DIFFERENCES IN PHYSICIAN USE OF ELECTRONIC HEALTH RECORDS: DEVELOPMENT OF A SCALE ASSESSING INDIVIDUAL FACTORS INFLUENCING PHYSICIAN ACTUALIZATION

A Dissertation

by

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ABSTRACT

Electronic health records (EHRs) are one of the most talked about topics within and surrounding health care organizations and the health care system in the United States; however, the U.S. has been slow to implement these computerized medical record systems into their organizations. One of the factors often overlooked regarding the implementation of EHRs, is the role of individual health care professionals and the effects produced by their interactions with the EHR as they perform their job duties throughout the day. Using a Theory of Organization-EHR Affordance Actualization as a guiding framework, the focus of this dissertation is to examine the factors that influence how physicians use the EHR at the individual-level during clinical interactions by analyzing physician perceptions of their interaction with the EHR while providing patient care in the exam room and how it influences their work process. A mixed methods approach was used to identify the affordances, EHR features, factors that influence EHR use, and individual physician characteristics that produce the visible effects of EHR use during the clinical encounter when individual physicians interact with the EHR.

The findings of this study confirm the identification of individual level affordances proposed by Strong and colleagues and propose three additional affordances. This study also identified additional features that should be taken into consideration when investigating individual level affordance actualization. Finally, this study provides a survey tool for practice managers, health care executives, trainers, and vendors to use in

order to better understand the individual user characteristics of their physicians, predict their patterns of use based on these user characteristics, and thus tailor their training to enhance affordance actualization and organizational goal attainment.

DEDICATION

This dissertation is dedicated my husband, my daughter, and the Holy Trinity, whom without all of them I would have never finished this project.

To my dear husband, Dr. Brad Wesner, it was because of you that I started down this road and it was because of you that I was able to finish. It was your love, support, and encouragement that kept me going and your willingness to read and reread all of my drafts and offer suggestions along the way that finally got me to this point. Thank you for all you have sacrificed for me to get me to end of this road, without you I would have never made it.

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CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Electronic health records (EHRs) are one of the most talked about topics within health care organizations and the health care system in the United States. The past two presidential administrations have launched initiatives and provided funding to spur the implementation and use of EHRs in the U.S. health care system (Redhead, 2009; U.S. Department of Health & Human Services, n.d.); however, the U.S. has still been slow to implement these computerized medical record systems into their organizations. The largest barrier to implementation within the organization is the cost in both money and time, as implementation requires an initial decrease in the number of patients that can be seen each day and increased work time for health care providers. In addition, implementation has a high risk of failure, as the ability to successfully implement these systems is historically low, with estimates between a third and over 50% of health care organizations failing to implement EHR systems successfully (Mostashari, Tripathi, & Kendall, 2009). This leaves health care administrators and health care professionals hesitant to assume the risk of implementation.

One possible reason that implementations are not successful is that those implementing the system (health care managers, IT professionals, and vendors) may not be fully considering how the implementation of a new information technology will produce desired and undesired organizational effects. Within health care organizations, health care executives have specific goals associated with EHR implementation, such as

financial gain, improvements to quality of care, and increased patient/health care provider satisfaction. However, health care executives may overlook the underlying processes connecting the implementation of the EHR to the desired/undesired effects that the introduction of a new information technology produces within the organization. For example, they may assume that this process is fairly seamless in that the EHR is rolled out, the health care professionals will be trained to use it, and the desired results will be achieved. However, the process is much more complicated, accounting for the low success rate that has been documented regarding EHR implementation in the U.S. (Mostashari et al., 2009).

Health care executives are more likely focused on how the EHR can benefit the clinic, yet they overlook the role of the individual health care professionals and the effects produced by their interactions with the EHR while providing care throughout the day. Studies have shown that the individual actions of health care professionals are very important, noting that the organizational benefits desired by the health care executives do not arise directly from EHR implementation, but indirectly through individualized interactions with the EHR (DeLone & McLean, 1992; Goodhue & Thompson, 1995; Soh & Markus, 1995; Strong et al., 2009). Thus, the factors and processes that influence the individual use of the EHR must to be understood if the success rate of EHR implementations is to increase and the purported benefits of the EHR are to be realized.

Using Strong and colleagues (2014) Theory of Organization-EHR Affordance Actualization as a guiding framework, the focus of this dissertation is to examine the factors that influence how physicians use the EHR at the individual-level during clinical

interactions by analyzing physician perceptions of their interaction with the EHR while providing patient care in the exam room and how it influences their work process. Whereas the Theory of Organization-EHR Affordance Actualization was developed as a theory that looks mostly at a clinic/organization-EHR level, they highlight that it is the aggregation of individual-level actions that produce organizational effects (Strong et al., 2014). However, their focus is not on the individual or the factors that influence a physician's ability to be able use the EHR effectively. As such, this study examines the day-to-day interactions that physicians have with the EHR in the exam room and how those interactions produce the immediate concrete outcomes that result in whether the organizational goals are being met, and if so to what extent.

Operating under the framework of the aforementioned theoretical perspective, this dissertation specifically identifies theoretical concepts in the data such as: EHR features that influence the use of the EHR; the characteristics & capabilities of users (i.e. physicians); and the affordances (i.e. the potentials for action) that are produced as a result of the relationship between the users and the EHR. After these constructs were identified, a survey instrument was developed, refined, and validated to evaluate the user characteristics that influenced EHR use during the clinical encounter. By measuring these factors a greater understanding of what factors influence individual physician use of EHRs and the benefits and/or unintended consequences at the organizational level, can be attained.

The next section of this chapter consists of an overview of Strong and colleagues (2014) Theory of Organization-EHR Affordance Actualization. The third section of the

of this chapter will discuss the effects of EHR use in the exam room within the context of the theoretical concept of the "actualization of affordances" and "EHR features", which will be defined and discussed during the theoretical overview. This chapter concludes with the rationale and research questions for the dissertation.

Theoretical Overview

Strong and colleagues (2014) A Theory of Organization-EHR Affordance Actualization extends IT-associated organizational change theory by looking at the change process, IT artifact, and users through an "affordance" lens and applying and extending these concepts within the context of a specific organization type (health care organization), a specific technology (an EHR), and specific users (health care professionals). The result was the development of a theory that would allow researchers to address theoretical voids that currently exist regarding the interaction between the technology and its users and allow practitioners the ability to identify and address implementation challenges they face before, during, and after the implementation of EHR systems in their organizations. The theory allows researchers to look at both the technology and the individual user and how the interaction between the user and the technology impacts how the technology is actually used. By determining how the technology is actually put to use by the user, a better understanding of the impact of the technology on individual work process and organizational outcomes can be achieved (Strong et al., 2014). Within this context there are five theoretical concepts that are integral to explaining what influences a physician's use of the EHR in the exam room: affordances, actualization, features, user characteristics, and immediate concrete

outcomes. In the sections below I will discuss each of these concepts and provide an operational definition for each term, which will be used throughout the remainder of the dissertation.

Affordances and actualizations. The concept of affordances comes from the field of ecological psychology and has been adapted and expanded over the years within this field (see Gibson, 1979 and more recently Chemero, 2003). Originally, Gibson observed that animals do not do not perceive objects as a collection of small details or properties, but instead they perceive the object as a whole and what that object will enable them to do, i.e. eat, hide, sleep, protect, etc. and thus affordances as defined by Gibson are what an object offers, provides, or furnishes to someone or something (Gibson, 1979). Recently the concept of affordances has been introduced into the IT-associated organizational change literature. For example, Strong and colleagues (2014) define affordances as "the potential for behaviors associated with achieving an immediate concrete outcome and arising from the relation between an artifact and a goal-oriented actor or actors" (p. 69).

In the most simplistic definition, and for the purpose of this dissertation, an affordance can be defined as the potential work that the technology has the capability to do. However, like humans, having the potential to perform a certain task does not necessarily equate to having that task performed. For example, a laptop with word processing software has the capability of producing a written document. In this case the word processing software constitutes a feature present in the laptop, which allows for a specific use. Yet if there is not a human user who understands how the software works,

the document will not be produced. When a user with the necessary skillset interacts with this feature of the laptop through the use of another feature, the keyboard, the document can then be produced with the skill level of the user dictating the amount of the feature's potential that is utilized. When the potential of the technology is enacted through the interaction of a user with the necessary skills the affordance of the technology is actualized, in other words the potential of the technology is realized (Strong et al, 2014). It should also be noted here that these concepts do not always clearly relate to the intent of the technology's designer when conceptualizing how the technology might be used, rather individual users dictate how the technology is used based on the interaction of the characteristics of the user and the features offered through the technology, as well as the organizational context in which the technology is being used.

EHR, features, and user characteristics. I extend this example to the use of an EHR during a clinical consultation in order to operationalize the terms features and user characteristics for the purposes of this study as well as to elaborate on what I mean by the term EHR in this context. The EHR refers to the technological device that the physician may or may not interact with in order to perform various tasks and processes associated with the process of conducting a medical interview and providing patient care. A feature is defined, as any part of the technological device that a user engages in order to perform a task, (i.e. keyboard, software, specific parts of the software, internet, etc.). The user characteristics of a physician refers to the demographic attributes, perceptions and attitudes about the practice of medicine and EHR use during the clinical

consultation, and his or her level of technological skills a physician has. A physician's characteristics influence their ability to be aware of the actions allotted to them by the EHR and its features (affordances), and to use the EHRs features to perform those actions during the clinical consultation (actualization). So for example, an EHR system has been recently introduced into the exam rooms at a medical practice and allows the physician to write an electronic prescription. The EHR has the ability to perform this task through the prescription-writing feature of the software. If the physician has the user characteristics to be aware that the EHR allows them to perform this action (affordance) and then performs the necessary actions to complete the task (actualization) the physician has actualized the affordance of prescription writing.

Strong and colleagues (2014) used parallel concepts while examining EHR's and identified eight affordances from their data. These eight affordances were identified as: 1) Capturing and archiving digital data about patients; 2) Accessing and using patient information anytime from anywhere; 3) Coordinating patient care across sites, facilities, and providers; 4) Standardizing data, processes, and roles; 5) Monitoring organizational operations; 6) Substituting healthcare professionals for each other; 7) Incorporating rich information into clinical decision making, and 8) Shifting work across roles.

Strong and colleagues (2014) also specify the features of the EHR and the user characteristics needed to be able to use the technology and extend the concept of affordances to the organizational level. While they extend the concept of affordances to the organizational level they also indicate that the organizational context affects individual users goals and actions, as it is related to the users professional roles and their

organization. However, they found that it was not the effect on organizational goals that were of primary importance to the users, but instead the immediate concrete outcomes that would result from EHR use. An immediate concrete outcome may be defined as an anticipated effect from the use of technology that allows for the achievement of goals.

For the purpose of this dissertation, I focused not on the organizational level affordances, but on the individual level affordances and their actualization, specifically: capturing and archiving data, accessing and using patient information anytime from anywhere, standardizing data, processes, and roles, monitoring organizational operations, and incorporating rich information into clinical decision making.

Individual level actualization in an organizational context. Strong and colleagues (2014) found that the actualization process simultaneously involved individual and organizational level journeys. The individual journeys occurred within the organization as users learned how to use the EHR and over came obstacles as the EHR evolved and managers intervened, where the organizational level journey was the result of the interaction and aggregation of the individual journeys. Of specific interest to this study as well as a key theme in Strong and colleagues findings was the individual actualization process.

The individual actualization process is experienced and enacted at different rates and in different ways by each goal-oriented user as they interact with the EHR. Even before the implementation of the EHR, Strong and colleagues (2014) found that individuals were anticipating what immediate concrete outcomes they would be able to achieve, such as making sure the specialist they referred their patient to would have all

the information they needed and would understand the reason for the referral. Further, actors also began speculating on what actions they would have to take to produce those outcomes (i.e. the actualization process), such as typing patient data into the EHR and whether these actions would produce desirable immediate concrete outcomes that would help them achieve their goals.

Strong and company (2014) found that individuals encountered factors that enabled and constrained their ability to use the EHR and thus enact different actualization actions. The key factors that they identified as influencing the individual actualization process within an organizational context were user characteristics, EHR features, and the work environment's characteristics. As discussed previously, the user characteristics and the EHR's features formed the affordance, but they also influenced the actualization process. As users encountered constraints due to these factors they would look for ways to reduce or eliminate them by requesting more training, trying to change the EHR, or not using the EHR to perform tasks. The ability to reduce or eliminate these constraints was influenced by the users characteristics and the EHR features that allowed, or did not allow, for adaptation. To continue with the example from above, if the physician was aware that the EHR allowed them to write electronic prescriptions, but it was too difficult for them to do so then they were not likely to take actions to perform this capability provided to them by the EHR. Examples that might lead the physician to feel that the task was too difficult might include: feeling that they did not have the ability to use the EHR to perform the task, that it would interfere with

their work style, or they didn't think the time necessary to learn and perform this task would be worth the effort.

On the other hand, if the physician felt they had the ability to perform the task, it was compatible with their work style, or was worth the time and effort needed to incorporate it into their work process then they would actualize that affordance. Individual actualization journeys became smoother when adjustments in the users characteristics as well as the EHR features were incorporated. This smoothing of the actualization process is typical following the implementation of a new IT artifact into an organization, however their data highlights the need of these adjustments to be based on the individual users involved and the constraints that those users face in order to maximize the use of the technology (Strong et al., 2014).

The third aspect that enabled and constrained individual actualization journeys were the characteristics of the organizational context. Strong and company (2014) found that some organizational sites were better at actualizing affordances through exploration and innovation, while others seemed to accept or continue to struggle with the EHR while not changing their actions or the EHR. This led to management improvement meetings across organizational sites so that successful affordance actualization ideas that emerged from one site could be shared with and implemented by other sites. Of particular interest to this dissertation is the individual actualization process specifically the first two aspects, user characteristics and EHR features.

The identification of affordances and the factors that influence the individual awareness of and actualization of these affordances by physicians within the clinical

encounter is the primary focus of this dissertation. Strong and colleagues (2014) focused their theory on the organizational context of the healthcare organization, yet emphasized the importance of the effects of the individual actualization journey within the organization, as it is the aggregate of these individual actualizations that produce the immediate concrete outcomes and whether organizational goals are achieved. However, they noted that their focus was not the individual actualization process and that the goal-action orientation of individuals was in relation to the overarching organizational goals not individual-level goals. These individual actualizations occur within the microcosm of the clinical encounter that ultimately produces the aggregate effect seen at the organizational level. While the individual using an EHR within the clinical encounter is not functioning within an independent silo, and thus is influenced by the organizational context, culture, and others, it is the interaction of their individual user characteristics, EHR features, and the organizational context that produce the individual and organizational outcomes. The next section of this chapter discusses the immediate concrete outcomes of affordance actualization in the clinical encounter.

Immediate Concrete Outcomes of Affordance Actualization in the Clinical Encounter

Immediate concrete outcomes illustrate how affordance actualization has taken place. It is by observing these outcomes that we see the effect that the EHR has during the clinical encounter. Working back from these outcomes we can identify the affordances that produce the outcomes when actualized by the user. Three affordances, as identified by Strong and colleagues (2014), are apparent in the EHR effects literature: capturing and archiving digital data about patients, accessing and using patient

information anytime from anywhere, and incorporating rich information into clinical decision making, and will be discussed in conjunction with the literature on EHR effects in the exam room.

It is important to note that the affordances identified by Strong and colleagues were at the organizational level. However, to fully understand the individual journey of the actualization of affordances it is important to identify affordances that are available at the individual-level during the clinical consultation, as that is where the physician interacts with the patient and the EHR, and it is the aggregation of the individual actualizations of affordances that produce the organizational actualizations and outcomes. Of the eight affordances Strong and colleagues (2014) identified at the organizational level, five of them are also seen at the individual-level: capturing and archiving digital data about patients, accessing and using patient information anytime from anywhere, standardizing data, processes, and roles, monitoring organizational operations, and incorporating rich information into clinical decision making. While all five of these affordances can be actualized by physicians during a clinical encounter, capturing and archiving digital data about patients, accessing and using patient information anytime from anywhere, and incorporating rich information into clinical decision making are most clearly evident in the EHR effects literature and thus will be used to illustrate and organize the EHR effects literature.

To illustrate how immediate concrete outcomes provide evidence of the existence and actualization of affordances, affordances related to capturing and archiving digital data about, accessing and using patient information anytime from anywhere, and

incorporating rich information into clinical decision making will be discussed below in conjunction with prior research that provides evidence of their existence and actualization. The affordances of capturing and archiving digital patient data and accessing and using patient information anytime from anywhere will be discussed together as the EHR effects literature often intertwines the immediate concrete outcomes related to them. In addition to the previously identified affordances, research has also provided immediate concrete outcomes of the actualization of affordances that have yet to be identified in the literature. These outcomes are also discussed below briefly and possible affordance relationships are proposed (Table 1).

Table 1
Affordances & Immediate Concrete Outcomes

Existing Affordances *Identified by Strong & Colleagues (2014)*	Immediate Concrete Outcomes
Capturing and archiving digital patient data	Patient data is entered into patient record during the clinical encounter
Accessing and using patient information anytime from anywhere	Physician accesses and uses patient data during the clinical encounter
Incorporating rich information into clinical decision making	Physician uses prompts and alerts along with patient data to make diagnoses and treatment decisions
Possible Affordances *(Proposed by author which expands model)*	
Organizing and structuring of the medical visit	Template and prompts suggest a process of gathering and recording patient data
Managing the physician-patient relationship	EHR serves as a tool to engage the patient in their health care

Capturing and archiving patient data & accessing and using patient information. While the affordances of capturing and archiving digital data about patients and accessing and using patient information anytime from anywhere have not been previously discussed as affordances in the EHR literature, the effects of the actualization of these affordances have been one of the driving forces behind the push for health care organizations to adopt EHRs in place of paper records (Bates, Ebell, Gotlieb, Zapp, & Mullins, 2003). Researchers have been interested in determining how EHR use affects various factors that would correspond to these affordances, such as completeness and accuracy of the medical record, access to and entry of patient information and exchange of information between the clinician and the patient (Bates et al., 2003; Chen, Ngo, Harrison, & Duong, 2011; Frankel et al., 2005; Hsu et al., 2005; Linder et al., 2006; Makoul, Curry, & Tang, 2001; Margalit, Roter, Dunevant, Larson, & Reis, 2006; Miller & Sim, 2004; Noordman, Verhaak, van Beljouw, & van Dulmen, 2010; Patel, Arocha, & Kushniruk, 2002; Shachak, Hadas-Dayagi, Ziv, & Reis, 2009; Shachak & Reis, 2009; Ventres et al., 2006). Research has shown that the immediate concrete outcomes related to these affordances produced by the integration of EHRs into the exam room have produced mixed results concerning whether the use of EHRs in the exam room has positively or negatively influenced physicians' ability to capture and archive digital patient data or access and use patient information as needed.

Negative effects. Several studies have shown that that are various factors related to EHR use in the exam room that negatively influence the exchange of information both in type and amount of information, between the physician and the patient. Specifically,

using EHRs in the exam room can have a negative impact on patient-centered communication (Shachak & Reis, 2009), such as reduced interpersonal contact (Rouf et al., 2007), reduced nonverbal communication behaviors (Bates et al., 2003; Frankel et al., 2005; Linder et al., 2006), reduced exploration of psychosocial/emotional issues (Margalit, Roter, Dunevant, Larson, & Reis, 2006; Makoul, Curry, & Tang, 2001), and reduced relationship-oriented communication (Makoul et al., 2001). Researchers have also found that the use of EHRs in the exam room may result in: a disruption in the temporal sequence in which patients explain their illness (Patel et al., 2002), less information given by physicians (Margalit et al., 2006; Noordman et al., 2010), and less information contributed by patients (Margalit et al., 2006).

Studies have also shown a negative impact on physician management of patient data when EHRs are used in the exam room (Shachak et al., 2009). Physicians attitudes, beliefs, and fears such as fearing the computer will be too slow, doubting one's ability to type quickly enough, and preferring to write long prose notes (Bates et al., 2003; Linder et al., 2006) negatively influences their ability to gather, enter, access, and utilize patient data in the EHR. Additionally, the accuracy of the data entered into the EHR has also emerged as a concern with research indicating that the automaticity of the EHR, often touted as a benefit of EHR use for its ability to improve efficiency while entering patient data, also can increase errors in patient data by selecting incorrect medication or entering data into the wrong patient record. When combined with interruptions while entering data, automaticity emerged as the main contributing factor associated with errors in patient data (Shachak, Hadas-Dayagi, Ziv, & Reis, 2009).

Positive effects. While the previous section highlighted the negative outcomes associated with the actualization of capturing and archiving digital patient data, others have found it to have enhanced the amount of certain types of information exchanged (Johnson, Ravich, & Cowan, 2004; Makoul et al., 2001; Shachak & Reis, 2009) and have noted improved chart availability, accuracy, legibility, and organization of information (Miller & Sim, 2004; Shachak et al., 2009). Specifically, Makoul and colleagues (2001) found that the use of EHRs in the exam room improved information-intensive tasks for physicians as EHR use encouraged clarification of information, asking follow-up questions, and checking completeness of the record. Further EHR presence increased communication about medical issues and contributed to better physician explanations of diagnoses and treatments (Hsu et al., 2005).

Additionally, research has shown that the use of EHRs has improved chart availability, data organization, and legibility (Miller & Sim, 2004), and that the comprehensiveness, organization, and readability of the EHR system in the exam room reduced physicians cognitive load by improving the readability of patient data (Shachak et al., 2009). It should be noted that the improvements seen in patient data have been found to be dependent upon the amount of viewable clinical data which is dependent upon how extensively physicians documented progress notes (Miller & Sim, 2004). Physician documentation of progress notes in EHRs can range from basic users, who had their dictated notes transcribed and imported in the EHR or typed their own notes into unstructured text boxes, to more advanced users who typed data into templates and included physical exam and documentation prompts. While the differences in

documentation style can be quite drastic, scholars also found that even basic use of the EHR provided benefits such as improved legibility and accessibility of progress notes, as well as increased availability of electronic problem and allergy lists (Miller & Sim, 2004).

Incorporating rich information into clinical decision making. Another attribute of EHRs that has been touted as having the ability to improve the quality of patient care is the ability to assist physicians with clinical decision-making. The decision-making affordance refers to the ability of the EHR to provide decision support features, such as drug-interaction alerts and online clinical references that enable physicians to make improved diagnoses and treatment decisions (Strong et al., 2014). Previous research has indicated that the use of an EHR for decision-making purposes increased patient comprehension of decisions made during the visit, and provided more positive perceptions of patient involvement in decision-making (Hsu et al., 2005). Still other studies have found that the level of EHR use directly influences the degree to which physicians are able to actualize the decision-making affordance and improve the quality of patient care. For example, Linder and colleagues (2006) found that the effectiveness of the EHR based clinical decision support was limited when physicians did not interact with the EHR during patient visits, and even when they did interact with it their level of interaction influenced the amount of clinical decision support that was used. Other studies have confirmed that for the decision making affordance to be optimized requires a more advanced EHR user, specifically a user capable of entering patient data as coded

data, rather than free-text data, which facilitates more advanced computer-based decision support for care coordination and chronic disease management (Miller & Sim, 2004).

Unidentified affordances. While the affordances provided by Strong and colleagues (2014) are found at both the organizational and individual levels, additional affordances available on the individual level have yet to be identified. Research on the use of EHRs in the exam room and the resulting observable effects provide hints about what some of the additional affordances may be. One such affordance could be the organizing and structuring of the medical visit, which refers to the influence of templates, prompts and alerts, and other documentation procedures on how the physician organizes and structures the medical interview, physical examination, and documentation of the record (Bates et al., 2003; Chen et al., 2011; Frankel et al., 2005; Linder et al., 2006; Pizziferri et al., 2005; Rouf et al., 2007). Another possible affordance is the managing of the physician-patient relationship which refers to the ability of physicians to perform relational formation and maintenance behaviors with patients while using the EHR during the clinical encounter. A couple of examples might be using the EHR as an attracting point to engage the patient and involve them in their healthcare or it may also hinder the physicians ability to perform communication behaviors that are necessary for relational formation and maintenance such as eye contact and body orientation (Bates, Ebell, et al., 2003; Frankel et al., 2005; Irani, Middleton, Marfatia, Omana, & D'Amico, 2009; Johnson, Serwint, Fagan, Thompson, & Wilson, 2005; Linder et al., 2006; Margalit et al., 2006; Noordman et al., 2010; Rouf et al., 2007; Ventres et al., 2006),

The influence of EHR features on affordance actualization. Some researchers have commented that the EHR system has become a "third person" in the exam that requires space and attention within the medical encounter (Margalit et al., 2006), and it is the physicality in terms of EHR features that will be discussed next in relation to the actualization of affordances. For example, the spatial arrangement and the physicality of the computer in the exam room can influence: physician attitudes, how EHRs are used to access, gather, and enter patient data, and the interaction between the physician and patient (Chen et al., 2011; Dagroso et al., 2007; Frankel et al., 2005; Margalit et al., 2006; Miller & Sim, 2004; Patel et al., 2002; Rosenbloom, Crow, Blackford, & Johnson, 2007; Ventres et al., 2006).

Specifically, studies have shown that EHR features have made accessing, gathering, and entering patient data difficult because of the multiplicity of screens, options, and navigational aids, making documentation of progress notes more difficult and causing physicians to spend extra time on these tasks (Dagroso et al., 2007; Miller & Sim, 2004; Patel et al., 2002). Additionally, research has indicated that EHRs influence the interaction between the physician and the patient. For example, Chen and colleagues (2011) found that physicians used micro-negotiations of the computer in order to facilitate eye contact and encourage patient participation and control the medical interview process by protecting screen activities and controlling the length and content of the medical interview. Another example is Frankel and colleagues (2005) study which found that the use of the computer in the exam room amplified current baseline communication skills of the physician. Thus, if the baseline communication skills of the

physician are low prior to the computer being in the exam room, they will be worse after the computer has been installed. However, if the physician is already a competent communicator in the exam room, the computer improves their communication behaviors with patients.

Rationale and Research Questions

While Strong and colleagues (2014) have developed their theoretical perspective to extend to the outcomes at an organizational level and while one must be aware of the influence of the organizational outcomes on individuals and their actions, this dissertation focuses its attention at the individual-level of physicians during the clinical encounter where the actualization of affordances that occur between the EHR features and users are enacted multiple times a day. This allowed for the identification of affordances (RQ 2), through the identification of the EHR features (RQ1) and user characteristics. It also identifies the factors that influence how a physician actualizes the affordances that are available to them (RQ 3) and how user characteristics influence EHR use during the clinical encounter (RQ 4). This dissertation contributes to the information systems/management, EHR, and organizational behavior/communication literature through the confirmation of previously identified affordances (Strong et al., 2014) and the identification of unidentified affordances, as well as what user characteristics influence EHR use during the clinical consultation.

RQ 1: What EHR features are seen as useful by physicians in the exam room?

RQ 2: What affordances manifest between the EHR and physician during the clinical encounter?

RQ 3: What factors impact affordance actualization?

RQ 4: What physician characteristics impact affordance actualization during the clinical consultation?

CHAPTER II

METHODOLOGY

The purpose of this research is to understand what influences physicians' use of EHRs at the individual level, as it has been shown that it is the individual actions of physicians that are integral in achieving the desired benefits health care organizations are seeking through EHR implementation (DeLone & McLean, 1992; Goodhue & Thompson, 1995; Soh & Markus, 1995; Strong et al., 2009). While The Theory of Clinic-EHR Affordance Actualization was used as the theoretical framework for this research, this dissertation specifically looks at four areas of the model: the EHR features, the users characteristics, the potentials for use that the EHR provides (affordances), and how the EHR is used during the clinical encounter (actualized affordances). In addition, these four areas were examined within the more micro level of the medical consultation, instead of the overarching organizational level in which the theory was originally developed. Due to the recent development of this theoretical perspective, additional exploration and confirmation of the proposed theoretical model is needed. The following sections of this chapter will discuss why a mixed methods approach was chosen, the qualitative data collection and analysis procedures, and the quantitative data collection and analysis procedures.

Why a Mixed Methods Approach Was Chosen

Mixed methods research "combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection,

analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration" (Johnson, Onwuegbuzie, & Turner, 2007, p. 123) and can occur within in a single study or within a program of research across a set of related studies (Johnson et al., 2007). A mixed methods approach was chosen as the methodological framework for this project as it is a natural fit for the critical realist perspective offered by the theoretical framework of this study and provides an opportunity to explore and gain a more in-depth and comprehensive understanding of an unknown area of knowledge then either a qualitative or quantitative approach alone could provide.

This specific mixed-methods research strategy is a sequential exploratory mixed-methods strategy consisting of two phases: the first phase uses qualitative methods to begin to understand a previously unexplored phenomena, and the second phase uses the qualitative data to help develop a survey instrument where quantitative methods will be used collect and analyze data generalizable to the specified population. This type of research design is commonly used, and has proven effective, when developing and validating new survey instruments (Borkan, 2004; Creswell, 2009; Haidet et al., 2008; Milton, Watkins, Studdard, & Burch, 2003).

Qualitative Data Collection and Analysis

The first phase of the research strategy for this project utilized a qualitative methodology as it provided a "means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2009, p. 4). The qualitative portion of this project sought to elicit physicians' experiences and opinions

about using EHRs within the medical consultation and the effects those EHR's have on how physicians' provide patient care, to identify which features (technical objects) of the EHR influenced clinician use, and what actual uses and potentials for use were available between the physicians and the actual EHR being used. Thus the qualitative portion of the research conducted here effectively provides answers to RQ 1, RQ 2, and RQ3. Additionally, the data gathered provides baseline knowledge for the development of the survey instrument in the second phase of the project.

Research participants & sampling. The research population for this dissertation consisted of clinicians working in primary care practices. Primary care practices are defined as "the patient's first point of entry into the health care system and as the continuing focal point for all needed health care services" (American Academy of Family Physicians, 2012). Primary care practices provide patients with access a personal physician who provides preventative care and diagnosis and treatment of illness in a variety of settings (American Academy of Family Physicians, 2012). This specific population was chosen as primary care providers, (i.e. general and family practice, and non-specialty areas of internal medicine, obstetrics and gynecology, and pediatrics) provide the majority of health care in the United States, with 60% of all physician office visits in 2008 being provided by primary care generalist physicians (National Center for Health Statistics, 2011).

Purposive sampling was used to select the facilities, as well as recruit the physicians who participated in this study. This sampling method allowed for the selection of facilities and physicians who met specific criteria and would provide a broad

variety of responses to the phenomena of interest based on the various facility and clinician characteristics (Creswell, 2009; Lindlof & Taylor, 2010). Four different primary care facilities agreed to participate in the study. Each primary care facility served different patient populations in terms of size and characteristics and used different EHRs which allowed me to gather in-depth and nuanced information regarding the differences of features comprising the EHRs; the influence of external factors, such as training, organizational culture, and patient issues which influenced clinician use of EHRs. The specific facilities that were chosen by the researcher were determined by the ability of the researcher to gain access to these facilities through colleagues and my advisor, as well as ensuring that different EHRs were used at the different facilities. The following is a description of the four different primary care facilities.

Facility A is a non-profit free clinic that serves a low-income population in a rural area of central Texas. Patients who frequent this clinic do not have health insurance and do not qualify for government programs such as Medicare, Medicaid, or County Indigent funds. This facility serves approximately 5,000 patients a year using a small paid staff, volunteer medical professionals, and community partners. The primary clinical staff includes: a physician, a pharmacist, a nurse practitioner, and a nurse.

Facility B is a university health center that provides medical care and health education to a large undergraduate and graduate student population at a state university in Texas. Fourteen physicians and two nurse practitioners, as well as a number of nurses provide the clinical care at facility B.

Facility C is a multi-specialty multi-site facility, including primary care, which has approximately 110 providers and is located in a rural area of central Texas. It is a part of a non-profit collaborative health care system that is comprised of 12 hospitals and 60 clinics, provides health care plans to over 229,000 members, and serves patients in a 29,000 square mile service area.

Facility D is a primary health care facility, with over 6oo providers, which provides care for more than 130,000 veterans in southeast Texas and is a part of a national health care system that provides care to U.S. military veterans.

For each of the facilities a point of contact was made with an individual associated with the facility that I knew or my advisor knew. In facilities A, B, and C, the contact recruited physicians based on varying characteristics, such as years in practice (in total and at the particular facility the were currently working), EHR experience in total and with the current EHR, as well as availability. The contact then scheduled days and times that were convenient for the physicians. In facility D, the contact sent an email to colleagues meeting the sample criteria and the individual physicians contacted me to set up times for interviews if they were interested. I conducted a total of twenty interviews, with the majority of them being primary care physicians, with the exception of one ear, nose, and throat physician (ENT) and one physical therapist. A total of thirteen physicians were interviewed: one at facility A, three at facility B, seven at facility C, and three at facility D. Twelve of the thirteen physicians were primary care providers: ten family practitioners, two obstetric/gynecologists (OB/GYN), and one internist. The one physician who was not a primary care provider specialized in

otolaryngology (ear, nose, and throat). A total of five nurse practitioners (NPs) were interviewed: one family practice NP at facility A, two OB/GYN NPs at facility B, and two OB/GYN NPs at facility C. Additionally, one OB/GYN nurse and one physical therapist were interviewed, both at facility C.

Interviews. Semi-structured one-on-one interviews were used as the method of data collection for the qualitative portion of this study. This type of interview provides the researcher with flexibility to adapt questioning and conversationally probe the respondent for further insight that may be integral to the understanding of the phenomena of interest (Creswell, 2007). This method of interviewing also allows for the emergence and gathering of data that the researcher had not anticipated at the onset of the study, (Lindlof & Taylor, 2010), thus providing the researcher an opportunity to gain a more thorough understanding of the phenomenon through the emergence of relevant themes common across responses.

Each interview ranged in time from twenty minutes to one hour, with the average interview lasting approximately thirty minutes. A total of 20 interviews were conducted. All of the interviews at facilities A, B, and C (n=17) were conducted face-to-face in the clinician's private office at their health care facility. The interviews from facility D (n=3) were conducted over the phone with the clinician located in their private office and the researcher located in her private office. All of the physicians reviewed and signed the required consent forms, which were approved by the Institutional Review Board at Texas A&M University (Appendix A), and were assured of confidentiality

prior to the beginning of the interviews. The interviews were audio recorded and subsequently transcribed.

During the interviews, the researcher used an interview guide (Appendix B) that was developed to guide the interview process through a variety of topics which covered: 1) the clinician's philosophy of patient care, 2) their views about/experiences with computers and technology in their personal lives, 3) their experiences using EHRs, 4) the technical features of the EHR that allowed for or inhibited their use of the EHR, 5) the training and skill enhancement they received or would have liked to receive prior to beginning use of the EHR, as well as continued training, and 6) their beliefs regarding the role of EHRs in patient care and health care organizations.

Additionally, during the interview process, the researcher encouraged the physicians to describe in detail how they used EHRs during a typical medical consultation and then would further probe the clinician on how, why, or what was influencing their actions during the medical consultation. This probing was done to help facilitate a deeper understanding of what is influencing clinician use of EHRs and to discover phenomena which may have not been originally considered. Throughout the process of interviewing physicians, the researcher took note of potential ideas and concepts as they emerged, thus allowing for the continued adaptation and refinement of the interview process and deeper probing of topics.

Qualitative data analysis. All of the interviews were digitally audio recorded and subsequently professionally transcribed to provide a text for the researcher to analyze. Once the interview data had been transcribed, the researcher reviewed the transcripts and

audio recordings to ensure that complete and accurate transcripts were used as the basis of analysis. A thematic analysis was then conducted using a six-step recursive analytical process to identify and describe recurrent patterns or themes in the data. These six steps include: familiarizing yourself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report (Braun & Clarke, 2006). The researcher began the analysis by open-coding each interview transcript. After each transcript was initially coded, codes were compared across interviews to refine and consolidate codes. To enhance the reliability of the coding process, the researcher and another colleague both independently coded a sample of transcripts and compared results to further refine the coding scheme and establish intercoder consistency. Once the coding scheme had been refined, these codes were analyzed and collated into broader themes and the corresponding data was organized within the potential themes, along with exemplars of the themes that were seen in data. The initial themes, corresponding data, and exemplars were then reviewed to determine if they were representative of the entire data set. Once the themes were found to be representative of the entire data set the researcher named and defined each theme, selected exemplars from the data, and related the themes and exemplars back to the research questions and previous literature.

Quantitative Data Collection and Analysis

The second phase of the research utilized a quantitative methodology to identify dimensions that influence the actualization of EHR-physician affordances; develop survey items for these dimensions; identify and modify existing individual skill and

characteristic scales and integrate them into one survey instrument; and pilot-test the survey instrument. The purpose of this phase of the project is to develop and conduct a preliminary validation of a survey instrument that predicts patterns of EHR use based on the EHR features that are available to the physicians and individual user characteristics that influence how the EHR is used during the clinical encounter, thus answering RQ4. A cross-sectional survey design was used to assess respondents at one specific point in time (Frey, Botan, & Kreps, 2000).

Survey development. The development of this survey instrument started with the systematic identification of dimensions that influence the individual physician actualization of affordances within the realm of the EHR-physician-exam room context. This systematic identification of dimensions was conducted by: 1) reviewing existing literature on EHR implementation and integration focusing specifically on issues that led to successful and unsuccessful outcomes and 2) analyzing data gathered from twenty qualitative interviews with family medicine physicians previously discussed in the qualitative section of this chapter.

A literature review was conducted using targeted searches of three applicable databases as well as by the identification of additional articles through the review of reference lists of the articles found in the targeted searches. The analysis of the articles led to the identification of key factors that influenced physician use of EHRs within the context of the clinical encounter. Additionally, the emergent themes from the qualitative interviews with clinicians were integrated into the process of dimension identification

and through the analysis and integration of both of these data sources the influential dimensions of EHR use within the context of the clinical encounter were identified. Once the dimensions were identified, the process of item development for each of the dimensions was initiated. This process used multiple cycles of item creation, review, and editing, which occurred between myself, and an expert panel consisting of two physicians, two researchers, and a patient. All scale items measuring physician perceptions of EHR use were worded as statements and used a six-point Likert response scale (Likert, 1932) that ranged from 'strongly disagree' to 'strongly agree' (Table 2). A factor analysis of these items will be conducted in order to create composite scales of the outcome variables.

Additionally, the researcher created a predictor variable called EHR Use, which was developed to provide ordinal level data on the amount of EHR Use in the exam room. The question asked how often the physician used each of the following aspects of the EHR on a daily basis (Table 3). For each item the respondent received a score ranging from 6 "for every visit" to a score of 1 for "N/A" (N/A refers to the feature never being used during the consultation) and then all items were added together to form a composite variable, which indicated the total amount of daily EHR use with a minimum score of 10 and a maximum score of 60.

Table 2

Questionnaire Items Measuring Physician Perceptions of EHR Use During the Clinical Encounter - Researcher Developed

Questionnaire Item
Putting patient information in the EHR during the patient visit reduces the amount of information I have to remember about the patient.
Using the EHR during the patient visit helps me reduce potential mistakes.
Using the EHR during the patient visit distracts me from providing thorough medical care.
Using the EHR during the patient visit, helps me gather all the patient information I needed.
During the patient visit I spend a majority of the time at the computer using the EHR to review, elicit, and document problem-oriented information regarding the patient's medical condition.
Using the EHR in the exam room allows me to access the most current orders and lab results in real-time.
It is difficult to use the EHR during the patient visit.
Reviewing the patient's medical history in the EHR during the medical encounter slows me down.
During the patient visit, the EHR helps me to actively involve the patient in their health care
During the patient visit, the EHR helps me to educate my patients about their medical conditions and treatment plan.
During the patient visit, I spend a majority of my time away from the computer looking at the patient rather than looking at the computer.
During the patient visit I alternate my attention between looking at the patient and looking at the computer.
Using the EHR during the patient visit limits the amount of eye contact I maintain with my patients.
Using the EHR during the patient visit helps me to engage in shared decision-making with my patients.
The EHR interface is easy to use (i.e. user friendly).
Documenting the patient visit in the EHR during the medical encounter is difficult if the patient has complex medical issues.
Using the EHR during the patient visit enhances my communication with the patient.
Using the EHR during the patient visit interferes with my ability to listen to the patient.
Using the EHR during the patient visit enhances the physician-patient relationship.
Note. These items will undergo factor analysis and become the outcome variables for the quantitative analysis.

Table 3
Daily EHR Use Questionnaire Items – Predictor Variable – Researcher Developed

	For every visit	Most visits	Half of my visits	A few visits	Not on a daily basis	N/A
Review patient information	☐	☐	☐	☐	☐	☐
Record patient information	☐	☐	☐	☐	☐	☐
Write prescriptions	☐	☐	☐	☐	☐	☐
Provide patient education	☐	☐	☐	☐	☐	☐
Order labs and tests	☐	☐	☐	☐	☐	☐
Review labs and tests	☐	☐	☐	☐	☐	☐
View potential drug interactions	☐	☐	☐	☐	☐	☐
Create a care plan	☐	☐	☐	☐	☐	☐
Set up referrals	☐	☐	☐	☐	☐	☐
Review suggested health maintenance screenings	☐	☐	☐	☐	☐	☐

Once the initial pool of items was finalized, existing validated scales measuring user characteristics and skills thought to influence EHR use were integrated into the survey instrument. Two of the previously validated scales were adapted from an article that looked at individual preferences in task performance using different technology systems, these scales were Perceived Task Tension (renamed EHR Anxiety in this study, Table 4) and Perceived Task Self-Efficacy (renamed EHR Skill, Table 5) (Sun, 2012). These scales were selected to assess physician perceptions of EHR use during patient

visits. Responses were recorded using a six-point Likert response scale (Likert, 1932) that ranged from 'strongly disagree' to 'strongly agree'.

Table 4 *EHR Anxiety Scale – Predictor Variable*
I feel very tense while using the EHR in front of patients.
I feel pressured while using the EHR during a patient visit.
I am anxious while using the EHR in front of patients.
I am very relaxed while using the EHR during a patient visit.
Note. Adapted from Perceived Task Tension Scale - Sun, 2012

Table 5 *EHR Skill - Predictor Variable*
I think I am pretty good at using the EHR.
After having used the EHR for a while, I felt pretty competent.
I am pretty skilled at using the EHR.
I am not very proficient in using the EHR.
Note. Adapted from Perceived Task Self-Efficacy – Sun, 2012

The third scale (renamed Patient-Physician Interaction Style (PPIS)) is made up of the "Sharing" items from the Patient-Practitioner Orientation Scale (PPOS) (Table 6) (Krupat, Putnam, & Yeager, 1996) used to measure physician opinion about physician-patient interactions. Responses were recorded using a six-point Likert response scale (Likert, 1932) that ranged from 'strongly disagree' to 'strongly agree'.

Table 6 *Patient Physician Interaction Style – Predictor Variable*
The doctor is the one who should decide what is talked about during a visit.
Although health care is less personal these days, this is a small price to pay for medical advance.
The most important part of the standard medical visit is the physical examination
It is often best for patients if they do not have a full explanation of their medical condition.
Patients should rely on their doctors' knowledge and not try to find out about their conditions on their own.
When doctors ask a lot of questions about a patient's background, they are prying too much into personal matters.
If doctors are truly good at diagnosis and treatment, the way they relate to patients is not that important.
Many patients continue asking questions even though they are not learning anything new.
Patients should be treated as if they were partners with the doctor, equal in power and status.
Note. Sharing scale from PPOS – Krupat, Putnam, & Yeager, 1996

The survey instrument was then reviewed by the expert panel, along with the researcher, in order to eliminate and/or clarify redundant and unclear/confusing items. After this initial instrument was compiled, a convenience sample of 10 family medicine physicians reviewed the survey and offered feedback through the identification of problematic items and offered suggestions for improvement of item wording. Once all corrections had occurred the survey was finalized and then recreated as an online survey using SurveyMonkey.com and prepared for distribution.

Research participants & sampling. Following Institutional Review Board (IRB) approval, participants for this study were recruited from various facilities via a point of

contact known to the researcher or the researcher's advisor. Each point of contact emailed the survey url and a request for their participation in the study to those physicians employed by their health care facilities. The research participants in this study were recruited from facilities B, C, and D as described above, as well as an additional facility similar to facility D but located in California, and a university medical center in the midwest. The survey was open for three months to allow time for the participants to respond at a time that was convenient to them. Regardless of the broad reach that was executed to recruit as many participants as possible only 55 surveys were returned (n=55) and of those 49 of them were fully completed. In an effort to capture all possible data a pairwise deletion procedure was used. All 55 returned surveys were input for analysis with missing values coded (-9). This pairwise deletion accounts for different sample sizes reported for some correlations and regressions.

Due to the sampling strategy of having the url emailed by contacts within the health care facilities and not knowing how many people were contacted, an accurate response rate cannot be determined, however it appears just from the few surveys completed that the response rate was quite low. Of those that responded, approximately half of the participants surveyed reported being male and over 50 years of age, and approximately three quarters of the respondents reported being Caucasian. The majority of physicians reported being in practice for more than 15 years, having used EHRs in general for over six years, and using their current EHR system for more than three years. Half of the respondents specialized in general medicine/family practice (Table 7).

Table 7
Participant Demographics (n=55)

Gender	
Male	53%
Female	47%
Age	
> 60 years	10%
50-59 years	41%
40-49 years	27%
30-39 years	20%
< 30 years	2%
Ethnicity	
Caucasian	72%
Asian	16%
Other	12%
Years in Practice	
> 15 years	59%
5-15 years	28%
< 5 years	12%
Medical Speciality	
Family Practice/ General Medicine	50%
Ob/Gyn	12%
Other	38%
EHR Experience	
> 6 years	62%
3-6 years	25%
< 3 years	13%
Current EHR Experience	
> 3 years	67%
1-3 years	23%
< 1 year	10%
EHR System Used	
Next Gen	43%
CPRS	27%
EPIC	12%
Point & Click	10%
Other	8%

Quantitative data analysis. Upon completion of data collection, the data was downloaded in an Excel spreadsheet file format and was subsequently converted into a format that could be uploaded into SPSS. After the incomplete responses were removed from the data, I recoded the survey responses from text-based answers into a numerical format so that the data could be read by SPSS. The data was then uploaded to SPSS, where labels were assigned for each of the answer choices of each question and each type of question was designated as nominal, ordinal, or scale. Responses to negatively worded items were also reverse coded to allow for accurate interpretation of the data. Any missing items were coded as missing data (-9) in SPSS so that they would not impact the sample and subsequent statistical analysis. Once this was complete I ran frequency distributions and descriptive statistics on the data to screen the data for outliers, incorrectly coded data, and missing data (Mertler & Vannatta, 2005). No discrepancies were identified with this analysis.

Factor analysis, correlations, and multiple regressions were then run on the data to complete data analysis. The factor analysis was done in order to identify and construct composite scales from the researcher developed survey items in order to assess how physicians are using EHRs during the clinical encounter. These scales were used as outcome variables in the correlation and multiple regression analyses. Once these subscales were identified, correlations were run to determine if any relationships occurred between the physician user characteristics (demographics, daily EHR use, EHR Anxiety, and EHR Skill) and how they used the EHR during the clinical encounter (outcome variables determined by factor analysis). Finally, multiple regressions were

run to determine if the user characteristics (demographics, daily EHR use, EHR Anxiety, and EHR Skill) predicted how physicians would use the EHR during the clinical encounter (outcome variables determined by factor analysis). All findings are reported in the quantitative results section of this dissertation.

CHAPTER III

QUALITATIVE RESULTS

The following section provides the results of the qualitative analysis of interview data collected for the first study of this dissertation. The results in this section will be organized by research question and will answer RQ 1, RQ 2, and RQ 3 (stipulated below). I will address each of the research questions by providing a description of the emergent themes that were found and providing relevant examples from the data to illustrate the existence of those themes.

RQ 1: What EHR Features are Seen as Useful by Physicians During the Clinical Encounter?

When coding the transcripts to answer research question one I looked for instances where the clinician spoke about specific features of the EHR system that enabled or constrained their use of the technology and thus influenced their ability to perceive the potential uses provided by the EHR system. The EHR system includes not only the EHR software, but also the technological device that contains the EHR software (ie. desktop/laptop, computer, tablet, phone, etc.), as well as additional software and capabilities that the device provided such as Internet access and the ability to view lab results, medical databases, etc. In the four facilities where interviews were conducted, each facility used either desktop computers or laptop computers as their technological device.

The following themes were identified in the interview transcripts as being features of the EHR system that were used in the exam room: (1) templates/checklists;

(2) ordering and prescription writing; (3) real-time capabilities; (4) alerts and prompts; (5) data entry methods; (6) and additional resources. Each of these themes, will be described below, along with explanations of how they are used, and excerpts from the transcripts that serve as exemplars of the theme.

Templates and checklists. Templates and checklists are predetermined structures that are provided by the EHR software for physicians to document patient visits by recording patient information. They were a major component in the EHRs at all four facilities and were viewed as both enabling and constraining the physicians' ability to document the patient visit. The clinician's perceived ease of use and the capability of the template to fully document the visit, appeared to influence whether the physicians saw it as enabling or constraining. Perceived ease of use refers to how easy they believe it is to use the EHR to document the record information using templates and/or checklists, thus enabling or constraining their ability to document the patient visit. The ability to fully document the visit using a template was influenced by the following factors: 1) the flexibility of documentation options within the template, 2) the time it took for the clinician to enter the data in the template vs. other documentation methods such as dictation or typing in free-text boxes, and 3) the complexity of patient issues. Most clinicians viewed the templates and checklists as more constraining than enabling as seen in the examples below:

Enabling

Time

Template Example 1: The templates are nice in an aspect…so it's a reminder to ask. If they have a urinary tract infection, that's where your checklists come in. It

makes for less typing. It makes for a reminder of questions because you don't have to say, "They complained of xyz, abc." You can just, "They complained of the below," and you just have, "Yes, yes, no, no," whatever.

Constraining

Flexibility

Template Example 2: We can't personalize a note by filling out dots on a template….. it doesn't tell a story, which is what the patient came in to tell me. And so if I go back to compare two notes on patients with allergies or sinusitis, if I just fill out the template, there is no real good way I can tell the difference between those two patients. On the other hand, combining the templating with voice recognition software to record the details and tell the story, now we've documented probably better than we documented in the past and still tell the story.

Complexity of Patient Issues

Template Example 5: Sometimes there are things where it's hard to fit in to their little templates here, like the patient that came in with bipolar disorder and this horrible story and this weird part of her knee or ankle or you know, just sometimes they don't make sense. It takes a little more time to actually type in a story than it will be just to say it and have it transcribed.

Template Example 3: If you come in to me and you have a complex gynecologic problem, pelvic mass, it's going to be hard to template that. But if you come in for a routine annual exam or birth control, that can be templated easily.

Time, Flexibility, Complexity of Patient Issues

Template Example 4: I haven't really gotten as involved with templating as some of the people because it takes about two or three times longer to do a note than it is to dictate a note for me, because I'm a very fast dictator, and so I like to try it and I'm open to trying it and I do some of my notes but mostly on simple visits. If it's a more complicated visit that needs more explanation, I find that the template is harder to do and takes me probably at least twice as long, maybe longer than that.

Ordering and prescription writing. All of the facilities had EHRs that allowed physicians the capability to do order entry. Being able to order laboratory tests, radiology tests, immunizations, etc. and writing prescriptions electronically seemed to be

everyone's favorite aspect of using EHRs and were noted repeatedly in responses given. These two related tasks were the only tasks used within the EHR that no one commented negatively about and that physicians found easy to use and described as reducing workload instead of increasing it. Thus the following are all examples of the EHR enabling the physicians to perform these tasks more efficiently:

> Enabling
>
> Ordering Example 1: Well I think ordering is very easy…
>
> Ordering Example 2: I can order sets for kids, like I saw a 4-month-old today, so I just had to order the four-month checks. I didn't have to check off each particular one. So that was a pretty handy thing to do. So I like to order immunizations on there.
>
> Prescription Example 1:Well, by default, doing all the prescription here is done on the computer. You don't handwrite it unless you don't have access because the power is out or something, or if like, for example, you have to prescribe a medication that needs to be on a special prescription form like in triplicate for controlled substance.
>
> Prescription Example 2: I liked the fact that you can do electronic prescribing and it does a check on the interaction of the medications assuming the medication record is up to date.
>
> Prescription Example 3: So I will just highlight what medicine you're taking, how many I want to give you, accept it, and what pharmacy do you use, and I can send it for you. The patients really like that. They think it's really cool that I send it and it'll be ready for you when you get there and they don't have to carry a paper prescription.

Real-time capabilities. Real-time capabilities refer to the ability to access up to date patient information at any moment in time such as their history, test results, medication lists, previous visit notes, diagnoses, confirmation of task completion, message retrieval etc., rather than waiting for hard copies to be pulled/delivered or

electronic documentation that is stored as a static repository of information that doesn't allow immediate access or the ability to update the record in present time. If the EHR allowed physicians immediate access to the information they were looking for in an easy to access, find, and/or use format then the EHR was seen to be enabling the physicians perform their duties more easily; however, if it prevented clinicians from accessing, finding, or using desired information easily, it was seen as constraining the clinicians and making their duties more difficult.

Enabling

> Real-time Example 1: I like being able to look at x-rays and, again, answer my messages and get right to the chart without having to wait for somebody to bring me the paper chart.
>
> Real-time Example 2: Well, I think, like I said, I can pull up the previous test results, it's more organized, I can show the patient right then and there that their lab value for certain labs are going in a certain direction and here's what we need to do. I can show them their vitals. It's kept in a sequential fashion, so they can see what I'm talking about.

Constraining

> Real-time Example 3: ….the thing we want most in OB is a problem list. I must have done a dozen or more charts before I figured out that the EHR had a problem list, because it's buried in the middle of the page and they have a lot of things that are in bold and highlighted. Their problem list title is in regular print.
>
> Real-time Example 4: We have a potential for a very accurate, up-to-date medication list. We have the potential for a very active up-to-date problem list and history list on there, but as far as using it to efficiently and in a personalized fashion document the interaction with the patient, they're not there yet.

Alerts and prompts. Alerts and prompts are signals that are generated by the EHR system to catch the physicians attention or provide a reminder to gather specific information, order specific labs and tests, notify of potential drug interactions with other

drugs, diseases, and allergies, etc. based on the patient's health information and history. Physicians found that the alerts and prompts that they received allowed them to provide more efficient and better care, but acknowledged that alerts and prompts are sometimes annoying when it is a common drug-drug interaction they are aware of and that the EHR systems themselves are not quite where they could be technologically speaking to allow further personalization and removal of technological glitches that provide out of date alerts.

Enabling

> Alerts Example 1: There are some really slick things about the system as far as doing some things we've never been able to do such as drug-drug interactions, drug-allergy interactions, drug-disease interactions.
>
> Alerts Example 2: You can give yourself a message, like I want to recheck a Pap test in six months. I can't remember six months, but I know that somebody had an annual Pap test, but I can put in the computer and in six months it'll bring up a little reminder and says, "Recheck Janis' Pap test." And so that's a really nice feature…
>
> Alerts Example 3: Well, you know, certainly with a machine that comes up and, you know, tells me, "Oh, this is a drug interaction that you have to worry about," in that way it's a better check on me.

Constraining

> Alerts Example 4: It does flag like allergies. It does flag certain drug-to-drug interactions. For some reason, this system flags the medication that the patient is not currently taking anymore, so I'm not sure, you know, I think there's a bug somewhere that needs to be worked out.
>
> Alerts Example 5: Oh yeah, it's great. It comes up, you know, when they list what they are allergic to and what they're already taking in the record, and so if I go to write for something that they're allergic to or that will interact with something like birth control pills, for instance. A lot of the antibiotics interact. So, if I have to write for amoxicillin on someone who's on birth control pills, it annoyingly reminds me that this may decrease the effectiveness of the birth control pill. Now, you know, there's not a doctor on this earth that doesn't know

that amoxicillin interacts. But that's one where it's annoying to me, but in a lot of cases it's helpful.

Data entry methods. Entering patient information is one of the major ways that the EHR has changed how physicians work. Prior to entering the data into the medical record electronically themselves via a computer keyboard, physicians typically would take handwritten notes during the patient visit and then dictate their notes in their office via a phone system. Medical transcriptionists would then transcribe the clinician's notes and enter them into the patient's record, or physicians would hand write all of their notes in the patient's record. Entering the data themselves via a computer keyboard during the clinical encounter (and often times finishing up their notes after the patient visit back in their office) seems to be the one EHR feature that physicians often find constrains their ability to efficiently document the patient visit and interact with the patient simultaneously. While they enjoy many aspects of the EHR, most physicians complain about repetitive data entry, the increased time it takes to document the patient visit, and decreased interaction time with the patient. Consider the following examples:

Constraining

Data Example 1: I have to put it in at least two or three different places. The height and weight should auto-populate throughout the entire system if it's put in once, but it doesn't, and it requires that I put it in in pounds in one place and—no, it's in inches in one place and feet and inches in another place.

Data Example 2: It's taking more time away from the face-to-face, I'm spending time putting that stuff into the system or spending time completely after the visit going back and documenting, but I used to do that when I would dictate anyway to some degree. But if it's in the office visit, I'm trying to create their plan they can walk out and go with it, that's an improvement when they walk out the door, but at the expense of this taking some time away from us discussing or spending more time counseling. And it may be that something like a scribe or something like that down the road, sitting there, listening to all this, and they're typing faster

than I'll ever type, getting that stuff in the system, may be a better way to do this long-term.

Additional resources. Physicians often mentioned that they used, or would like to use, additional resources outside the EHR system to provide patient education, look up additional medical information, or to reduce repetitive data entry. These resources are available to the physicians in the exam room during a patient consultation as well as in their offices via a laptop they take with them to each location or desktop computers in each location depending on how each health care organization decided to integrate computers and EHRs into their facilities.

Enabling

Resources Example 1: "Up-to-date" is a resource on here, in fact I have it up right now because I go to it all the time. And it is a database where I can go in and I can put almost anything in there, and I can pull up patient information that it's a handout that I can hand the patient, and I use it all day long every day. It is a website that our organization pays for us to use.

Resources Example 2: I have a drug reference on my computer, so I use that software quite frequently, very, very frequently I have a cheat sheet that I've done from basic exams that I have put in multiple plans (for urinary tract infections, birth control pills, etc.). So, if this is what I'm going to see them for, I can copy and paste. So I don't type it in, because I found I was typing the same thing in. I have an STI guideline from CDC, which was done in 2010, and I used this this morning. It's all right there, so it makes it handy.

Constraining

Resources Example 3: One thing that would be nice for me, and we do have somebody from the library come over, but it would be nice to be able to go into the computer, and some of my colleagues can do this easily, and suppose I have unusual diagnoses and I want to know a little bit more about it, I have all these books, I can look things up, but if you could get into the computer quickly and get the quick five-minute consult on lupus to see if there's something unusual, that would be helpful just to get through your EMR somehow rather than be attached to the library or someplace where you could get into the more common

> up-to-date information xyz unusual disease. But for somebody like me, (currently) I can do it, but it's going to take me 30, 40 minutes.

RQ 2: What Affordances Manifest Between the EHR and Physicians During the Clinical Encounter?

As described in the literature review, affordances are the potential work that the technology has the capability to do. As such, when identifying the affordances in this study it is through looking at the actual use of the EHR that provides the basis for identifying the affordances that are available to the physicians. The affordances that were identified in this analysis are, theoretically, available to all physicians; however, affordance availability may be constrained by the EHR system itself, as the EHR system may not contain the features necessary to provide for the affordance between the physician and the EHR system, and/or user characteristics may not facilitate user awareness of the available affordances. The following affordances originally identified by Strong and colleagues (2014) were also identified in this data: Capturing and Archiving Digital Data About Patients, Accessing and Using Patient Information Anytime From Anywhere, Incorporating Rich Information into Clinical Decision Making, Standardizing Data, Processes, and Roles, and Monitoring Organizational Operations. Additionally, three new affordances were identified in the data: Organization and Structure of the Consultation, Clinician-Patient Relationship Management and Patient Education.

Capturing and archiving digital data about patients. Capturing and archiving digital data about patients was identified as an affordance that could allow physicians to enter, store, and update any information that is related to patient care providing a

dynamic repository of the most current information. This is one of the main affordances that occurs between the EHR and the physician and the actualization of this affordance often causes frustration for physicians. Below are several excerpts that illustrate the affordance of capturing and archiving digital data about patients:

> Capturing & Archiving Example 1: Um it's a balance. For me I usually do it after the particular conversation that way it is still fresh and if I am typing it and I am like oh wait a minute what did you say about this (I just had a thought?). I find that if I wait until afterwards I usually end up thinking of something new um or having a little question about what the patient meant about something

> Capturing & Archiving Example 2: The problem is it takes time to do the record. Even if the patient comes in with something very, very minor it only took you five minutes to deal with the patient, whatever it was, it's a minor thing, "Would you look at this mole?" "Okay," and it looks fine, it's nothing to worry about, it takes you five to 10 minutes to do the record on that.

Accessing and using patient information anytime from anywhere. This affordance allows the user to access and use the most current patient data regardless of location and time. It reduces the waiting time and access to current information as users don't have to wait for paper copies to be brought to them and the user has access to the most current information about the patient, even if it is from a different clinic or doctor within the same healthcare system. This affordance also provides the user with the ability to access patient data from the exam room, their office, the nurses station, a lap top or mobile device, etc, so they can access it whenever and wherever they need to. Below are two examples.

> Accessing & Using Example 1: That's very nice to not have to deal with big charts and how people have to run and go get the information for me when I need to do medicine refills or answer labs. I can just look it up. I like being able to do it at my house. I even take a laptop with me when I go on vacation so that I can keep up, and before I had that I would have to come back from vacation a day

> early and spend about three or four hours in the clinic the day before I started to catch up with everything.
>
> Accessing & Using Example 2: Well, I think it provides very accurate information and it provides an opportunity for me not to repeat labs and x-rays that have been somewhere else. So if I had a patient that was just in the hospital at Clinic C in Temple or saw one of my colleagues in Georgetown or whatever, I can see that they just had their electrolytes tested last week, so I might not order it again, or if I wanted to see the results of that CAT scan that they did in Urgent Care last week, I can get at it very quickly and I'm not tempted to say, "Let me just get a new so I can do that."

Incorporating rich information into clinical decision making. This affordance refers to the ability of the EHR to offer prompts and alerts to physicians about preventative care reminders, screenings and immunizations that are past due, and possible adverse interactions. The built in safety nets help to ensure that the clinician is providing the necessary care at that particular moment as well as ensuring that the treatment plan that is prescribed will not have any adverse interactions with a patient's current medications and health conditions or drug allergies. Physicians perceived this aspect of the EHR as useful in ensuring quality care even though the alerts and prompts can be bothersome at times. The following examples illustrate how physicians incorporate rich information into clinical decision making:

> Decision Making Example 1: Um it does have a lot of nice little security checking things, you know so if you have two patients with the same name and we use like the last four of the social, it will say hey there are two patients make sure this is really the one you want. It also has reminders built in so as you are seeing the patient, and this is what I mentioned before, sometimes that is nice and sometimes it gets in the way of you talking to the patient, but it will say hey this patient is due for a hemoglobin A1C, you know click here if you want to order it. Little things like that are nice.
>
> Decision Making Example 2: I can see if you're due for anything, especially if you're pediatrics, it'll show me in red what your past due for (i.e. immunizations)

> Decision Making Example 3: Oh yeah, this is a drug that you don't write for very often. Oh yeah, I forgot that this could have a reaction with that, so that's very helpful. I think it definitely is good as far as liability is concerned.
>
> Decision Making Example 4: So you hand me your drugs that you can pick from—I love the computer because what it does when in that instance, if I put in a drug and there is an interaction with that with something else that they're on, it'll pop it up, and I have to acknowledge it before I can even prescribe it.

Standardizing data, processes, and roles. The standardizing data, processes, and roles affordance that was identified by Strong and her colleagues, was partially found in the analysis of the interview data, with respect to the standardization of the data. The standardization of the processes and roles was not identified in this data and is likely due to the focus on the interaction during the medical consultation in this study in contrast to the broader organizational context that the affordance was originally identified in by Strong and colleagues. Below are a few examples of the use of templates to enter patient data into the EHR and how it can allow for the standardization of patient data but also inhibit the users ability to document the visit well:

> Standardizing Data Example 1: We use the templates. I use them all the time. You know, you can get by without using them, but the record's much better if you use a template. And you have to type everything else up, which takes a lot more time, if you don't use the templates.
>
> Standardizing Data Example 3: No, I have to do a lot of free text because some of our templates were poorly designed. We're constantly revising (them).

Monitoring organizational operations. This affordance allows the user to know "what has been done, by whom, and when," (Strong et al., 2014, p. 69). It allows the user to know what tasks have and have not been completed, who is supposed to be completing tasks, etc. This affordance allows users, both on the front lines with patients as well as managers and executives, the ability to know what is going on with patients, if

there are problems in getting work done where they occur, etc. Within the medical consultation the physicians report having this ability as a positive in that it can help them prevent tasks and patients from "falling through the cracks." The following examples illustrate the physician's ability to monitor organizational operations.

> Monitoring Example 1: I have to open their chart, review it, accept it, and then task my nurse with what we're going to do about it.
>
> Monitoring Example 2: I think from the positive standpoint, it has been really good for reviewing lab results and checking off on them and make sure that the results came to the doctor. We had absolutely nothing prior to that that would guarantee that a record result, a lab result, would not fall through the cracks.

Organization and structure of the consultation. The organization and structure of the consultation was an affordance that emerged from the analysis that was not previously identified by Strong and colleagues. The data revealed that while the EHR did not change their job duties or the outcome of the patient visit, it did influence how they organized and structured the consultation. The prompts and templates of the EHR provided a structure for the consultations that influenced how they conversed with the patient and in which order they would ask questions and/or enter data. These features often reduced the amount of flexibility the physicians had to control the flow of the conversation, if they were going to enter data into the EHR during the consultation using the templates and following the prompts. The following examples illustrate the influence EHR features had on how physicians organized and structured the consultation:

> Org & Strx Example 1: So, you go from topic to topic, area to area. You can sort of jump around a little bit, but it's kind of forces you still in a linear fashion. When I talk to a patient sometimes, they may go off on a tangent somewhere that sometimes is totally irrelevant and I have to steer them back to the main topic. But sometimes they may say something that kind of says, "Hey, you know, this is something I need to follow up on because that could be important." So, on a

paper system, I can just jot a note on the side for myself that I need to ask that later this visit or maybe that's something I need to keep in the back of my mind into how it fits into this whole person's health.

Org & Strx Example 2: My urinary tract ones, when I bring them in and do what I told I do, the order that I do things in, my chart's three-fourths done before the patient ever leaves. But is my annual (exam) three-fourths done? No.

Org & Strx Example 3: Well I think the increasing role of EHRs sort of adds a little bit of a buffer so that you actually communicate less but I don't think that the roles change that much, I think you still kind of provide them the same guidance uh the same sort of advice um I do think the provider is becoming more of a liaison between the little pop-ups on the computer that say you know you have to ask the patient about this. Obviously in the paper world you didn't really have that much you may have had a form that said ask the patient about this and ask you patient about this, but I think with EMRs I think and maybe for better or maybe for worse um your sort of doing a lot of relaying between what the computer is asking you know to put the data in and you actually communicating this with the patient

Org & Strx Example 4: "Well, I see you have a cold," I look it up and I go through, there's a list of questions, there are 12 questions for colds. Do you have a runny nose? Do you have a sore throat? ……. So, I check out all those, and then if they say something else, "Oh, but by the way, I had xyz happen last week," I may type that in. So then I do your exam. Generally, I will put most of that in the computer right then so I don't forget that I looked at their ears and I was checking their belly and there isn't any problem. …. then I'll put the tentative diagnosis. And then, when they get back up from the lab, if they have mono I'll put infectious mononucleosis as our diagnosis, or if they have strep throat, I'll put strep throat as their diagnosis, or if it didn't show one of those, I'll just put pharyngitis and leave it at that. If I'm really busy, I may leave the charge and the rest of that off because I may want to go back and type in something later.

Clinician-patient relationship management. Of major concern for physicians when using an EHR is the influence it has on the physician-patient relationship. This clinician-patient relationship management affordance refers to ability of users to perform relational formation and maintenance behaviors in the clinical relationship with patients.

The following are examples of how this affordance was actualized by various physicians.

Negative Relational Impact

Rel Mgmt Example 1: It does create a barrier between me and the patient. You have a machine sitting between you and the patient. So, I think it interferes with some of the communication skills that you have. There's a lot to be said from the inflection of somebody's voice and the look on their face when they're telling you whatever it is, and so when you have this machine in front of you, you're not maybe quite as attuned to those differences.

As far as taking care of the patient, it does interfere with the communication, I think, a little bit. Now, I really thought the young patients that I deal with now are so used to using a computer, they use it all the time, that they would be more accepting perhaps than, say, an older patient when you're using the computer. I don't know that that's necessarily true. Like I say, there are innuendos of things that you might miss, and I don't have as much eye contact with them as I did before. So, with the computer, you're typing away and you have to look at what you're doing, so you lose some of the eye contact, because otherwise the patient's just sitting there while you're typing and they feel kind of like, "What am I doing here?"

Rel Mgmt Example 2: I think it takes away from the patient-provider interaction that I think is so important. Especially with our patient population, we have a lot of patients with depression and anxiety issues umm you know you really need that time with them to build a rapport and let them know you are really listening to them and I feel like having the screen in front of us … I mean usually what I do is I set this (referring to the laptop) on the table and the patient is sitting in front of me out here so there's no barriers in between us … So um I don't know like, my dad was asking me last night do you think if you had a microphone or you know like a recorder, and I was like well that would still be very distracting if I was trying to record stuff while you know … but I don't know I think there's still options out there its just ….. there's good things about every system and bad things about every system.

Positive Relational Impact

Rel Mgmt Example 3: We were all fearful that when you took paper away and you put a computer screen, doctors would be doing this – not looking, contacting, communicating, interacting with the patient. Actually, the electronic record, unlike the paper record, is an attracting point, you know, where they can both come together.

> Rel Mgmt Example 4: I think it is. I think its gone um … well for one thing I think communication, uh direct patient to provider communication is sort of decreasing. I think EHRs are great in many aspects but I think the fact that we use them, we pay a lot more attention to them then when we just used sheets of paper. You know the sheet of paper isn't going to take all of your attention.
>
> I think personally I have taken a more active role in trying to spend more time with the patient. Hopefully it will kind of balance out and I will be where I was before we had EHRs um so pretty much I think there is a natural trend to pay more attention to the computer, but I think if you know that's the trend or a tendency you can make an active effort to sort of pull yourself away from it. I think patients appreciate that too, you get a totally different conversation in response when you are sitting there looking at them, listening, collecting the story in your head and then afterwards putting it in the computer as opposed to trying to type it as they talk.
>
> Um it's a balance. For me I usually do it after the particular conversation that way it is still fresh and if I am typing it and I am like oh wait a minute what did you say about this (I just had a thought?). I find that if I wait until afterwards I usually end up thinking of something new um or having a little question about what the patient meant about something

Patient education. The physicians also indicated that the EHR provided ways for them to educate and interact with the patient in a way in which they were previously unable to do. While a number of physicians indicated that they used various aspects of the EHR and some additional resources made available to them on the computer to provide patient education, not all physicians used the patient education resources available even when they were aware of them. As indicated in one of the examples below, the clinician was aware that the resources were there but had not integrated that aspect of the EHR into their workflow during the medical consultations.

> Pt Ed Example 1: "Up-to-date" is a resource on here, in fact I have it up right now because I go to it all the time. And it is a database where I can go in and I can put almost anything in there, and I can pull up patient information that it's a handout that I can hand the patient, and I use it all day long every day. It is a website that our organization pays for us to use.

> Pt Ed Example 2: And again, I frequently turn—birth control interacts with a lot of things, so I frequently turn the screen and show them what it says and tell them what I recommend.
>
> Pt Ed Example 3: There's a lot of patient education stuff on here, and I just have not incorporated that into my habits yet.
>
> Pt Ed Example 4: And they enjoy seeing their x-rays. And I can take a lab value and show them what has occurred over time, and we can look at their blood sugar from 2002 and see this is what's happened, and I think they appreciate that, being able to see it in a graphical fashion and seeing the trends over time.

RQ3: What Factors Impact Affordance Actualization?

Three broad themes emerged that appeared to impact affordance actualization during the clinical encounter and thus answer research question three: physician cognition, EHR functionality, and EHR training. In the following sections I will elaborate on each of the above themes and provide exemplars taken from the interviews I conducted. These themes will later provide several of the variables used in the construction of the quantitative instrument used in the second part of this study.

Physician cognition. There were three factors that appear to influence if a physician would use the EHR during the clinical encounter and if so how they would use it. These three factors were identified as physician task orientation, cognitive load, and feature awareness. Each of these factors seemed to indicate that physicians saw the EHR as another "entity" in the room that either allowed them to do their work more efficiently and/or accurately or as a source of distraction that interfered with their ability to provide quality patient care. Each of these factors and examples from the interview data are described below.

Physician task orientation. One of the most striking themes that emerged from the data was physician task orientation, which is defined as the tension between the importance placed on patient interaction verses the importance of documenting the visit in the EHR during the clinical encounter. For example, physicians often commented that interaction with the patient was very important to them during the clinical encounter often citing this as a reason why they continued documenting visits on paper and then entered their notes electronically at a later time immediately following the patient visit, at the end of morning/afternoon, or at home. Consider the following statements by two respondents:

> PTO Example 1: I usually just use it to um verify their medication, their allergies, and date of birth. And then um I put in their social history, so their smoking, drinking, drugs and then for women mammograms and pap smears. After that I use my handy dandy clipboard, and I do my notes in the computer later on because … it does take away from your patient interaction. So I can write and talk at the same time, like make eye contact, but I can't do that (and type). I mean I can type but I just feel like there is a big screen in front of me. Yeah, well I can keep it down here and just jot down things down (referring to the clipboard) um so I try not to type when I'm in the room with the patient. I do it later. So that doesn't make things as efficient

> PTO Example 2: I will never say never, but the number of notes I have taken in the exam room probably would not be more than one every six months, so yeah, I just remember what's said. I'm not going to use it in the exam room. I think that other than writing the prescription, there's just something wrong with having your back turned to the patient while you're typing in the machine. I don't think that's going to happen. But then, even when we had paper charts, I wasn't one to take many notes in the exam room.

Other clinicians indicated that while interacting with the patient was also very important to them, being able to document the visit using the EHR in the exam room provided them an opportunity to ensure that they did not forget any information and had produced a patient record which was accurate, up to date, and correct before the patient

left the clinical encounter. Further, in some instances physicians reported using the EHR to provide documentation and educational materials for the patient at the conclusion of the visit. In order to accommodate their use of the EHR during the visit, while trying to maximize their interaction with the patient, clinicians often described switching back and forth between talking with the patient and documenting the visit in the EHR. Physicians further reported that they would inform the patient that they were going to use the EHR at various points throughout the visit to view patient information, labs, document, etc., They also reported including the EHR in their discussion with the patient to educate and involve the patients in their care by showing them labs, x-rays, and changes in weight and blood pressure, as well as illustrations and images to show and explain their medical issues, etc. Most physicians who documented more in the exam room noted that while they believed it did negatively affect the amount of interaction time that they had with patients, they felt that it did not negatively impact the care they provided to their patients. These physicians reported that most of their patients really liked that the clinician was using the EHR and enjoyed having all of their information in one place. Other physicians commented that using the EHR in the exam room actually allowed them more time to spend with the patient. The following two accounts illustrate these perspectives:

> PTO Example 3: Yeah uh well because it has been pointed out by many people in papers, you know how physicians don't pay attention to the patients as much anymore, I think personally I have taken a more active role in trying to spend more time with the patient. Hopefully it will kind of balance out and I will be where I was before we had EHRs um so pretty much I think there is a natural trend to pay more attention to the computer, but I think if you know that's the trend or a tendency you can make an active effort to sort of pull yourself away from it. I think patients appreciate that too, you get a totally different

> conversation in response when you are sitting there looking at them, listening, collecting the story in your head and then afterwards putting it in the computer as opposed to trying to type it as they talk. Um it's a balance. For me I usually do it after the particular conversation that way it is still fresh and if I am typing it and I am like oh wait a minute what did you say about this (I just had a thought?). I find that if I wait until afterwards I usually end up thinking of something new um or having a little question about what the patient meant about something.
>
> PTO Example 4: Patients seem to like it and accept it, and I can show them things on there or quickly get information, so I think, especially younger ones, but most people with me have learned to expect it, unless it's those times where they're crying and telling you these sad stories about their life where you don't want to be typing as they say that. But for the most part when they're just telling you little symptoms, I think you can kind of quickly get a lot of the note done just talking to them. And I think they get more time with me because instead of me having to finish the thing and then dictating and do this and that, I can spend more time with them because as I'm kind of completing my note, I can let them talk about what's going on or ask them about their life and stuff, so I think it actually makes the visit a little bit better.

Cognitive load. Cognitive load (CL) was identified as another main factor impacting EHR use in the clinical encounter. Physicians reported varying accounts of how patient data was recorded including using the EHR, using paper, or using nothing at all to record patient data during the clinical encounter. The method chosen was partially influenced by what the physicians perceived to reduce or better manage their cognitive burden and accommodate their preferred style of care. Physicians who reported that they entered patient information into the EHR during the clinical encounter while the patient was present seemed to do so to ensure that all of the information regarding the visit that they wanted in the patient's record was entered into the patient's record and that they did not forget anything. Thus, the EHR was perceived by these respondents as allowing the physician to reduce their cognitive load by allowing them to thoroughly document the visit and not having to remember everything about every visit throughout

the day in order to enter it at a later time and as a result providing a more thorough and accurate patient record. Consider the following accounts:

> CL Example 1: Well, of course, as I've gotten older, I can't remember all the normal things. I mean, I can remember, yes, oh, my goodness, they had something terrifically bad …., but I can't remember, what did they say, their mom had breast cancer or not, ….. So, it's good to put that all down right then especially with the normal findings because I can remember the things that are really obviously abnormal, but the things that are normal sometimes I might forget. So, anyway, it helps to get all that information down right away so you don't forget it.

> CL Example 2: In the exam room, I definitely think getting your note going (is good) …. It's nice to be able to, you know (finish)the patient note while I was talking with you, while I started it in there, and I just had to do a couple of pieces to finish it here, whereas dictation you're stuck doing one whole thing at one time, so if you don't have a free two, three minutes, whatever, you don't have time to do it. It helps with remembering……I forget if I leave the room… So, I think for me…getting me out of here on time is good (and) taking care of them because I don't dictate three days later and forget exactly what they said and so my note's not accurate anymore… is good.

Other physicians reported that they did not use the EHR during the consultation because it was a distraction and made it more difficult to provide patient care in a patient-centered and timely manner, as they were spending too much time trying to figure out how to use the EHR. This subgroup also included a few physicians who reported that they did not record patient information, in the EHR or sometimes even on paper, during the medical consultation as they were able to remember the information they wanted to include in the patient's record, preferred to do it after the visit was over, or believed it was a distraction and diminished the care they provided to the patient. In these cases, physicians reported that using the EHR added another element of cognitive processing that was not congruent with their style of patient care or interfered with their ability to provide quality care for their patients.

CL Example 3: But when you're there you talk to the patient. I still think it's more accurate…When your attention isn't divided, you're going to be less likely to make mistakes.

CL Example 4: I do it later. Because it's hard to go back and forth and it's a little frustrating, and I don't want to do that in front of a patient.

CL Example 5: I don't want anything that becomes very cumbersome, takes a lot of time.

CL Example 6: So we need to be taking care of the patient care and have somebody in there doing that (being a scribe). That that's the biggest interference, if we have to input data, which is a huge thing, and the fact that I can't really look at my patient and look at the medical record at the same time, umm umm it's frustrating, um whereas if we had somebody with a notebook (laptop) in there with us, a scribe, then I could spend my time with the patient and they could be inputting data in real-time and at the end of the visit I could look over it and make sure everything is okay, click it, be done with it, the note would be finished and I think that gives the best opportunity to accumulate the data in an accurate fashion and timely fashion.

CL Example 7: I think EHRs are great in many aspects but I think the fact that we use them, we may a lot more attention to them then when we just used sheets of paper. You know the sheet of paper isn't going to take all of your attention. Also I think that EHRs are at the moment kind of complex, its not necessarily easy to find what you are looking for right away, um I can't say paper was too much better but I think you kinda gave up quicker. You sorta talked to the patient more and got the information sort of fresh.

Feature awareness. A physician's ability to perceive affordances and EHR features served as a facilitator or barrier to the physician depending if physicians were aware of those capabilities, and how intuitive and easy the system was to use. The more capabilities the system had (or was perceived to have), and the more intuitive it was, the more the clinicians reported using the system. While this may seem like common sense, responses indicate that some of the EHR systems seem to not be designed in ways that would encourage use with the majority of physicians interviewed indicating that current

levels of EHR functionality limit the amount that the physician would like to be able to do with the EHR system. Consider the differences in the accounts below as physicians presented two differing accounts of using the same EHR, one in which the physician is aware of a certain functionality, and another where the clinician is not aware of the functionality.

Aware

> Awareness Example 1: We have references in here. These are the prices of birth control that are in here. Over-the-counter price list – this is from the pharmacy. So, if you wanted them to go down and get on vitamin C, they could a hundred count of vitamin C for about $3. This is all on the health record. These are references that you can get, too. There's our procedure list, pricing as to what it is. Handouts are on here. It comes to a different aspect.

Unaware

> Awareness Example 2: But I do like to be able to tell them what something will cost because they'll ask me, "Well, what's the difference in the price between this…" Because I'll give them their treatment options. What's the different in the price? Well, sometimes I know, on things that I do all the time, but sometimes I don't know and I have to call down there to find out how much it would cost there. Then they'll say, "Oh well, it's a generic. I can go get it from my insurance for x amount." So they choose to go elsewhere because they know what the price is, but there's no way I can look it up. And the comment when we ask for that is always, "Well, the prices are always changing," and I've said, "Well, give me a ballpark." So that's a drawback. I mean, that's a hindrance to care because, now a lot of people would just tell the student, I'm serious, would just tell the student, "Go down the pharmacy and ask them," but I don't. I try to help.

EHR functionality. EHR functionality also appears to be an important factor in determining EHR use. EHR functionality, refers not to the EHR features themselves, as identified in research question one, but as attributes of the EHR as a whole that influence a user's ability to actualize the available affordances provided by EHR. These functionalities often become evident when physicians go to perform a task and the EHR

easily allows them to be able to perform the task, such as ordering a prescription, or prevents them from being able to perform the task efficiently or effectively. A number of physicians reported use of more than one EHR during their career and as a result were able to talk about the pros and cons of the various systems. The responses of the physicians indicated that these functionalities were very important in determining whether the EHR was used, during which part(s) of the clinical encounter it was used, and the extent that it was used. These functionalities served as a facilitator or barrier to the physician depending on whether or not the system they used had the desired capabilities and how intuitive and easy the system was to use. The EHR functionalities that were identified include: customizability, ease of use, and display of information. Consider the following examples:

> Customizability
>
> Fxn Example 1: For example, in this system…like the prescriptions, everything has to be tied to a days supply inventory. Well we don't use inventory here so the whole days supply thing doesn't work for us, but that's what it all has to be tied to. And if we could figure out a way, if we had the proprietary information so that we could unhook it from the day supply and harness it to the infrastructure needs that we need so that it all flows, that would be helpful but you know that just doesn't happen because it doesn't have a fluid infrastructure for these things.
>
> Ease of Use
>
> Fxn Example 2: Sometimes a template is incorrect, like for example, someone could say they have a sore throat when they call and they make an appointment. So, we set things up for a sore throat, but the main complaint when I talk to them is not a sore throat but it's something else. So the template for a sore throat may not be appropriate. So I have to switch gears, and then on a piece of paper I just scribble something else. There may not be a template for whatever is going on. There is a general form, but again, the general form is not going to be encompassing every possible thing. Yeah. So, after I finish, sometimes I would go back and find a template that closely matched what I think was going on or I know of one already. I'm still learning the system.

Fxn Example 3: Or maybe they have a cold but they're really here for the depression and they didn't want to mention that, but halfway through the interview they say, "Well, you know, I've been really depressed lately," or, "I'm not sleeping as well as I think I should," and I'm like, "What does this have to do with your cold?" And you're kind of backing up and having to refocus on something different than what you originally thought they were here for, and of course that takes more time, and then you have to go through and try to find the right problem for the patient and figure that out. And of course, then, sometimes they also have three or four different things, "Oh, by the way, would you look at this mole," which is not what they were here for either, so you go back in another template and find the mole template, and you look at that and go through all of that. So, it's sometimes a little bit awkward especially if you get started on the wrong thing.

Fxn Example 4: Um well the labs. On here (showing me the EHR) just an example, to get to the labs you have to go out of the screen that your in with the patient's visit for today and go to documents and scroll all the way down until you get to labs. So in order for me not to have to do that I have access to the labs website so I can go and get the labs from their website. If I didn't have that it would probably take me hours to find the labs and stuff. In the past, other places I've been, I haven't had to do that, it's been right there. It would actually send alerts to you on your computer and highlight it if it there was an abnormal … let's say hemoglobin or platelet counts or something like that. They were able to send tasks to the nurses and to the doctors if there was a lab that needed to be reviewed online, it would be sent you automatically. As long as the computer system was up it was great. Um but we just don't have that capability here.

<u>Display of Information</u>

Fxn Example 5: It was paper charts, and they were hard to read. This at least is legible. One of the biggest things is that if a clinician sends you a patient and you want to know what they've done, you can read what they've done. So that is one of the biggest perks over paper.

Fxn Example 6: The pages are really busy. When I first started working with it, I wanted it. I was looking forward to it. I opened them up and I was like, "Oh my gosh." There were so many lines, there was so much information on there, and then the thing we want most in OB is a problem list. I must have done a dozen or more charts before I figured out that it had a problem list, because it's buried in the middle of the page and they have a lot of things that are in bold and highlighted. Their problem list title is in regular print. And it's like, that's just about the most important thing. Now, when you print it, it prints at the top of the page, which is great…but you can't find it on the computer. Then as you go

> through all those different tabs, the due date's not there. You're like when I pull up the thing to enter in what we call the flow sheet where you keep track of what happens each month, the due date is not there at the top of the page. I wish the due date was put in more different tabs.
>
> Fxn Example 9: I think the way that it displays information, other than the labs, is pretty good, it's just that there is so much information it kind of bogs you down.

EHR training. The final factor that appears to impact affordance acualization is the type and amount of training physicians received. Surprisingly most accounts describe organizations spending very little time with training. Those organizations who did have a more extensive amount of time set aside for training indicated that the types of training used and whether the EHR system used during the training was at full capacity influenced their ability to learn how to use the system effectively. While the effective use of the system depends on more than just training, for example the ability of the provider to match their physician task orientation with the capabilities and functionality of the EHR system, the lack of training that was evident in the vast majority of interviews appeared to hinder the physicians ability to more fully and efficiently utilize the EHR system. A few physicians noted that they spent extra personal time and even attended user conferences independently so they could learn more about their EHR system and how to better harness the capabilities it had to offer to improve the way they used it in their practice and thus improve their skill level at using the EHR during the clinical consultiaotn. Consider the following accounts:

> Training Example 1: We had none. It was horrible. It was me just playing, because when I came I initially started off seeing like four to eight patients a half-day, so basically they said, "This is our system. We're doing medicines on here." And I was like, "Well, can I start doing notes on there because I'm used to it?" and they were like, "We don't know what will happen if you do a note."

So, I started tinkering with it and kind of figured out from just trial and error where things were, how to do them, and then there are a couple of us here that kind of did that. I think I'm the only one still that does it like full board, but the other guys here have kind of been doing…started on kind of doing more and more notes.

And then we went to a meeting one time for NextGen, and they had like a top 10 ways to make it fast and efficient for you, and things we had figured out over like four months they taught us in like 30 minutes … But we never really had trainers come down until recently. We started, me and Dr. X, we've actually been training all the family docs and internal medicine docs, just a little two-three hour evening course where we just kind of give a basic kind of walk through everything, and I think people said that's been pretty helpful.

We did it horribly the first time, but once we started doing our thing here, a lot more people got on board to starting their notes, and so if we had people like Dr. X and I, I think, that are willing to do that, it would be fine, or if they want to send people or whatever.

Training Example 2: Uh I believe there was like an hour or hour and a half session that they basically walked you through the basics and I can tell you the first time I saw it, I think everyone in the room was I mean we could log in and we could look at a patient's (chart) but we were pretty much lost beyond that. Um I would say that it is probably a great introduction to the EHR and then you kind of have to go play around with it yourself, uh but I don't think that one hour was enough.

Training Example 3: Someone showed me, "Here's what this does, here's how you get to it, and here's how you pull up this and this. Enjoy." I mean, there was a test patient that everybody played around with that the information wouldn't be for real. So, you play with it, you enter information, you get familiar with how to get around and navigate to different parts of it. Personally, I think I learn better doing it myself, and until I face a situation I wouldn't know what I need to know ahead of time. So, from my past experience of teaching people how to use things on a computer, doing like a lecture-type standing in front, showing them how to do something, there's very little information that's retained. Most of the time, the person would not know how to do something unless they have to sit there and do it over and over and over again, and then they get familiar with it and they get comfortable with it.

In conclusion, the themes that emerged which appear to impact affordance actualization during the clinical encounter are: physician cognition, EHR functionality,

and EHR training. The themes from this research question served as a foundation to develop and validate scale items to measure how the EHR is used during the clinical encounter. The development and results of these measures are discussed in detail in the methodology and quantitative results chapters of this dissertation.

CHAPTER IV

QUANTITATIVE RESULTS

The purpose of this phase of the project is to develop and validate a survey instrument that predicts patterns of EHR use based on the EHR features, EHR-physician affordances, and individual characteristics and skills that influence EHR-physician affordance realization and actualization, thus answering RQ 4 (see below). The following sections provide the results of the quantitative analysis of the survey data collected for the second study of this dissertation. The results in this chapter will be organized by: (1) Factor Analysis, (2) Correlation, and (3) Multiple Regression; and serve to address the following research question: RQ 4: What user characteristics impact physician actualization of affordances during the clinical consultation?

Initial Data Screening and Factor Analysis

There were a total of 55 responses (cases) in the data set. One set of scale questions in the survey that was developed based on the qualitative data and previous studies, which needed to be factor analyzed in order to identify the factors contributing to EHR use by physicians in the exam room (see Table 3 in methodology chapter). Another set of questions were developed based on the qualitative data to measure daily EHR use (see Table 4 in methodology chapter). The other scales used in the survey were found in existing literature and have previously been validated (see Tables 5,6, & 7 in methodology chapter). The complete survey instrument can be found in the Appendix section of this dissertation (see Appendix C).

To prepare for analysis, the survey data were evaluated to screen for outliers and assess normality and linearity (Mertler & Vannatta, 2005). Using Mahalanobis distance, three outliers were found (cases number 13, 23, and 49) and eliminated. Due to the small sample size, a set of five criteria was used to evaluate the data to determine the number of factors and the variables that loaded onto the factors (Zhao, 2009). The following outlines the statistical process and criteria used for data evaluation during factor analysis.

A Principal Components Factor Analysis with Varimax Rotation was used for the factor analysis process. Upon completion of factor analysis Kaiser-Meyer-Olkin (KMO) indicated a score greater than .60 (.770) that proved sufficient for further variable communality analysis. An analysis of communality found two variables under the .60 threshold (Q1c distracts and Q1f real time), which were eliminated from further analysis. The remaining variables produced a communality mean value, which exceeded .70 (.738) (Table 8) and a KMO of .820 (Table 9). Using KMO strategy, I then dropped all components with eigenvalues under 1.0 (Table 10) and then used a Scree plot to determine the number of factors included (Figure 1). Finally, and continuing with KMO strategy, I set the size cut off value to .60 and dropped any remaining factors that contained less than three variables (Table 11). Upon completion of analysis, four factors emerged: (1) patient involvement, (2) EHR impact on provider-patient interaction, (3) information management, and (4) computer interaction.

Within the survey instrument there was a set of nineteen questions related to physicians perceptions of using EHRs during the medical consultation in the exam room.

These questions were factor analyzed using principal component analysis with Varimax rotation. The analysis yielded four factors explaining 73.822% of the variance. The first factor was labeled "Patient Involvement " and explained 22.074% of the variance. It is made up of the following items: (1) helps me to educate my patients about their medical conditions and treatment plan, (2) helps me to engage in shared decision-making with my patients, and (3) helps me to actively involve the patient in their health care. The second factor derived from the analysis was labeled "EHR Impact on Provider-Patient Interaction" and explained 21.206% of the variance. It is made up of the following items: (1) reviewing the patient's medical history slows me down, (2) limits the amount of eye contact I maintain with my patients, (3) enhances the physician-patient relationship, (4) interferes with my ability to listen to the patient, and (5) enhances my communication with the patient.

The third factor derived from the analysis was labeled "Information Management" and explained 16.551% of the variance. It is made up of the following items: (1) helps me reduce potential mistakes, (2) entering patient information during the patient visit reduces the amount of information I have to remember about the patient, and (3) helps me gather all the patient information I need. The fourth factor was labeled "Computer Interaction" and explained 13.991% of the variance. It is made up of the following items: (1) spends majority time away from the computer looking at the patient rather than the computer, (2) spends majority of the time at the computer reviewing, eliciting, and documenting problem-oriented information regarding the patient's medical

condition, and (3) alternate my attention between looking at the patient and looking at the computer.

Table 8
Communalities

	Initial	Extraction
Q1a-Remember	1.000	.798
Q1b-ReduMist	1.000	.812
Q1d-Gather	1.000	.762
Q1e-Rev/DocPtInfo	1.000	.687
Q1g-DifftoUse	1.000	.700
Q1h-RevSlwDwn	1.000	.713
Q1i-InvPt	1.000	.738
Q1j-PtEd	1.000	.889
Q1k-LookatPt	1.000	.801
Q1l-AlterPtComp	1.000	.621
Q1m-MtnEyeCtct	1.000	.656
Q1n-ShrdDmkg	1.000	.838
Q1o-EasytoUse	1.000	.623
Q1p-CplxMedIss	1.000	.682
Q1q-Comm	1.000	.748
Q1r-Listen	1.000	.683
Q1s-PPR	1.000	.799

Table 9
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.820
Bartlett's Test of Sphricity	Approx. Chi-Square	627.799
	Df	136
	Sig.	.000

Table 10
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.960	46.824	46.824	7.960	46.824	46.824	3.753	22.074	22.074
2	2.151	12.653	59.477	2.151	12.653	59.477	3.605	21.206	43.280
3	1.355	7.968	67.445	1.355	7.968	67.445	2.814	16.551	59.831
4	1.084	6.377	73.822	1.084	6.377	73.822	2.378	13.991	73.822
5	.859	5.050	78.872						
6	.604	3.553	82.425						
7	.511	3.005	85.429						
8	.444	2.611	88.040						
9	.409	2.407	90.447						
10	.342	2.013	92.459						
11	.325	1.911	94.370						
12	.310	1.825	96.195						
13	.223	1.315	97.510						
14	.193	1.133	98.643						
15	.104	.611	99.254						
16	.068	.398	99.652						
17	.059	.348	100.000						

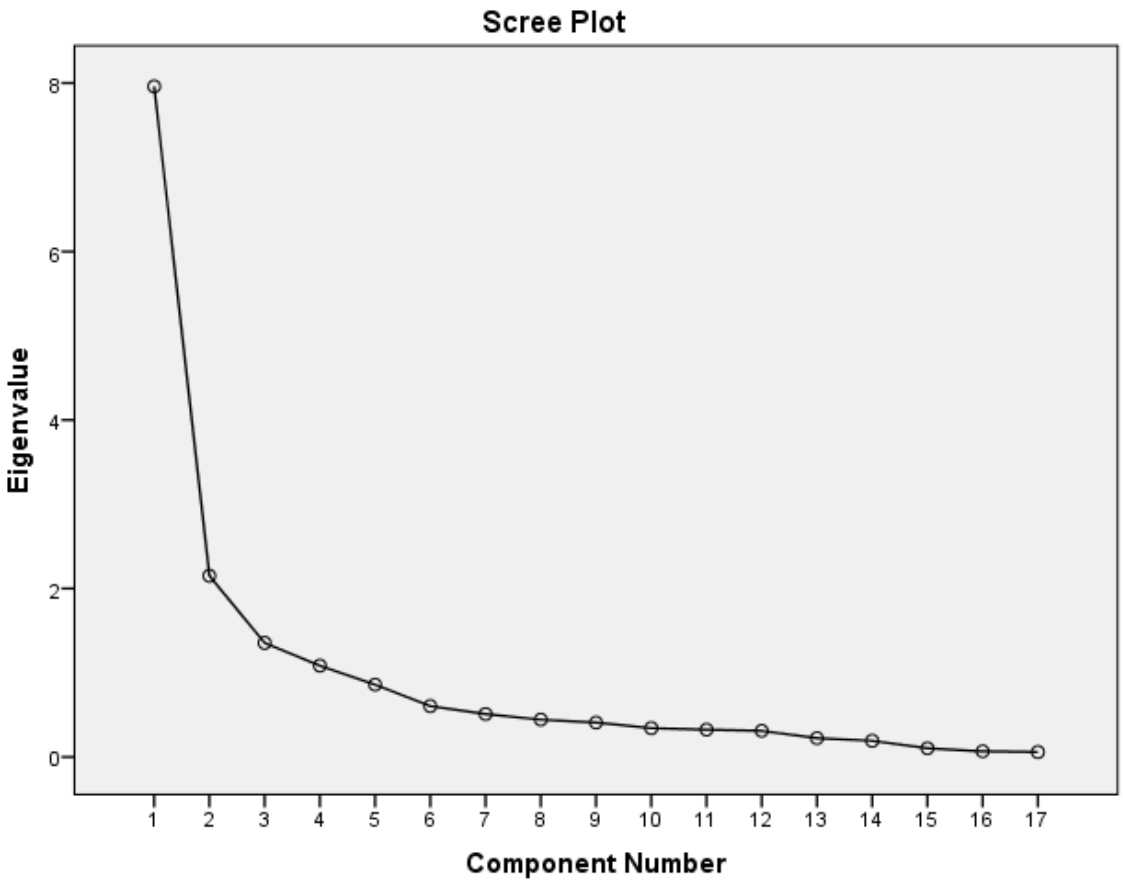

Figure 1. Scree plot of factor analysis.

Table 11
Rotated Component Matrix

	Component			
	1	2	3	4
Q1j-PtEd	.891	.198	.163	-.169
Q1n-ShrdDmkg	.849	.158	.293	-.080
Q1i-InvPt	.757	.361	.158	-.101
Q1h-RevSlwDwn	.089	.772	.310	-.115
Q1m-MtnEyeCtct	.175	.752	-.073	.233
Q1s-PPR	.534	.678	.219	-.080
Q1r-Listen	.379	.633	.349	-.131
Q1q-Comm	.504	.621	.321	-.072
Q1p-CplxMedIss	.107	.559	.399	-.446
Q1g-DifftoUse	-.383	-.547	-.414	.286
Q1b-ReduMist	.254	.267	.812	-.127
Q1a-Remember	.440	.153	.759	-.074
Q1d-Gather	.605	.095	.614	-.099
Q1o-EasytoUse	.001	.492	.591	.178
Q1k-LookatPt	.047	.088	.000	.890
Q1e-Rev/DocPtInfo	-.120	-.001	-.096	.815
Q1l-AlterPtComp	.381	.193	.001	-.662

Table 12
Researcher Developed Outcome Variables Determined by Factor Analysis

Patient Involvement
During the patient visit, the EHR helps me to educate my patients about their medical conditions and treatment plan.
Using the EHR during the patient visit helps me to engage in shared decision-making with my patients.
During the patient visit, the EHR helps me to actively involve the patient in their health care
EHR Impact on Provider-Patient Interaction
Reviewing the patient's medical history in the EHR during the medical encounter slows me down.
Using the EHR during the patient visit limits the amount of eye contact I maintain with my patients.
Using the EHR during the patient visit enhances the physician-patient relationship.
Using the EHR during the patient visit interferes with my ability to listen to the patient.
Using the EHR during the patient visit enhances my communication with the patient.
Information Management
Using the EHR during the patient visit helps me reduce potential mistakes.
Putting patient information in the EHR during the patient visit reduces the amount of information I have to remember about the patient.
Using the EHR during the patient visit, helps me gather all the patient information I needed.
Computer Interaction
During the patient visit, I spend a majority of my time away from the computer looking at the patient rather than looking at the computer.
During the patient visit I spend a majority of the time at the computer using the EHR to review, elicit, and document problem-oriented information regarding the patient's medical condition.
*During the patient visit I alternate my attention between looking at the patient and looking at the computer.
Note. * Item is deleted from variable in final analysis due to reliability issues indicated below.

Internal consistency reliability. Once the factor analysis had been completed, Cronbach's alpha was run on each of the variables being used for analysis in this study to determine the internal consistency reliability of the measures. Upon analysis, all measures were determined to have good internal consistency reliability, except for Computer Interaction (α = -.203). Upon further analysis of the measures in this variable it was determined that the deletion of one of the items (alternate my attention between looking at the patient and looking at the computer) would greatly improve the internal consistency reliability of this variable (α = .765) and thus was deleted from this variable for the remainder of these analyses (Table 13).

Table 13
Scale Statistics & Reliability

Scale	Mean	Variance	Std. Deviation	N of items	Cronbach's Alpha
Patient Involvement	10.91	15.859	3.982	3	.903
EHR Impact on Provider-Patient Interaction	14.57	36.966	6.080	5	.869
Information Management	13.18	15.263	3.907	3	.885
Computer Interaction	7.67	8.830	2.972	2	.765
EHR Use	43.69	138.766	11.780	10	.900
EHR Anxiety	16.85	32.760	5.724	4	.960
EHR Skill	18.55	23.053	4.801	4	.939
PPIS	44.18	29.865	5.465	9	.710

Validity. The researcher determined that the researcher-developed scales (Patient Involvement, EHR Impact on Provider-Patient Interaction, Information Management, and Computer Interaction) had face validity by reviewing the scales and constructs they were intended to measure. A researcher and a physician, both of whom found the scales

to measure the attributes of the content being measured, determined content validity for the scales. Additionally, the scales were determined to have construct validity as each of the developed scales was correlated with either one or both of the following scales: EHR Anxiety and EHR Use (Table 16), which is consistent with the theoretical framework (Frey, Botan, Kreps, 2000).

Correlations

Standard two-tailed Pearson correlations were computed among eleven variables, including the recently identified outcome variables from the factor analysis. As previously discussed in the methodology chapter, the additional variables include demographic questions on age, sex, and ethnicity, three previously validated scales found in the literature that were adapted for use in this study (as previously described (see Tables 4, 5, & 6), and an EHR Use composite variable developed by the researcher (Table 3).

Overall, the correlations revealed that the level of comfort a physician has while using the EHR during the clinical encounter and the amount the EHR is used throughout the day is related to the how the physician uses the EHR is during the clinical encounter. Each of the outcome variables identified from the factor analysis are reported below along with the physician characteristics that show a significant relationship (Table 14, 15, & 16).

Patient involvement. The results indicate that physicians who reported the EHR helps them to better involve patients in their care (Patient Involvement) also reported being more comfortable using the EHR in the exam room (Anxiety) $r(49) = .410$, $p <$

.01., reported using the EHR more often throughout the day (EHR Use) $r(50) = .452$, $p <$ .01., helped them to better manage patient information during the clinical encounter $r(52) = .751$, $p < .001$, and had a positive impact on the patient-provider interaction $r(51) = .650$, $p < .001$.

EHR impact on provider-patient interaction. Physicians reporting positive impacts on the physician-patient interaction while using the EHR in the exam room (Impact on the Provider-Patient Interaction) believed that it helped them to better manage patient information during the clinical encounter better (Information Management) $r(52) = .628$, $p < .001$, were more comfortable using the EHR during the medical consultation (EHR Anxiety) $r(49) = .580$, $p < .001$, and helped to involve their patient more in their care (Patient Involvement) $r(51) = .650$, $p < .001$.

Information management. Physicians reporting that they believed the EHR allowed them better manage patient information during the consultation (Information Management) also reported higher use of EHR during the clinical encounter (EHR Use) $r(51) = .446$, $p < .01$, higher confidence in their ability to use the EHR during the clinical encounter (EHR Skill) $r(49) = .354$, $p < .05$, more comfortable using the EHR during the clinical encounter (EHR Anxiety) $r(50) = .365$, $p < .01$, that the EHR helped them to involve patients in their care (Patient Involvement) $r(52) = .751$, $p < .001$, and positively influenced provider-patient interactions (Impact on Interaction) $r(52) = .628$, $p < .001$.

Computer interaction. A significant inverse relationship was seen between ethnicity and computer interaction $r(48) = -.311$, $p < .05$, with physicians who reported being Caucasian reported focusing less on the patient and more on the EHR in the

clinical interaction. Additionally, a significant inverse relationship was seen between EHR use and computer interaction $r(50) = -.417$, $p < .01$, with physicians who reported focusing more on the patient then the EHR during the clinical consultation having lower levels of EHR use.

Table 14

Correlations of Outcome Variables and Physician Characteristics

		Sex	Age	Ethn	EHR Use	EHR Skill	EHR Anxiety	PPIS	Pt Involv	Impt Prov-Pt Int	Info Mgmt	Cmpt Int
Sex	Prsn Cor	1	.119	.140	-.157	-.161	.015	.076	-.184	-.136	-.082	.011
	(Sig 2-tailed		.405	.328	.271	.264	.919	.603	.200	.346	.566	.941
	N	51	51	51	51	50	51	49	50	50	51	50
Age	Prsn Cor	.119	1	-.236	.021	-.201	-.115	.146	.139	.063	.073	.043
	Sig. 2-tailed	.405		.095	.884	.163	.420	.316	.336	.666	.611	.767
	N	51	51	51	51	50	51	49	50	50	51	50
Ethn	Prsn Cor	.140	-.236	1	.057	.015	.047	-.067	-.045	-.183	-.130	-.311*
	Sig 2-tailed	.328	.095		.690	.918	.743	.645	.759	.204	.362	.028
	N	51	51	51	51	50	51	49	50	50	51	50
EHR Use	Prsn Cor	-.157	.021	.057	1	.429**	.194	.086	.452**	.244	.446**	-.417**
	Sig 2-tailed	.271	.884	.690		.002	.168	.554	.001	.081	.001	.002
	N	51	51	51	53	51	52	50	52	52	53	52
EHR Skill	Prsn Cor	-.161	-.201	.015	.429**	1	.277*	.163	.106	.225	.354*	.013
	Sig 2-tailed	.264	.163	.918	.002		.049	.264	.465	.116	.011	.928
	N	50	50	50	51	51	51	49	50	50	51	50
EHR Anxiety	Prsn Cor	.015	-.115	.047	.194	.277*	1	.315*	.410**	.580***	.365**	.070
	Sig 2-tailed	.919	.420	.743	.168	.049		.026	.003	.000	.008	.623
	N	51	51	51	52	51	52	50	51	51	52	51
PPIS	Prsn Cor	.076	.146	-.067	.086	.163	.315*	1	.044	.102	.065	-.028
	Sig 2-tailed	.603	.316	.645	.554	.264	.026		.763	.485	.653	.848
	N	49	49	49	50	49	50	50	49	49	50	49
Pt Invol	Prsn Cor	-.184	.139	-.045	.452**	.106	.410**	.044	1	.650***	.751***	-.158
	Sig 2-tailed	.200	.336	.759	.001	.465	.003	.763		.000	.000	.258
	N	50	50	50	52	50	51	49	54	53	54	53
Impt Prov-Pt Int	Prsn Cor	-.136	.063	-.183	.244	.225	.580***	.102	.650**	1	.628***	-.062
	Sig 2-tailed	.346	.666	.204	.081	.116	.000	.485	.000		.000	.658
	N	50	50	50	52	50	51	49	53	54	54	53
Info Mgmt	Prsn Cor	-.082	.073	-.130	.446**	.354*	.365**	.065	.751***	.628***	1	-.143
	Sig 2-tailed	.566	.611	.362	.001	.011	.008	.653	.000	.000		.301
	N	51	51	51	53	51	52	50	54	54	55	54
Cmpt Int	Prsn Cor	.011	.043	-.311*	-.417**	.013	.070	-.028	-.158	-.062	-.143	1
	Sig 2-tailed	.941	.767	.028	.002	.928	.623	.848	.258	.658	.301	
	N	50	50	50	52	50	51	49	53	53	54	54

Note. Abbreviations: Ethn = Ethnicity; PPIS = Patient Provider Interaction Style; Pt Involv = Patient Involvement; Impt Prov-Pt Int = EHR Impact on Patient Interaction; Info Mgmt = Information Management; Cmpt Int = Computer Interaction. Data coding for non-scale items: Sex: 1=Female, 2=Male; Age: 1= < 30, 2=30-39, 3=40-49, 4=50-59, 5= >60; Ethn: 1=Caucasian, 2=Other.

*p < .05 **p < .01 ***p < .001

Table 15
Correlations of Outcome Variables and Demographics

		Sex	Age	Ethn
Pt Invol	Prsn Cor	-.184	.139	-.045
	Sig 2-tailed	.200	.336	.759
	N	50	50	50
Impt Prov-Pt Int	Prsn Cor	-.136	.063	-.183
	Sig 2-tailed	.346	.666	.204
	N	50	50	50
Info Mgmt	Prsn Cor	-.082	.073	-.130
	Sig 2-tailed	.566	.611	.362
	N	51	51	51
Cmpt Int	Prsn Cor	.011	.043	-.311*
	Sig 2-tailed	.941	.767	.028
	N	50	50	50

Note. Abbreviations: Ethn = Ethnicity; Pt Involv = Patient Involvement; Impt Prov-Pt Int = EHR Impact on Patient Interaction; Info Mgmt = Information Management; Cmpt Int = Computer Interaction. Data coding for non-scale items: Sex: 1=Female, 2=Male; Age: 1= < 30, 2=30-39, 3=40-49, 4=50-59, 5= >60; Ethn: 1=Caucasian, 2=Other.

*p < .05

Table 16
Correlations of Outcome Variables and User Characteristics

		EHR Use	EHR Skill	EHR Anxiety	PPIS
Pt Invol	Prsn Cor	.452**	.106	.410**	.044
	Sig 2-tailed	.001	.465	.003	.763
	N	52	50	51	49
Impt Prov-Pt Int	Prsn Cor	.244	.225	.580***	.102
	Sig 2-tailed	.081	.116	.000	.485
	N	52	50	51	49
Info Mgmt	Prsn Cor	.446**	.354*	.365**	.065
	Sig 2-tailed	.001	.011	.008	.653
	N	53	51	52	50
Cmpt Int	Prsn Cor	-.417**	.013	.070	-.028
	Sig 2-tailed	.002	.928	.623	.848
	N	52	50	51	49

Note. Abbreviations: Ethn = Ethnicity; PPIS = Patient Provider Interaction Style; Pt Involv = Patient Involvement; Impt Prov-Pt Int = EHR Impact on Patient Interaction; Info Mgmt = Information Management; Cmpt Int = Computer Interaction. Data coding for non-scale items: Sex: 1=Female, 2=Male; Age: 1= < 30, 2=30-39, 3=40-49, 4=50-59, 5= >60; Ethn: 1=Caucasian, 2=Other.

*p < .05 **p < .01 ***p < .001

Multiple Regressions

Multiple linear regression analyses were conducted to examine the relationship between the theoretical variables believed to influence EHR use and how it is used by physicians during a medical consultation. For all regressions the "enter" method was used with "estimates" and "model fit" selected for statistical analysis. This analysis was used to determine if the seven variables (EHR Use, Sex, Age, Ethnicity, EHR Skill, and Physician-Patient Interaction Style) seen in the correlations would predict each of

the four factors identified by the factor analysis as immediate concrete outcomes produced by the actualization of affordances during the clinical encounter.

Patient involvement. The multiple regression model with all seven predictors shows a significant relationship $R^2 = .403$, $F(7, 46) = 3.756$, $p<.01$. While the full model produced a significant result, EHR Use and Anxiety were the only predictor variable that had significant ($p<.01$) partial effects in the full model (Table 17). This indicates that physicians with higher daily usage of the EHR during the clinical encounter and who were more comfortable using the EHR doing the clinical encounter were more likely to see the EHR as allowing them to more actively involve their patients in their health care by using the EHR in that manner during the medical consultation.

Table 17
Regression Model for Patient Involvement Factor

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.146	6.514		1.097	.279
	Ethnicity	-.452	1.429	-.041	-.316	.753
	Sex	-1.573	1.325	-.155	-1.187	.242
	Age	1.017	.731	.188	1.390	.172
	EHR Skill	-.144	.157	-.135	-.914	.366
	EHR Anxiety	.370	.124	.409	2.990	.005
	PPIS	-.087	.125	-.092	-.692	.493
	EHR Use	.179	.058	.429	3.061	.004

Note. Abbreviations: PPIS = Patient Provider Interaction Style. Data coding for non-scale items: Sex: 1=Female, 2=Male; Age: 1= < 30, 2=30-39, 3=40-49, 4=50-59, 5= >60; Ethn: 1=Caucasian, 2=Other.

EHR impact on physician-patient interaction. The multiple regression model with all seven predictors shows a significant relationship $R^2 = .479$, $F(7, 46) = 5.122$, $p<.001$. As seen in the Table 18 the EHR Anxiety scale is the only predictor variable that had a significant ($p<.01$) partial effect in the full model. This indicates that the more comfortable a clinician felt about using the EHR in the medical consultation the more likely they were likely to see the EHR as positively influencing their quality of patient interactions.

Table 18
Regression Model for EHR Impact on Physician-Patient Interaction Factor

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.825	7.205		1.086	.284
	Ethnicity	-2.333	1.621	-.176	-1.439	.158
	Sex	-1.370	1.496	-.113	-.916	.365
	Age	.609	.817	.095	.745	.460
	Skill	-.040	.174	-.032	-.233	.817
	Anxiety	.691	.137	.648	5.045	.000
	PPIS	-.099	.141	-.088	-.701	.488
	EHR Use	.067	.065	.136	1.019	.314

Note. Abbreviations: PPIS = Patient Provider Interaction Style. Data coding for non-scale items: Sex: 1=Female, 2=Male; Age: 1= < 30, 2=30-39, 3=40-49, 4=50-59, 5= >60; Ethn: 1=Caucasian, 2=Other.

Information management. The multiple regression model with all seven predictors shows a significant relationship $R^2 = .339$, $F(7, 47) = 2.930$, $p<.05$. As seen in Table 19, EHR Use and Anxiety were the only predictor variables that had significant ($p<.05$) partial effects in the full model. This indicates that physicians with higher daily usage of the EHR during the clinical encounter and who were more comfortable using the EHR doing the clinical encounter were more likely to see the EHR as allowing them to better manage patient information by using the EHR during the medical consultation.

Table 19
Regression Model for Information Management Factor

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.034	5.342		1.130	.265
	Ethnicity	-1.276	1.200	-.142	-1.064	.294
	Sex	.054	1.101	.007	.049	.961
	Age	.374	.595	.088	.629	.533
	Skill	.125	.131	.148	.958	.344
	Anxiety	.219	.103	.304	2.128	.040
	PPIS	-.083	.105	-.110	-.785	.437
	EHR Use	.115	.049	.345	2.341	.024

Note. Abbreviations: PPIS = Patient Provider Interaction Style. Data coding for non-scale items: Sex: 1=Female, 2=Male; Age: 1= < 30, 2=30-39, 3=40-49, 4=50-59, 5= >60; Ethn: 1=Caucasian, 2=Other.

Computer interaction. The multiple regression model with all seven predictors shows a significant relationship $R^2 = .381$, $F(7, 46) = 3.429$, $p<.05$. As seen in Table 20, EHR Use ($p<.01$) and Ethnicity ($p<.05$) were the only predictor variables that had significant partial effects in the full model. This indicates that physicians with higher daily usage of the EHR during the clinical encounter and who reported being Caucasian were more likely to focus their attention on using the computer than to focus their attention on the patients during the clinical encounter.

Table 20
Regression Model for Computer Interaction Factor

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.833	3.759		3.414	.002
	Ethnicity	-1.925	.834	-.302	-2.309	.026
	Sex	.546	.765	.093	.713	.480
	Age	.314	.422	.101	.744	.461
	Skill	.080	.093	.129	.860	.395
	Anxiety	.143	.074	.276	1.942	.059
	PPIS	-.067	.075	-.121	-.894	.377
	EHR Use	-.127	.035	-.527	-3.679	.001

Note. Abbreviations: PPIS = Patient Provider Interaction Style. Data coding for non-scale items: Sex: 1=Female, 2=Male; Age: 1= < 30, 2=30-39, 3=40-49, 4=50-59, 5= >60; Ethn: 1=Caucasian, 2=Other.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Successful implementation of EHRs within the modern health care organization/system is highly desired by health care organizations. To help prevent unsuccessful implementations it is necessary to identify and understand the actions and processes that influence how organizational goals regarding EHR use are achieved. Recently an organizational-technology theory was developed using an affordance lens to look at the organizational change process, IT artifact, and users within a specific context (Strong et al., 2014). This Theory of Organization-EHR Affordance Actualization emphasizes the importance of individual-level affordance actualization with the aggregation of these actions producing organizational immediate outcomes that result in the degree of goal attainment achieved by the organization. This dissertation identifies the affordances, EHR features, factors that influence EHR use, and individual physician characteristics that produce the visible effects of EHR use during the clinical encounter when individual physicians interact with the EHR.

In this chapter I will discuss the theoretical implications identified in my data in comparison to those theoretical principals identified in the existing theoretical perspective noted above, including new theoretical implications specifically arising from this study. Secondly, I will identify and discuss implications for practice based on the findings including the specific EHR features that influence use of the EHR during the medical consultation and the user characteristics of the physicians influencing EHR use

during the clinical encounter. Finally, I will highlight potential areas for future research and identify any limitations associated with this study.

Theoretical Implications

This dissertation confirms the existence of several of the affordances and EHR features that Strong and colleagues (2014) identified in their study. Specifically this study confirmed the existence of the following affordances at the individual level: Capturing and Archiving Digital Data About Patients, Accessing and Using Patient Information Anytime From Anywhere, Incorporating Rich Information into Clinical Decision Making, Standardizing Data, Processes, and Roles, and Monitoring Organizational Operations (Table 21). Thus the findings of this study seem to reify the findings of Strong and colleagues strengthening their initial theoretical precepts.

Additionally, this study confirmed several of the EHR features identified by Strong and colleagues (2014) (Table 21). While the nomenclature was not the same, the following EHR features identified in the data were similar to the following EHR features and affordances seen in Strong and colleagues: templates/checklists, real-time capabilities, alerts and prompts, and additional resources. Finally, this study confirmed the importance of the role of user characteristics in influencing how an affordance is actualized.

However, not all aspects of the affordances as discussed by Strong and colleagues (2014) were applicable to the individual-level, such as Standardizing Data, Processes, and Roles. The data for this study confirmed the standardization of data aspect of the affordance, through the use of templates, but did not indicate the

standardization of processes and roles. The absence of the standardization of processes and roles in the data is likely due to the fact that this study focused on the individual level clinical encounter and the context in which that affordance was originally identified focused on the larger organizational level within the managerial roles of the organization. This indicates that while A Theory of EHR-Organization Affordance Actualization provides a way of identifying affordances at the organizational level and provides a good starting place to understand what affordances are available at an individual-level, in order to really understand what affordances are available to the individual physician a more specific lens must be used to look at the EHR features and clinician user characteristics that produce the affordance and the ability to actualize the affordances and produce the organizational effects seen. In order to facilitate this lens this study allows for the extension of the existing theoretical perspective to the individual level.

As such, this study contributes the addition of three new affordances specific to the individual-level for physicians: Organization and Structure of the Consultation, Physician-Patient Relationship Management, and Patient Education (Table 21). These affordances are more specific to the physician and the work that is performed during the clinical encounter. For example, the integration of the EHR influences how the clinician conducts the medical interview. While the EHR provides physicians with templates, prompts, etc. to guide them in the collection of information this may or may not be seen as desirable by the physician and they may or may not actualize this affordance during the clinical encounter. Once the EHR is integrated into the clinical encounter it will

influence how they conduct the medical interview, record, access, and use data, etc. Further, they may see the EHR features as reducing the amount of flexibility they have in controlling the flow of conversation and collecting and recording patient data or, conversely, they may feel that it provides a great structure to guide the conversation and provide safe guards and reminders to ask pertinent information. While the actualization of this affordance, as well as the other newly identified affordances, is at the individual-level the aggregation of these actualizations will impact the organization's ability to achieve it's goals as well, something that Strong and company seem to understand if only tacitly. Thus the identification of these new individual-level affordances provides a clearer picture of what the EHR and clinician are capable of performing and the influence the actualization of these affordances can have not only on the individual clinical encounter, but on the organization as a whole.

Additionally, this study identifies two additional EHR features that were not identified by Strong and colleagues, ordering/prescription writing and data entry methods (Table 21). Ordering/prescription writing was the EHR feature that all interview respondents reported using frequently and improved efficiency, while data entry methods was the feature reported to negatively impact a physician's use of the EHR, depending on the type of data entry method that they were suppose to use rather than what they preferred to use.

This study also identifies factors that are associated with affordance actualization (Table 21). While Strong and colleagues (2014) identify very basic characteristics a user must have for the affordance to be available for actualization, more specific characteristics identified in this study appear to be influencing if, and to what extent, the actualization of affordances is occurring. Specifically, the following factors were identified from the interview data: physician cognition, including the physicians task orientation, cognitive load, and awareness of EHR features; EHR functionality, including customizability of the EHR, user friendliness of the EHR, and how information was displayed on the EHR; and EHR training that the physician received. Knowing that these factors influence the degree to which EHR actualization takes place, the impact of these factors on existing theorization concerning EHR implementation should be taken into account.

Table 21
Theoretical Confirmations and Extensions

	Confirms	Extends
Affordances		
Capturing and Archiving Digital Data About Patients	✓	
Accessing and Using Patient Information Anytime From Anywhere	✓	
Incorporating Rich Information into Clinical Decision Making	✓	
Standardizing Data (but not Processes and Roles)	✓	
Monitoring Organizational Operations	✓	
Organization and Structure of the Consultation		✓
Physician-Patient Relationship Management		✓
Patient Education		✓
Features		
Templates/Checklists	✓	
Real-Time Capabilities	✓	
Alerts and Prompts	✓	
Additional Resources	✓	
Ordering/Prescription Writing		✓
Data Entry Methods		✓
Factors Influencing Affordance Actualization		
Physician Cognition (physicians task orientation, cognitive load, and awareness of EHR features)		✓
EHR functionality (customizability of the EHR, user friendliness of the EHR, and how information was displayed on the EHR)		✓
EHR training		✓
User Characteristics		
Importance of user characteristics	✓	
EHR Anxiety		✓
EHR Use		✓
EHR Skill		✓
Ethnicity		✓
EHR Utilization		
Patient Involvement		✓
EHR impact on physician-patient interaction		✓
Information Management		✓
Computer Interaction		✓

Finally, this study used the factors associated with affordance actualization identified above to create a series of survey items which, when factor analyzed, became the outcome variables allowing determination of what user characteristics impact EHR utilization. The outcome variables included: patient involvement, EHR impact on patient-provider interaction, information management, and computer interaction. Findings from this portion of the study indicate that two independent variables (EHR anxiety level, and level of EHR daily use) influence the outcome variables noted here and that higher levels of anxiety promote decreased patient involvement, decrease the quality of the patient provider interaction, reduce information management capability, and negatively impact computer interaction capability. Conversely, as EHR daily use increased improvements in all of the outcome variables but one, EHR impact on patient-provider interaction. To this end, we may conclude that the more comfortable we can make the physician with using the EHR during the clinical consultation, the more improvement we should see in the actualization of affordances.

It should be noted that the new affordances identified in this study are confirmed, albeit indirectly, by the EHR effects literature. For example, studies have reported on the influence of EHR use on the organization and structure of the medical visit (Bates et al., 2003; Chen, Ngo, Harrison, & Duong, 2011; Frankel et al., 2005; Linder et al., 2006; Pizziferri et al., 2005; Rouf, Whittle, Lu, & Schwartz, 2007), physician-patient relational management (Bates, Ebell, et al., 2003; Frankel et al., 2005; Irani, Middleton, Marfatia, Omana, & D'Amico, 2009; Johnson, Serwint, Fagan, Thompson, & Wilson, 2005; Linder et al., 2006; Margalit et al., 2006; Noordman et al., 2010; Rouf et al., 2007;

Ventres et al., 2006), and patient education (Goldzweig, Towfigh, Maglione, & Shekelle, 2009; Margalit et al., 2006; Menachemi & Brooks, 2006; Menachemi, Ford, Beitsch, & Brooks, 2007; Rouf et al., 2007; Ventres et al., 2006). It is the acutalization of the affordances that are identified in this study that produce the effects of EHR use reported in theses studies.

Practical Implications

These findings indicate that knowing the level of anxiety a physician has about using EHRs during the medical consultation would provide useful information to practice managers, health care executives, trainers, and vendors. It would allow practice managers and health care executives to know the comfort level their physicians have with integrating the EHR into their daily work tasks and processes and then provide additional training, instruction, and/or assistance to help them feel more comfortable using them during the clinical encounter. Thus helping physicians to become more comfortable using the EHR during clinical consultations should be of paramount importance to health care executives and managers when introducing an EHR system into their organization. For trainers and vendors having this knowledge before and during an implementation can help them to tailor training to various groups based on their level of anxiety, as well as product development and marketing. The survey instrument produced in this study (see Appendix C) proved highly effective in assessing this level of comfort/anxiety.

Additionally, assessing the level of EHR use, based on the frequency of features used and the frequency of visits that these features are used on a daily basis, would be

beneficial to practice managers, health care executives, trainers, and vendors. Practice managers and health care executives would know if the features were being used and to what extent and if they found that certain features were not being used as they anticipated that they would be they could inquire among the physicians as to why the feature is not being used. They could then use this information to contact the vendors and trainers to see if the feature could be redesigned and/or if additional training could be provided. The survey instrument created for this study should allow for this type of analysis after EHR installation and allow vendors to further customize and develop features that enhance EHR use over continued longitudinal studies and alert trainers which features may need more extensive training.

This study also found that the design of EHR and its features is important. If the necessary features are not available, are not customizable, are not user friendly, and do not display the information in way that allows physicians to easily find information then the EHR is not going to be used to the extent that is desired by the organization. Health care executives and practice managers need to thoroughly investigate these issues when selecting an EHR system for their organization as they are a major investment of money, time, and resources. They need to have their physicians "try out" the systems under consideration and make recommendations based on the functionality of the EHR. Additionally, vendors need to do a better job of designing and user-testing their products before selling these products to health care organizations. Their goal should not only be to make a profit but a quality product that is easy to use and can be customized to the needs of the organization.

These findings also indicate that while organizations invest monetarily into EHR systems they often do not invest in the necessary training that is needed to get the physicians to a level of use that would benefit, the physician, the patient, and the organization. While physicians differ on the amount of and type of training they want to receive, it is clear from the findings of this study that what they did receive was not sufficient. In fact the physicians that reported using the EHR during the clinical consultation to involve their patient in their health care and to provide patient education were the physicians who took their own personal time outside of their normal working hours to figure out how to use their EHR system more effectively and then went on to host training workshops for other physicians in their practice after work as well. This indicates that there clearly is a need for a substantial improvement in the training of physicians before, during, and after an EHR implementation and that practice managers and health care executives need to not only find the right EHR for their organization but also need to invest in the training of their physicians and not in a one-size-fits-all sort of training but a tailored approach that will meet the learning needs of their physicians.

Limitations

Previous studies have provided mixed results on whether age, sex, and ethnicity influence EHR use. In this study only ethnicity appeared to influence one other variable, that of computer interaction. Due to the limited ethnic diversity of the sample and small sample size this interaction may not actually exist. A larger sample with a more diverse population is needed to verify this finding. An additional limitation of this study is the size of the sample itself. Small sample size makes this study more subject to type 2

error, and makes generalization of data to the broader population impossible. While a broad reach was initiated by the researcher, due to the nature of their work, physicians did not respond in an amount large enough to account for wide spread generalization of findings. Further, the study examined four different EHR platforms, yet due to the small sample size comparison of the platforms was impossible. Finally, the study was cross-sectional indicating relationships between the variables but lacking the ability to determine definite causation. Additionally, this study was focused on clinician perspectives and relied on the self-reporting of clinicians. Observational studies are needed to observe clinician behaviors as they interact with the EHR and actualize affordances while providing patient care to provide a more complete picture of affordance actualization in the clinical encounter. Still, this study gives significant clues to what may be found if additional studies are completed with the instrument created here.

Future Research

Future research is needed to determine if there are additional individual level affordances that were not uncovered with this study as well as additional factors that influence a physician's ability to actualize affordances and thus achieve their individual goals as well as their organization's goals. As previously mentioned in the limitations section, observational studies are needed to gain a more complete picture of affordance actualization within the clinical encounter. An additional area of interest to pursue would be the affects of age on EHR use during the clinical encounter. While no effects were seen in this study, the population was made up of older generations of people who did

not grow up in the digital era, known as "digital immigrants." Digital immigrants"have integrated technology in varying degrees to their lives, but as a whole they remember and have lived most of their life learning and performing work outside of the digital era. "Digital natives," however, are the generations who have grown up in the digital era and have always used technology (Prensky, 2001). As these digital natives enter the workforce as health care professionals the way in which the EHR is used during the consultation is likely to change and the effects of these different generations on EHR use is likely to be seen.

Additionally, this study provides a tool to assess how the EHR is used during the clinical consultation as well as user characteristics, but the survey needs to be used in a larger sample to further validate the scales developed by the author as well as to be able to generalize results to the larger physician population as a whole.

Finally, the larger impact of ethnicity on how EHRs are used during the clinical consultation needs to be further investigated. As noted in the results chapter, a significant relationship was seen between ethnicity and how much focus they placed on computer interaction in the exam room, but further exploration of this concept is beyond the scope of this study and the capabilities of the data collected and instrument used. As ethnicity is not a variable that can be arbitrarily changed at will, additional studies may seek to determine if some form of ethnic bias exists within the EHR designs themselves or in various ethnicities perceptions of using technology in interpersonal interactions. As was noted in the limitations section, this finding is somewhat curious due to the ethnic composition of the sample itself.

Conclusions

This study has shown that A Theory of Organization-EHR Affordance Actualization provides a useful framework for looking at how technology is used in organizations and allows, in part, for more micro investigations, as seen in this study, or macro investigations that look at organizational effects for with the theory was initially postulated. The findings of this study confirm the identification of individual level affordances proposed by Strong and colleagues and propose three additional affordances. This study also identified additional features that should be taken into consideration when investigating individual level affordance actualization. Finally, this study provides a survey tool for practice managers, health care executives, trainers, and vendors to use in order to better understand the individual user characteristics of their physicians, predict their patterns of use based on these user characteristics, and thus tailor their training to enhance affordance actualization and organizational goal attainment.

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APPENDIX A

CONSENT FORM

Differences in physician use of electronic health records: Development of a scale assessing individual factors influencing physician actualization.

Introduction

The purpose of this form is to provide you (as a prospective research study participant) information that may affect your decision as to whether or not to participate in this research.

You have been asked to participate in a research study which seeks to understand how individual user characteristics influence individual physician use of electronic health records (EHRs). Using interviews, I will solicit your opinions about your philosophy of care, the role of EHRs in the exam room, and how you integrate EHRs into the exam room. The purpose of the study is to identify the various user characteristics that influence differences in individual use of EHRs so that eventually a scale can be developed which can measure these user characteristics and predict individual use patterns. You were selected to be a possible participant because of your professional role as a physician and your experience with EHRs.

What will I be asked to do?

If you agree to participate in this study, you will be asked to be interviewed concerning your philosophy of care, the role of EHRs in the exam room, and how you use EHRs in the exam room. This study will take one hour.

Your participation will be audio recorded.

What are the risks involved in this study?

The risks associated with this study are minimal, and are not greater than risks ordinarily encountered in daily life.

What are the possible benefits of this study?

You will receive no direct benefit from participating in this study; however, this study will benefit society by providing an understanding of how individual differences influence individual EHR use and provide the baseline data for survey instrument development in the future. The eventual survey instrument will be able to be used by physicians, health care organizations, and EHR vendors in order to identify the potential patterns of EHR use, prior to training and implementation, so that physicians and other health care providers can receive personalized training prior to, during, and after the implementation of the EHR, which hopefully will lead to a more seamless integration of EHRs into the day-to-day work of physicians and other health care professionals and

ultimately result in increased quality of care for patients, increased job satisfaction regarding the use of EHRs, and patient satisfaction with care.

Do I have to participate?
No. Your participation is voluntary. You may decide not to participate or to withdraw at any time without your current or future relations with Texas A&M University being affected.

Who will know about my participation in this research study?
This study is confidential and all records associated with this matter will be securely stored by the principal investigator (PI), Kylene Wesner and will be for her eyes only. Recorded records will include digital audio files and electronic transcriptions of those files. All files will be accessed only by the PI and will be password protected at all times on a hard drive that is not associated with any network and is encrypted. No identifiers linking you to this study will be included in any sort of report that might be published. Audio recordings will be kept by Kylene Wesner for 1 year and then will be destroyed.

Whom do I contact with questions about the research?
If you have questions regarding this study, you may contact Kylene Wesner, kylene@tamu.edu

Whom do I contact about my rights as a research participant?
This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at (979)458-4067 or irb@tamu.edu.

Signature
Please be sure you have read the above information, asked questions and received answers to your satisfaction. You will be given a copy of the consent form for your records. By signing this document, you consent to participate in this study.

Signature of Participant: _____ Date:_____

Printed Name: _____

Signature of Person Obtaining Consent: _____ Date:_____

Printed Name: _____

APPENDIX B

Interview Protocol

Introductory Questions:

1. What is your current job title/position?

2. How long have you been practicing medicine? How long have you been working at this health care facility?

3. How long have you been using the current EHR system?
    a. Was this current EHR your first exposure to and use of an EHR system?
    b. If not, how long have you been using EHRs?
    c. How many different EHR systems have you used?
    d. How long did you use each one?

4. Thinking about your philosophy of patient care, what do you believe the role of the physician is in health care / patient-provider relationship?
    a. Do you think the role of physician is changing? How so?

5. What do you believe the role of the patient is?
    a. Is it changing? How so?

6. How do you think your views of the roles of physician and patient influence how you communicate with your patients?

7. What do you believe the role of EHRs is in the patient-provider relationship?
    a. How do you think your views about EHRs influence your use of EHRs during a medical consultation with a patient?
    b. How does the use of EHRs influence your goals for providing patient care? (follow-up question)

Interview Questions:

1. Thinking about your current EHR system, what type of technology do you use a desktop computer that is in fixed position in the room, is it attached to a moveable arm, a tablet PC, etc?

2. What features of the "computer" and EHR system are available to you to use to during the medical interview in the exam room?

3. What features do you use a lot or depend on to provide patient care?
    a. How do these features help you to do your job as a physician in providing patient care?
    b. How did you perform these same functions prior to EHR use?
    c. Are there any additional capabilities that the EHR has provided that enable you to provide better patient care or improve your relationship with the patient, that you couldn't do with paper records?

4. What features of the EHR system/computer do you believe interfere with your ability to provide patient care?
    a. How do they interfere with your ability to provide patient care?
    b. How do you think they could be improved in order to make your day to day work easier? Benefit patient care? Benefit the health care organization?

5. What features of the EHR system/computer have do you find irrelevant or not useful in providing patient care?
    a. In your opinion, why are they not useful in providing patient care?

6. What features do you wish the EHR system/computer had that it doesn't have?
    a. What would these features allow you to do that is currently difficult to do or not possible for you to do now?

7. Generally speaking, what do you think is the ideal model of use for physicians using an EHR system/computer in providing patient care? Why?

8. How would you characterize your views/experiences with desktops/laptop computers in your personal life?
    a. Please describe what your personal use of a looks like during a typical day?
    b. How is using the computer in your personal life on a daily basis similar to using an EHR in the exam room? How are they different?
    c. How would you characterize your computer/keyboard skills?

9. What type of training did you receive prior to the rollout of the current EHR system?
    a. ……. During the first few months of the rollout?
    b. …….After the first year?
    c. What other types of training would you have liked to have had? Why?

10. Generally speaking, what types of training should be provided to physicians prior to the rollout of an EMR system?
    a. …….During the first months of the rollout?
    b. …….After the first year?

11. Thinking back from before you started using EHRs to now, how do you think the EHR has affected your work process (i.e. the way you do your job)?
    a. … how has it influenced the way in which you view your role as a physician and how you provide patient care?

APPENDIX C

Introduction
The purpose of this form is to provide you (as a prospective research study participant) information that may affect your decision as to whether or not to participate in this research.

You have been asked to participate in a research study to determine how individual characteristics and capabilities influence individual clinician use of electronic health records (EHRs). You will be given the opportunity to complete a survey instrument about your opinions and experiences using EHRs in the clinical setting. The purpose of the study is to identify the factors that influence differences in individual physician use of EHRs. You were selected to be a possible participant because of your professional role as a physician and your experience with EHRs.

What will I be asked to do?
If you agree to participate in this study, you will be asked to complete a survey instrument concerning your your opinions and experiences using EHRs in the exam room. This survey instrument will take approximately 5-10 minutes.

What are the risks involved in this study?
The risks associated with this study are minimal, and are not greater than risks ordinarily encountered in daily life

What are the possible benefits of this study?
You will receive no direct benefit from participating in this study; however, this study will benefit society by providing an understanding of how individual differences influence individual physician EHR use.and by refining the survey instrument. The refined survey instrument will then be able to be used by physicians, health care organizations, and EHR vendors in order to identify the potential patterns of EHR use, prior to training and implementation, so that physicians can receive personalized training prior to, during, and after the implementation of the EHR, which hopefully will lead to a more seamless integration of EHRs into the day-to-day work of physicians.

Do I have to participate?
No. Your participation is voluntary. You may decide not to participate or to withdraw at any time without your current or future relations with Texas A&M University being affected.

Who will know about my participation in this research study?
This study is confidential and all information related to your participation in the study will be treated in strict confidence to the extent provided by the law. All records and data associated with this matter will remain confidential to the extent permitted by the law.

Whom do I contact with questions about the research or about my rights as a research participant?
This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at (979)458-4067 or irb@tamu.edu.

Signature
Please be sure you have read the above information, asked questions and received answers to your satisfaction. You will be given a copy of the consent form for your records. By signing this document, you consent to participate in this study.

Signature of Participant: _____ **Date:** _____

Printed Name: _____

Please read before proceeding to the following questions:

Electronic Health Record (EHR): includes all clinical applications, including patient management software, voice recognition/recording software, patient information repository, etc; internet and other computer based resources; and computer hardware, which present clinical results and medical information to users and allows users to perform a variety of functions related to patient care including data entry.

Patient visit: is considered to be the time in which you are interacting with the patient during their medical encounter either in the exam room or physician office.

1. Please indicate your level of agreement from "Strongly Agree" to "Strongly Disagree", in response to the following statements about *your EHR use during a patient visit*.

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Agree	Strongly Disagree
Putting patient information in the EHR during the patient visit reduces the amount of information I have to remember about the patient.	☐	☐	☐	☐	☐	☐
Using the EHR during the patient visit helps me reduce potential mistakes.	☐	☐	☐	☐	☐	☐
Using the EHR during the patient visit distracts me from providing thorough medical care.	☐	☐	☐	☐	☐	☐
Using the EHR during the patient visit, helps me gather all the patient information I needed.	☐	☐	☐	☐	☐	☐
During the patient visit I spend a majority of the time at the computer using the EHR to review, elicit, and document problem-oriented information regarding the patient's medical condition.	☐	☐	☐	☐	☐	☐
Using the EHR in the exam room allows me to access the most current orders and lab results in real-time.	☐	☐	☐	☐	☐	☐
It is difficult to use the EHR during the patient visit.	☐	☐	☐	☐	☐	☐
Reviewing the patient's medical history in the EHR during the medical encounter slows me down.	☐	☐	☐	☐	☐	☐
During the patient visit, the EHR helps me to actively involve the patient in their health care	☐	☐	☐	☐	☐	☐
During the patient visit, the EHR helps me to educate my patients about their medical conditions and treatment plan.	☐	☐	☐	☐	☐	☐
During the patient visit, I spend a majority of my time away from the computer looking at the patient rather than looking at the computer.	☐	☐	☐	☐	☐	☐
During the patient visit I alternate my attention between looking at the patient and looking at the computer.	☐	☐	☐	☐	☐	☐
Using the EHR during the patient visit limits the amount of eye contact I maintain with my patients.	☐	☐	☐	☐	☐	☐
Using the EHR during the patient visit helps me to engage in shared decision-making with my patients.	☐	☐	☐	☐	☐	☐
The EHR interface is easy to use (i.e. user friendly).	☐	☐	☐	☐	☐	☐

Documenting the patient visit in the EHR during the medical encounter is difficult if the patient has complex medical issues.	☐	☐	☐	☐	☐	☐
Using the EHR during the patient visit enhances my communication with the patient.	☐	☐	☐	☐	☐	☐
Using the EHR during the patient visit interferes with my ability to listen to the patient.	☐	☐	☐	☐	☐	☐
Using the EHR during the patient visit enhances the physician-patient relationship.	☐	☐	☐	☐	☐	☐

2. Please indicate your daily level of EHR use from "For every visit" to "Not on a daily basis," in response to the following statements.

If you do not use the EHR for the listed activity then select N/A.

On a daily basis, **I use the EHR during the patient visit to _____.**

	For every visit	Most visits	Half of my visits	A few visits	Not on a daily basis	N/A
Review patient information	☐	☐	☐	☐	☐	☐
Record patient information	☐	☐	☐	☐	☐	☐
Write prescriptions	☐	☐	☐	☐	☐	☐
Provide patient education	☐	☐	☐	☐	☐	☐
Order labs and tests	☐	☐	☐	☐	☐	☐
Review labs and tests	☐	☐	☐	☐	☐	☐
View potential drug interactions	☐	☐	☐	☐	☐	☐
Create a care plan	☐	☐	☐	☐	☐	☐
Set up referrals	☐	☐	☐	☐	☐	☐
Review suggested health maintenance screenings	☐	☐	☐	☐	☐	☐

3. What style(s) of EHR training did you receive for the current EHR that you use? (Please select all that apply)

❑ Vendor/IT instructor-led classroom ❑ Physician super user-led classroom ❑ Job shadowing

❑ Vendor/IT one-on-one ❑ Physician super user one-on-one ❑ EHR Manual Self-study

❑ Online or computer-based ❑ Video-based ❑ No training was provided

❑ Other: _____

4. Please indicate your level of agreement from "Strongly Agree" to Strongly Disagree," in response to the following statements about the EHR training that you participated in.

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Agree	Strongly Disagree
The training I received on the EHR was adequate.	☐	☐	☐	☐	☐	☐
I have received the training that I need to be able to understand and use the EHR.	☐	☐	☐	☐	☐	☐
The EHR training made the EHR more useful to me.	☐	☐	☐	☐	☐	☐
The EHR training made it easier for me to use the EHR.	☐	☐	☐	☐	☐	☐

5. When thinking about future EHR trainings, please rank the following EHR training styles in order from *most preferred training style* to *least preferred training style*, with "1" indicating your "most preferred" and "8" indicating your "least preferred" training style.

_____ Vendor/IT instructor-led classroom
_____ Vendor/IT one-on-one
_____ Physician super user-led classroom
_____ Physician super user one-on-one
_____ Job shadowing
_____ Online or computer-based
_____ Video/DVD-based
_____ EHR Manual Self-study

6. Please indicate your level of agreement from "Strongly Agree" to "Strongly Disagree," in response to the following statements *about your EHR use.*

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Agree	Strongly Disagree
I think I am pretty good at using the EHR.	☐	☐	☐	☐	☐	☐
After having used the EHR for a while, I felt pretty competent.	☐	☐	☐	☐	☐	☐
I am pretty skilled at using the EHR.	☐	☐	☐	☐	☐	☐
I am not very proficient in using the EHR.	☐	☐	☐	☐	☐	☐

7. Please indicate your level of agreement from "Strongly Agree" to "Strongly Disagree," in response to the following statements about *how you feel while using the EHR.*

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Agree	Strongly Disagree
I feel very tense while using the EHR in front of patients.	☐	☐	☐	☐	☐	☐
I feel pressured while using the EHR during a patient visit.	☐	☐	☐	☐	☐	☐
I am anxious while using the EHR in front of patients.	☐	☐	☐	☐	☐	☐
I am very relaxed while using the EHR during a patient visit.	☐	☐	☐	☐	☐	☐

8. Please indicate your level of agreement from "Strongly Agree" to "Strongly Disagree", in response to the following statements about *physician-patient interactions during a patient visit.*

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Agree	Strongly Disagree
The doctor is the one who should decide what is talked about during a visit.	☐	☐	☐	☐	☐	☐
Although health care is less personal these days, this is a small price to pay for medical advance.	☐	☐	☐	☐	☐	☐
The most important part of the standard medical visit is the physical examination	☐	☐	☐	☐	☐	☐
It is often best for patients if they do not have a full explanation of their medical condition.	☐	☐	☐	☐	☐	☐
Patients should rely on their doctors' knowledge and not try to find out about their conditions on their own.	☐	☐	☐	☐	☐	☐
When doctors ask a lot of questions about a patient's background, they are prying too much into personal matters.	☐	☐	☐	☐	☐	☐
If doctors are truly good at diagnosis and treatment, the way they relate to patients is not that important.	☐	☐	☐	☐	☐	☐
Many patients continue asking questions even though they are not learning anything new.	☐	☐	☐	☐	☐	☐
Patients should be treated as if they were partners with the doctor, equal in power and status.	☐	☐	☐	☐	☐	☐

9. Gender (select one): ❑ Female ❑ Male

10. Age (select one):
    - ❑ Under 30 years
    - ❑ 30 – 39 years
    - ❑ 40 – 49 years
    - ❑ 50 – 59 years
    - ❑ 60 years and older

11. Ethnicity (select one):
    - ❑ Caucasian
    - ❑ African American
    - ❑ Hispanic
    - ❑ Native American
    - ❑ Asian
    - ❑ Pacific Islander
    - ❑ Middle Eastern
    - ❑ Other _____

12. How long have you been working in the health care field as a physician? (select one)
    - ❑ Less than 5 years
    - ❑ 5 – 10 years
    - ❑ 11 - 15 years
    - ❑ More than 15 years

13. In which area of medicine do you currently specialize? (select primary specialty)

❑ Allergy & immunology	❑ Infectious disease	❑ Pediatrics
❑ Anesthesiology	❑ Medicine, general	❑ Physical med/Rehab
❑ Cardiology	❑ Nephrology	❑ Plastic Surgery
❑ Cardiothoracic surgery	❑ Neurology	❑ Psychiatry
❑ Dermatology	❑ Neurosurgery	❑ Pulmonary medicine
❑ Diagnostic imaging	❑ OB/GYN	❑ Radiation oncology
❑ Digestive disease	❑ Oncology	❑ Radiology
❑ Emergency medicine	❑ Ophthalmology	❑ Rheumatology
❑ Endocrinology	❑ Oral surgery	❑ Surgery, general
❑ Family/general practice	❑ Orthopedics	❑ Trauma surgery
❑ Geriatrics	❑ Otolaryngology	❑ Urology
❑ Hematology/Oncology	❑ Pathology	❑ Vascular Surgery

❑ Other _____

10. How long have you personally been using electronic health records (EHRs)?
    - ❑ Less than 1 year
    - ❑ 1 – 3 years
    - ❑ 3 – 6 years
    - ❑ More than 6 years

11. How long have you been using the current EHR system at your current health care facility?
    - ❑ Less than 6 months
    - ❑ 6 months – 1 year
    - ❑ 1 – 3 years
    - ❑ More than 3 years

12. What is the name of the current EHR system that you are using?
    - ❑ Epic
    - ❑ Next Gen
    - ❑ Point & Click
    - ❑ CPRS
    - ❑ Other (Please Specify):_____