examination rooms.

Our limited number of patient interviews was sufficient for this phase of research and has helped set up future inquiries. However, more in-depth interviews are needed to explore the variety of responses from our patient survey data, with a range of patient experiences to correlate to the healthcare environments.

3. RESULTS

In this section, we discuss current practices, challenges, workarounds, and opportunities in four categories determined by our data analysis: space, form factors of tools (computer, screen, furniture, etc.), interfaces (EMRs), and the interactions between clinicians, patients, tools, and space. Figure 2 shows the two key stakeholders, provider and patient, interacting in an examination room. In this space, the clinician and patient are surrounded by various tools—physical artifacts and EMRs—which may impact the way they interact. Figure 2 and the table below also illustrate our key findings and describe specific challenges and proposed

solutions based on our design brainstorming. We also describe participants' attitudes toward technology in the examination room.



	Challenges	Proposed Solutions
1 Spaces for Clinicians & Patients	1. Creating space for privacy	1. Position door for privacy
	2. Difficult to accommodate family members	2. Multiple patient chairs to accommodate caregivers
	3. Older buildings must be retrofitted with the appropriate technology	3. Handheld device can be used for doctor input without major retrofitting of building
2 Form Factors of Tools	1. Size and shape of current technology limits its use	1. Smaller mobile or hands free workstation
	2. Tools do not support sharing of information between a clinician and patient	2. Display screen on wall for patient viewing
3 Interface Tools	1. Inefficient usage of EMR causing backups	1. Sufficient training and a usability tested system
	2. Getting the right information to the right clinician when they need it	2. Ubiquitous sensors in rooms & RFID tags to identify which clinician is seeing which patient
4 Interaction	1. Nurse too busy documenting during a procedure to assist doctor	1. Create an automatic documenting system
	2. Clinician looking at the monitor, not the patient	2. Mobile workstation set up so clinician is facing the patient, with no barriers in between

Figure 2. A clinician and patient experience tools of various form factors within the healthcare space. The clinician uses the interface, while the patient both perceives the interface and the clinician using it. The clinician and patient also interact within this space. This experience creates challenges, which good design may be able to address.

3.1 Spaces for Clinicians and Patients

The clinical examination room is usually where a patient will spend the greatest amount of time. Its design, if done without forethought, can have an impact on the effectiveness of the communication between doctors and patients [3]. Participant F1, whose specialty is designing medical facilities, described the importance of collaborative teamwork to create a healthcare space (see Figure 3) that promotes seamless interaction between clinicians and patients. He described how doctors, nurses, project managers, and IT professionals were actively involved in the design process, deciding configuration and positioning of the objects to create a good examination room experience. They designed the mobile workstation to be pivoted for patient viewing and gave great emphasis to the placement and door swing direction to promote patient privacy. In addition, the patient chairs were placed to encourage communication.

F1: *"That first point of contact (for the clinician) should be the patient, not the sink. When you wash your hands, you can actually be talking to the patient. And so it improved that communication."*

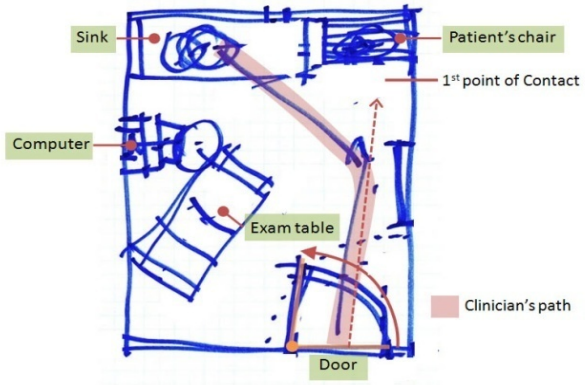


Figure 3. Sketch of an ideal examination room by F1.

Two facilities we examined were built with electronic records in mind. The layout of the computer workstation, whether stationary or mobile, did not heavily impact the workflow of the room. The other two facilities examined were built before the advent of electronic records. The layout of the computer workstations (both stationary) was not conducive to free flowing communication. For example, if a computer was badly placed in an examination room and seen as an impediment to communication, patients would comment on the "disconnection" felt.

P1: *"I was sitting on the bed and the doctor was facing the wall over there. It was weird, I feel really disconnected from what they are talking about."* (see Figure 4)

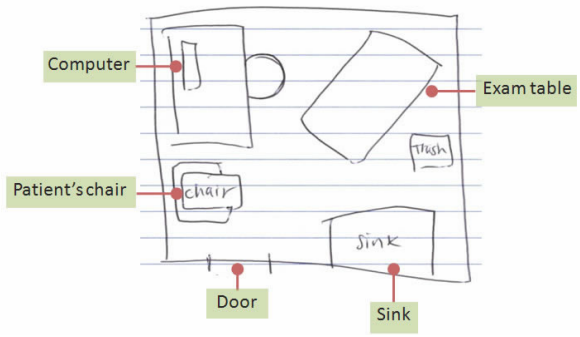


Figure 4. P1's sketch of a current examination room. Clinician's chair faces the wall rather than the patient's exam table.

Participants reported that retrofitted rooms in office buildings converted to clinics can cause frustration for clinicians trying to do their job. The inadequacy of the space required clinicians to constantly modify the room to adapt to the needs of different patients. This illustrates the importance of proper design.

N1: *"The examination rooms in this particular building were set up prior to the advent of all the technology, so we've been jerry-rigging our spaces to meet the needs."*

The clinicians we interviewed raised the issue of the arrangement and placement of chairs. Many patients were in large wheelchairs

pushed by multiple caregivers; others were in need of translators. There was an expectation from clinicians and patients alike that all would be seated in the consultation rooms to participate in the education and examination process. Most rooms studied were not able to accommodate this configuration. A nurse practitioner (N3) described an ideal room as able to accommodate wheelchairs, with multiple patient chairs surrounding the clinician's stool and a large screen monitor on the wall for patient viewing. The clinician is using a tablet device for access to the patient's chart. It is interesting to note that due to her specific patient population, this clinician was more focused on accommodating wheelchairs through an enlarged door rather than establishing privacy.

3.2 Form Factors of Tools

Computer workstations with electronic medical record systems were the main tools used for data input and data extraction during an examination in the facilities we studied. Thus, a clinician's ability to easily use a computer in the context of the consultation room is key to a patient's successful visit. How computing technology is implemented in the design of a room plays a role in how it is used. Innovation continually provides smaller technology, but the majority of workstations are large, heavy, and slow. The monitors are usually freestanding with limited ability to pivot, which relegates them to a corner or wall with access to power and a network connection. In Figure 1, the older model computer workstation is located in the far corner of the room. This placement does not allow the clinician easy access to the online patient chart, which requires notes and reports to be handwritten. These limitations on location and size are prime areas for change.

3.3 Interface Tools

There are many benefits to an electronic storage system: less storage space is needed, access to data is easier, and a permanent record is kept. Utilized efficiently, it can be useful as a care management tool and changing test values can be demonstrated dynamically over time. Despite the benefits, the adoption of the format has been slow [1]. The healthcare industry is still in the infancy of its transition from paper to electronic. In an interview, a physician with 10 years experience dealing with EMRs described the process.

D2: *"Most organizations (spend) an inordinate—or a fair amount of their early years—utilizing the electronic health record essentially as they would an electronic version of their paper chart. It's a very, very painful time, because in many respects, it's more efficient than a paper chart, and in other respects it's perhaps less efficient than a surrogate paper chart."*

An EMR is now the main information tool that clinicians use in the delivery of health care for many locations. Like any other tool, its strength lies in learning how to use it properly and adequate training is critical. An EMR that is maladapted to the facility where it is used can be perceived as a barrier to good patient-doctor interaction [6]. This can cause slowdowns and roadblocks for providers focused not on the perfection of information captured, but on the quality of care given to their patients.

Out of the seven facilities investigated, five relied on EMRs for storage and retrieval of information during a patient appointment, using paper only for intake forms, procedure consent, lab orders, and provider note keeping. One facility had an electronic record, but patient care notes were handwritten and copied into a paper chart. All facilities studied were still reliant upon hardcopy for signatures, lab forms, and printed handouts for the patient, even though the majority of their records are in an electronic format. Facilities that began using EMRs by 2005 had a high utilization of the electronic record. Those that implemented EMRs after 2005 had intermediate to low usage of the electronic record.

Inputting information directly into the electronic record while in the consultation room was the most efficient way to capture this information. Some providers were quite comfortable with this approach, sitting alongside the patient, turning the computer screen, trying to include the patient in the process whenever possible. Others were uncomfortable with this approach, preferring to directly face the patient and take handwritten notes. If a provider was not comfortable using the reporting programs available, they spent twice as much time handwriting notes during an exam, and then dictating their notes into the electronic chart.

N2: *"I don't input any information because I need to look up information for the patient during the appointment. I am not facile enough with (the system), so I have to dictate everything later.*

3.4 Interaction

Information sharing is critical to the doctor-patient relationship [9]. A few clinicians, specifically ARNPs, felt that understanding and relating to their patients on a personal level was paramount in the information gathering process. They were especially sensitive to any breakdowns in the system that they perceived as a barrier. They felt time on the computer was taking time away from the patient, and so preferred to spend face-to-face time discussing patient concerns.

N2: *"I don't use the computer to input anything into the patient's chart, it just takes too long. And using the computer gets in the way of me communicating directly with the patient."*

However, patients and providers alike felt sharing test results or growth charts pulled up from the EMR was very helpful. Test results and instructions are also printed out and then given to the patient to take home. Instructional diagrams and specific directions would often be handwritten on these handouts. This was especially important to help inform the caretakers of patients who had severe cognitive or physical impairments.

3.5 Attitudes toward Current Technology

Patients' attitudes as gathered from our survey ranged from positive to indifferent to technologies being used in the consultation room setting. Some felt it did not greatly impact communication with their provider. This is especially noted in the younger generation, which sees technology as a necessary part of everyday interactions [5], which was confirmed by one nurse.

N5: *"That (18-25) demographic is very comfortable with typing while talking... I think that there's more challenge with the acceptance of (that) style with the demographic of employees who are more mature, who have experience in their lifetime that phone calls and typing would be considered rude when you're having a face-to-face interaction."*

They did, however, note feelings of anxiety and unease if the technology used was inadequately placed in the room, such as if the monitor was difficult to see or if it forced the clinician to turn his or her back to the patient.

Three out of the seven clinicians we interviewed had a very positive view of technology use in the consultation setting. Their utilization of the EMR was high. They did not feel it greatly impacted their communication with patients. It is interesting to note that these three clinicians worked at facilities where EMRs had been in use for 5-10 years. The remaining four clinicians were ambivalent to negative, stating that use of the EMRs was distracting and time consuming. Their utilization of technologies in the consultation room was low. EMRs have been in place at each of these facilities 3-5 years. These clinicians did feel the use

of technologies had a detrimental impact on their communication with their patient. In some facilities, the placement of the computer did not enable face-to-face interaction, in others, the inability to use an EMR to its full potential, (i.e. lack of training, lack of upgrades to the system), created slowdowns in the consultation process. All providers agreed that as long as the use of technology did not interfere with their interaction with the patient, it was a necessary part of healthcare.

4. DESIGN OPPORTUNITIES

Technology, used to its fullest extent, can assist and amplify a provider's ability to monitor and care for their patients [7]. Our goal is to increase ways to share information, store and capture information, and offer refinements to existing technologies. In this section, we present design opportunities and ideas for how technology could be better integrated into the design of healthcare spaces. These designs are based on ideal examination rooms and our proposed solutions to the challenges summarized in Figure 3.

Space: The consultation room space should be designed to support the technology needed for information sharing, support the need for patient privacy, and allow the participation of caregivers and support personnel.

Form Factors of Tools: Mobile devices, such as tablets with an expandable keyboard, can be used to access the patient chart and to share information in a way that would support communication. Newer designs, such as Apple's iPad®, have improved usability, are more lightweight, and have sufficient battery life. Updating to a portable tablet device eliminates the need to retrofit an older facility with a large amount of new equipment. Another potential design is for a large wall screen that allows digital x-rays, MRIs, photos, and other results to be viewed by all in the examination room. Finally, another opportunity may be for ubiquitous sensing used to simultaneously document and monitor a patient in real time while in an examination room. Figure 5 illustrates this set up.

Figure 5. Examination room mock up in Second Life shows a monitor on the wall for patient viewing, tablet supporting clinician mobility, and ubiquitous sensing of patient status.

Interface Tools: An easy log in/log out method via voice recognition during an appointment could quicken interactions. Patients could link their Personal Health Records (PHR) to the hospital-based EMR to share agendas and recommendations and use PHRs to store questions for review. After the exam, a permanent record that can be accessed, refined, and distributed quickly to all parties could also be created. Implemented, these ideas could achieve an increased amount of quality interaction between provider and patient with minimal cost.

5. CONCLUSIONS AND FUTURE WORK

EMRs are a necessary part of the healthcare experience. But having sophisticated tools available does not mean they will always be used successfully. Our initial findings about space and the tools that providers use can be leveraged for future examination on a closer and more quantitative level. One possibility for future work is an interactive tool that would allow testing of many spatial and technical configurations. A virtual immersive space like Second Life® would allow designers to inexpensively and rapidly change configurations and conduct user tests with architects, IT teams, clinicians, and patients before the effort of constructing the space is made. This would empower stakeholders to make changes and allow a form of participatory design not easily achievable in a physical space. It could also encourage an increase in participation, allowing for a wider range of user experiences to be captured. This is necessary in order to expand and test our design recommendations. Changes users suggest can be recorded and tracked over time and evaluated by designers and healthcare professionals. Our research indicated that clinicians were interested in participating in a virtual arena and being active in user testing. The findings from this study, when used in the design of future healthcare spaces, can lead to new designs and devices to aid in a more satisfactory experience for patients and providers.

6. ACKNOWLEDGMENTS

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7. REFERENCES

[1] Belletti, D., Zacker, C., Mullins, C.D. (2010). *Perspectives on electronic medical records adoption: electronic medical records (EMR) in outcomes research*. Patient Related Outcome Measures.

[2] Glaser, B. G. (1992). *Emergence vs forcing: Basics of grounded theory analysis*. Mill Valley, CA: Sociology Press.

[3] Hamilton, D. K., & Watkins, D. H. (2009). *Evidence-based design for multiple building types*. Hoboken, N.J.: Wiley.

[4] Jangland, E., Gunningberg, L., & Carlsson, M. (2009). *Patients' and relatives' complaints about encounters and communication in health care: Evidence for quality improvement*. Patient Education and Counseling, 75, 2, 199-204.

[5] Lelievre, S., & Schultz K. (2010). Does computer use in patient-physician encounters influence patient satisfaction? *Canadian Family Physician*. 56 (1), e6-e12.

[6] O'Malley, A.S., Cohen, G.R., and Grossman, J.M. (2010). Electronic Medical Records and Communication with Patients and Other Clinicians: Are We Talking Less? *Center for Studying Health System Change Issue Brief*. No. 131.

[7] Page, A. (2004). *Keeping patients safe: Transforming the work environment of nurses*. Washington, DC: National Academies Press.

[8] Unruh, K.T., Skeels, M., Civan-Hartzler, A., Pratt, W. (2010) Transforming Clinic Environments into Information Workspaces for Patients. *CHI 2010*. New York: ACM Press.

[9] Weiner, S.J., Barnet, B., Cheng, T.L., & Daaleman, T.P. (2005). Processes for effective communication in primary care. *Annals of Internal Medicine*. 142 (8), 709