PERCEIVED E-CONSULTATION DIAGNOSTICITY AND PROVIDER ACCEPTANCE OF TELEMEDICINE

by

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(Under the Direction of Elena Karahanna)

ABSTRACT

Despite increasing investments in the U.S. healthcare system, patients—especially those in rural areas—still face barriers in accessing healthcare services at affordable rates. Thus, there are many opportunities for the implementation of telemedicine consultation (TMC) solutions to bridge the gaps in access, cost, and quality. A TMC involves a technology-mediated interaction between an expert consultant (in the medical context, a consulting healthcare provider) and an advice-seeker in which information exchange between these individuals is pivotal in evaluating the problem. A salient concern within this context is whether the TMC system will enable consulting providers to make efficacious evaluations. We call this concept *perceived e-consultation diagnosticity* and define it as the perceived efficacy of the TMC system to enable consulting providers to understand and evaluate remote patients' health conditions. The research draws on concepts primarily from the marketing and technology acceptance domains to develop and test a research model that theorizes substitutive effects of the evaluative process requirements, IT capabilities, and user capabilities in shaping e-consultation diagnosticity perceptions. An important contribution of this research is identifying the types of user capabilities that are relevant within the TMC context and potentially across other expert consultation contexts. We propose two new constructs, *presentation* and *elicitation,* as well as the user roles of presenter and consultant. Presenters have the capability of presentation, which reflects their ability to relay information relevant to the medical consultation process, and consultants possess the capability of elicitation, which reflects their ability to elicit information relevant to the medical consultation process. While extant research theorizes technology's role in facilitating virtual collaborative processes, we specifically theorize the users' capability to compensate for weaknesses in the technology. We employ a mixed methods research design, combining qualitative and quantitative methodologies, in order to gain a more complete understanding of our research domain than what we would be able to gain by using a single method alone. Findings from our analysis suggest that both IT and user capabilities are indeed important influences of perceived e-consultation diagnosticity.

INDEX WORDS: Health IT, Telemedicine, Technology Acceptance, Process Virtualization, Perceived Diagnosticity

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CHAPTER 1: INTRODUCTION

1.1. BACKGROUND

Worldwide, societies face challenges in providing populations access to health care services at reduced costs. In the United States specifically, these challenges include escalating costs, increased barriers to health care access, and a growing shortage of physicians (Pear 2009). Despite the soaring investments in health care, patients still face systematic barriers in accessing health care services at affordable rates. In particular, individuals who live in rural communities find it difficult to access specialty physicians, who typically are located in urban areas (Whitten and Love 2005). In light of these challenges, there is vast opportunity for the implementation of telemedicine consultation (TMC) solutions to bridge the gaps in access and cost.

Telemedicine is defined in this dissertation as *the use of networking and telecommunication systems to provide healthcare services at a distance*. While telemedicine solutions have been in existence for decades, and studies reveal positive attitudes toward use of telemedicine, widespread acceptance and diffusion of telemedicine has not yet been realized (Whitten and Mackert 2005; Whitten and Holtz 2008). Hence, telemedicine acceptance remains an important area to study.

While telemedicine acceptance in general is important to study, provider acceptance of telemedicine in particular is a key area of acceptance that needs further exploration. We define *provider* as any health care practitioner that provides direct patient care: physicians, mid-level providers (nurse practitioners and physician assistants), nurses, and allied health providers (e.g. therapists, social workers, paramedics, radiographers, etc.). Of all stakeholders involved in telemedicine acceptance, providers are considered the main decision-makers in determining whether patients will receive telemedicine services. Thus, providers are the gatekeepers who ultimately determine whether telemedicine will be utilized (Whitten and Mackert 2005). As such, a deeper understanding of the antecedents that drive provider acceptance of telemedicine is warranted. In this dissertation, we categorize telemedicine providers as consulting providers, presenting providers, and referring providers. A detailed description of these roles is included in Chapter 2.

There are numerous telemedicine studies that have explored provider perceptions of telemedicine. However, most of these studies are atheoretical and lack rigorous study design and methodology. Even theory-based studies use a very limited set of theoretical perspectives (namely, the technology acceptance model (TAM) (Davis 1986, 1989) and diffusion of innovations (DOI) theory (Rogers 1995)) to examine the phenomenon. Despite the confirmatory results in these theory-based studies, physicians are considered a conservative group for whom it is challenging to predict acceptance of telemedicine (Guiterrez 2001) and, indeed, despite reported positive attitudes and satisfaction by this group with telemedicine, their use is still limited (Larsen et al. 2003, Peddle 2007). Thus, there has been a call to conduct more rigorous research that addresses provider perceptions as they relate to successful implementations of telemedicine (Merrell and Doarn 2010) and a need to examine the phenomenon from a broader theoretical perspective.

1.2. MOTIVATION

To address this call, we move beyond the frequently used technology acceptance antecedents used in the literature. A study conducted by Serrano and Karahanna (2009) indicates that *perceived e-consultation diagnosticity* plays a key role in determining telemedicine acceptance. They define e-consultation diagnosticity as the perceived ability of the telemedicine system (which includes the technology and users) to enable consulting providers to understand

and evaluate the health conditions of remote patients. The significance of this construct makes intuitive sense because the medical diagnosis is widely regarded as one of the consulting provider's primary tasks (Kassirer 1989), a task that is often knowledge-intensive and wrought with uncertainty (Griffin et al. 1998). The treatment decision consulting providers make is based on their clinical evaluations; hence, there is high expectation that they evaluate patients correctly. According to Craig et al. (1999), "in order for telemedicine applications to gain widespread acceptance, clinicians will need to be convinced of their effectiveness in each particular setting. One aspect of this will be to ensure that diagnoses can be made accurately" (p. 180).

While research in the telemedicine literature has explored the concept of diagnostic accuracy and reliability, this concept has been limited primarily to objective measures and has not been fully explored in the wider context of acceptance of telemedicine applications. Given the observed viability of telemedicine's effectiveness in enabling diagnoses, our primary focus is to study telemedicine providers' *subjective* perceptions of telemedicine-enabled assessments and the influence of these perceptions in determining adoption of such technologies. While all telemedicine stakeholders' perceptions of e-consultation dignosticity are important, we specifically focus on consulting provider perspectives in this dissertation because they are the providers that fill the role of the expert consultant who performs evaluations of patients. Our review of provider telemedicine acceptance presented in Chapter 2 also reveals that perceptions of e-consultation diagnosticity are especially a concern for consulting providers.

1.3. OBJECTIVES AND RESEARCH QUESTIONS

The main research objective in this dissertation is to gain a better understanding of how to effectively virtualize the medical consultation process. A telemedicine consultation involves a technology-mediated interaction between an expert and an advice-seeker in which information exchange between individuals in these two roles is pivotal in evaluating the nature of the problem. Key questions in this context include the factors that facilitate the information exchange in a virtual consultation and how these factors impact perceptions of the telemedicine system's ability to allow for efficacious evaluations (i.e., perceived e-consultation diagnosticity).

To better understand perceived e-consultation diagnosticity and its impact on consulting providers' acceptance of telemedicine, we will develop and test a theoretical model in order to explain and predict the antecedents that influence consulting providers' perceptions of e-consultation diagnosticity. Ultimately, we propose that perceptions of e-consultation diagnosticity will be a key driver of TMC use and the consequent success of TMCs and, therefore, warrant investigation. Factors that explain consulting provider acceptance of telemedicine will be thoroughly explored to determine the appropriate nomological network in which to embed the e-consultation diagnosticity construct and its antecedents. Thus, the research questions for this dissertation are the following:

RQ1. *What are the determinants of perceived e-consultation diagnosticity in telemedicine consultations?*

RQ2. *What is the influence of perceived e-consultation diagnosticity on consulting providers' use of telemedicine consultations?*

The research draws on concepts from the healthcare, marketing, and technology acceptance domains to develop the research model that will be tested in this dissertation. Based on concepts of diagnostic efficacy in healthcare (Hersh et al. 2002, 2006), perceived diagnosticity in marketing (Kempf and Smith 1998) and information systems (Jiang and Benbasat 2004, Jiang and Benbasat 2007, Pavlou and Fygenson 2006, Pavlou et al. 2007, Mudambi and Schuff 2010), and process virtualization theory (Overby 2008), we develop a research model that theorizes complementary and substitutive effects of the evaluative process requirements, IT capabilities, and human process participant capabilities in shaping e-consultation diagnosticity perceptions.

1.4. KEY CONTRIBUTIONS

While Overby's (2008) process virtualization model includes the elements of tasks and technology, and proposes that a process can be virtualized to the extent to which requirements of task are met by the capabilities of the technology, it omits the contribution of the user in determining system usage. In defining system usage, Burton-Jones and Straub (2006) propose that system usage involves the three elements of the task, technology, and user. Hence, a key theoretical contribution of this dissertation is to include constructs and propositions concerning the process participants' role in enabling the virtualization of the consultation process. In addition, a practical contribution of this dissertation is the development of a research model that will highlight the factors that will enable successful virtualization of the medical consultation process, which can help guide practitioners in their design and implementation of telemedicine systems. Furthermore, while our research focuses on the medical consultation, concepts from our research model will extend to other expert consultation domains, such as technology help desks and financial consulting.

1.5. DISSERTATION STRUCTURE

To address these research questions, this dissertation is organized as follows. **Chapter Two** presents an overview of telemedicine and provider acceptance of telemedicine. This background information is presented first to provide a detailed description of the context in which we will embed our research model. Chapter Two continues with a review of the literature on diagnostic efficacy and perceived diagnosticity, followed by a summary of process virtualization theory. The chapter concludes with a conceptual model that provides the framework for our research model. **Chapter Three** steps through the development of the research model and hypotheses. It includes quotes from qualitative data that have been collected for this study in order to provide support for the research hypotheses. In **Chapter Four**, we discuss the research design for this dissertation. We describe our methodology for collecting both qualitative and quantitative data to test the research model and elaborate on the procedures we followed to develop the instrument for the field survey. **Chapter Five** presents the preliminary results of the qualitative data analysis as well as the scale validation and findings from the quantitative study. **Chapter Six** discusses the research findings, limitations, and directions for future research.

CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1. INTRODUCTION

The aim of this chapter is to develop a conceptual model of determinants of e-consultation diagnosticity situated within a nomological network of provider acceptance of telemedicine. While e-consultation diagnosticity is the focus of this dissertation, it is important to understand the telemedicine context within which we develop and situate this construct. Thus, we begin this chapter with a review of key telemedicine concepts and describe how we define telemedicine in this dissertation. Then we present a brief review of the literature on provider acceptance of telemedicine, which informs our identification of constructs to include in the nomological network and points to gaps in telemedicine research regarding e-consultation diagnosticity and provider acceptance. Following this discussion, we draw from theories and concepts from the healthcare, marketing, and information systems (IS) domains to inform the development of our conceptual model, which we present at the end of the chapter.

2.2. OVERVIEW OF TELEMEDICINE

The term “telemedicine” can be understood in many different ways. In a review of 104 peer-reviewed articles, Sood et al. (2007) determined that the following four components were often cited in telemedicine definitions: medical, technological, spatial, and benefits. In other words, telemedicine typically involves the provision of medical services using networking and communications technologies to bridge the geographic separation between participants, in order to yield certain benefits. In our definition, we adopt the components of medical, technological, and spatial, but leave benefits and outcomes as separate from the definition. A discussion of telemedicine benefits is included later in this chapter.

In a taxonomy of telemedicine, Tulu et al. (2007) propose three dimensions to telemedicine: technology, perspective, and applications (Figure 1). For this dissertation, we focus on *provider* perceptions of *synchronous* (interactive video) telemedicine technology for *clinical* applications. We define provider as any health care practitioner that provides direct patient care: physicians, mid-level providers (nurse practitioners and physician assistants), nurses, and allied health providers (e.g. therapists, social workers, paramedics, radiographers, etc.). Of all stakeholders involved in telemedicine acceptance, providers are considered the main decision-makers in determining whether patients will receive telemedicine services. Thus, providers are the gatekeepers who ultimately determine whether telemedicine will be utilized (Whitten and Mackert 2005), and their perceptions are especially important to study.

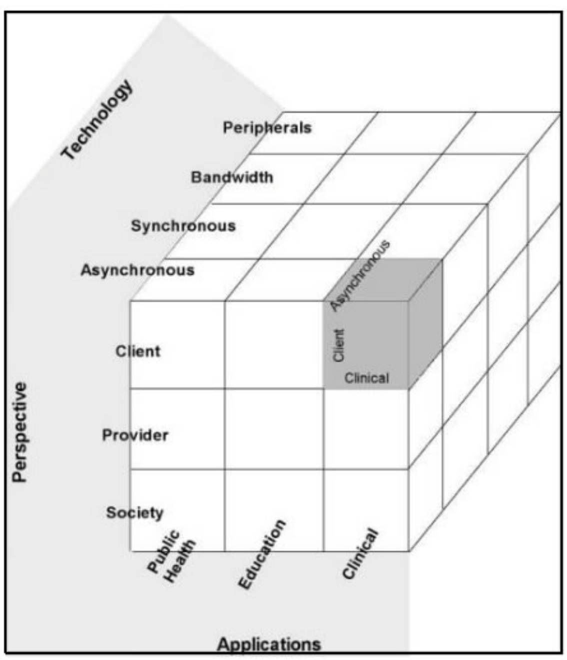


Figure 1. Telemedicine Taxonomy (Tulu et al. 2007)

2.2.1. TELEMEDICINE CONSULTATION PARTICIPANT ROLES

Because we focus on clinical applications of telemedicine, we can identify the typical participants in telemedicine consultations, whether synchronous or asynchronous. In most cases, there will be a ***referring provider*** who refers patients to receive telemedicine services. During a telemedicine consultation, there is often a presenting provider whose role is to present the patient to the consulting provider. The ***presenting provider*** may help articulate the patient's medical history and current symptoms, as well as perform a physical exam to relay physical clinical information to the consulting provider. In asynchronous, or store-and-forward, consultations, the presenting provider may take digital images of the patient's physical conditions and electronically transfer these images and other patient-related clinical information to the consulting provider. In some cases, the referring provider is also the presenting provider. The ***consulting provider*** serves as the expert consultant and will assess patients' medical conditions via electronic consultations in order to render diagnoses and recommendations for treatment. Figure 2 illustrates the various roles participants assume in telemedicine consultations.

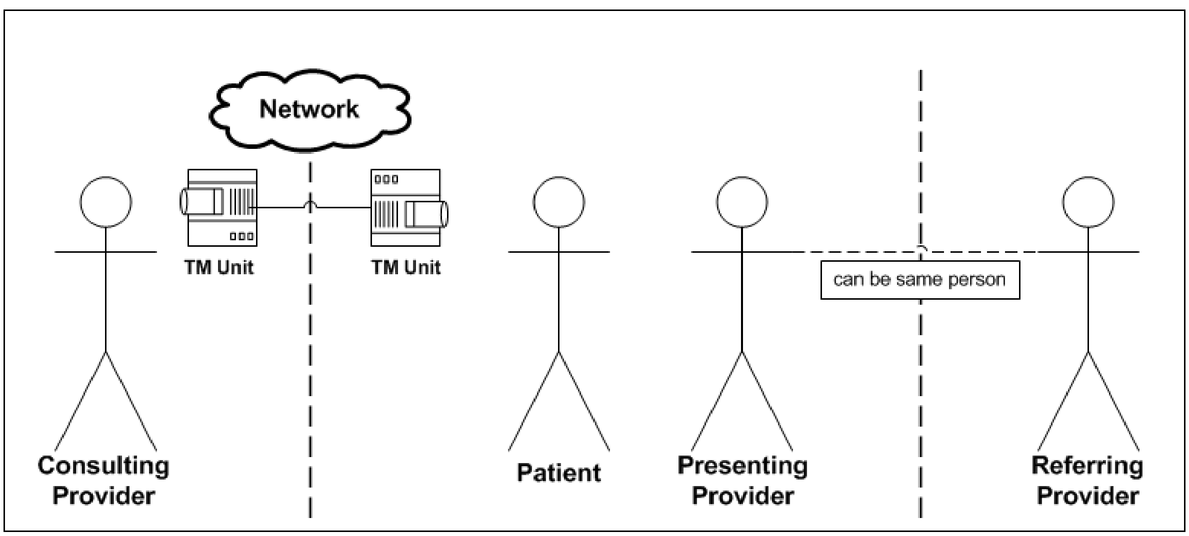


Figure 2. Telemedicine Consultation Participant Roles at the Individual Level

2.2.2. BENEFITS OF TELEMEDICINE

There are three main areas where telemedicine is purported to provide benefits in healthcare delivery: accessibility, quality, and cost (Bashshur 1995), referred to as the "triple aim" of healthcare (Berwick et al. 2008). Given that telemedicine can bridge the geographic separation between remote patients and healthcare providers, it has been touted as a solution to improve access to healthcare. Furthermore, by providing patients access to care they normally would not be able to obtain, telemedicine can also improve health outcomes and the quality of care. Telemedicine also reduces transportation costs for both patients and providers and helps avoid unnecessary health services and diagnostic tests, which also results in cost savings. While many studies report the benefits of telemedicine, a review conducted by Hailey et al. (2002) indicates that telemedicine may achieve the most beneficial outcomes in certain specialties, such as radiology, mental health, cardiology, dermatology, and home health. Nevertheless, the general consensus is that telemedicine has the potential to increase access to quality healthcare, while reducing costs. Thus, telemedicine acceptance remains an important area to study.

2.3. REVIEW OF PROVIDER ACCEPTANCE OF TELEMEDICINE

To gain better insights into provider acceptance of telemedicine, we conducted a meta review of this domain and analyzed 105 manuscripts that span healthcare and information systems literatures (Serrano and Karahanna 2011). Based on this review, several factors emerged from the provider perspective in determining use of telemedicine. While we reviewed telemedicine acceptance from consulting, presenting, and referring provider perspectives, for the purposes of this dissertation, we will only briefly summarize the review of consulting provider acceptance of telemedicine in this chapter. A comprehensive summary of findings from the meta review across all provider perspectives is presented in an integrated conceptual model, presented in Appendix A.

From a consulting provider perspective, the two perceptions that were most frequently cited are e-consultation diagnosticity and trust in the presenting provider's abilities. Regarding trust in the presenting provider, the telemedicine technology inherently imposes limitations on the extent of patient examination that the consulting provider can conduct and manage him/herself. Thus, in many cases, the consulting provider must rely on a presenting provider who is with the patient. In some studies, consulting providers specifically mentioned the importance of having a skilled presenting provider with the patient. Often, consulting providers mentioned that they must be able to trust that the presenting provider has the proper level of skills and knowledge to be able to effectively conduct a patient presentation.

Perceptions of e-consultation diagnosticity were primarily reflected by consulting providers in a post-usage context and were reflected in concepts such as the "effectiveness of telemedicine for patient examination and diagnosis" (Barton et al. 2007, p. 491), whether the medium provided sufficient clinical information for assessments (Fuchs 1979), and the perceived potential of making and receiving a diagnosis via telemedicine based solely on remote clinical presentations (Demartines et al. 2000). In most cases, consulting providers indicated perceptions of high e-consultation diagnosticity.

Other perceptions salient to consulting providers were shared across the different type telemedicine providers and can be characterized according to widely used technology acceptance and behavioral intention theories, such as Rogers' (1995) theory of diffusion of innovations (DOI), the technology acceptance model (TAM) (Davis 1986, 1989), the theory of reasoned action (TRA) (Fishbein and Ajzen 1975, Ajzen and Fishbein 1980), and the theory of planned behavior (TPB) (Ajzen 1991). Thus, perceptions of relative advantage (Rogers 1995), perceived usefulness and ease of use (Davis 1986, 1989) and facilitating conditions were also important factors determining consulting provider acceptance of telemedicine.

While the studies we reviewed are helpful in gaining a better understanding of the phenomenon of provider acceptance of telemedicine, many of the studies do not apply theory or rigorous methodologies. Furthermore, the studies that do apply theory and more advanced statistical techniques fail to consider the type of telemedicine in use, the type of provider, etc. For the most part, these studies test widely accepted telemedicine acceptance theories (TAM, TRA/TPB, DOI) in a telemedicine context but without theorizing about the context. In order to deepen the understanding of technology acceptance in a telemedicine context, researchers should theorize about the contextual factors (e.g., characteristics of the telemedicine system, type of provider, etc.) that will impact perceptions of use (Johns 2006).

In moving forward the research in telemedicine, there is a need for more studies that are rooted in contextualized theorizing and that employ rigorous study designs and data analyses. Based on our meta review, perceptions of e-consultation diagnosticity were most frequently cited as a relevant consideration by consulting providers. However, this concept was often captured in a single comment or survey item, and none of the studies explored what this concept means theoretically or the factors that determine e-consultation diagnosticity. Furthermore, this construct has not been developed theoretically and tested empirically within a nomological network of technology acceptance. To address these gaps, we will develop and test a theoretical model in order to explain and predict e-consultation diagnosticity and its impact on TMC use.

2.4. THEORETICAL BACKGROUND

In this section, we will describe theories and concepts that we use to develop the construct of e-consultation diagnosticity and its antecedents. The theoretical background includes concepts from the following domains: healthcare, marketing, and technology acceptance. Each of these concepts will be summarized next. The chapter concludes with a conceptual model that we further develop into a research model and hypotheses in chapter 3.

2.4.1. DIAGNOSTIC ACCURACY, AGREEMENT, AND CONFIDENCE

In the healthcare domain, the concept of diagnostic accuracy involves two dimensions: *sensitivity*, which indicates how well a test will correctly identify people who have a disease or condition, and *specificity*, which reflects how well a test will correctly identify people who do not have a disease or condition (Grigsby et al. 1995). Typically, studies assessing diagnostic accuracy use a "gold standard" against which to compare TMC decision outcomes (Hersh et al. 2006). The "gold standard" (also called "reference" or "criterion" standard) is the best method of determining the true outcome and usually involves a test (e.g. a biopsy) or combination of tests (Jaeschke et al. 1994), though sometimes the gold standard is an agreed upon diagnosis shared by two or more providers (Hersh et al. 2006).

Studies have also investigated diagnostic agreement between FTF medical consultation decision outcomes and TMC decision outcomes. These studies address the level of concordance between decisions rendered via TMCs versus FTF consultations regarding the same patient problem. As opposed to diagnostic accuracy studies, diagnostic agreement studies purely investigate a level of agreement between TMCs and FTF consultations, whereas diagnostic accuracy studies typically include sensitivity and specificity analyses (Hersh et al. 2006).

Studies concerning diagnostic accuracy and agreement are fairly inconsistent, primarily due to a lack of rigorous study designs and tests for statistical significance (Hersh et al. 2002, 2006). Hersh et al. (2002) conducted a systematic review of the diagnostic efficacy of telemedicine and assessed 33 interactive video studies and 22 store-and-forward studies, published through February 2001. They categorized studies based on the methodological rigor employed in the study designs and found that only 4 interactive video studies and 2 store-and-forward studies met the criteria for their highest quality category. In this review, the most common specialties studied for interactive video telemedicine were psychiatry, dermatology, cardiology and emergency medicine. They concluded that there were high levels of diagnostic accuracy and agreement in these studies, with the exception of dermatology, in which the highest quality study revealed significantly lower diagnostic agreement between telemedicine consultations and an in-person gold standard and as compared with FTF consultations and the same in-person gold standard. For store-and-forward studies, the most common specialties were dermatology and ophthalmology. As opposed to the studies of interactive teledermatology, the studies on store-and-forward dermatology revealed that telemedicine diagnoses were nearly as accurate as in-person diagnoses. Most studies on store-and-forward ophthalmology showed moderate to high levels of diagnostic accuracy and agreement, though one study showed lower levels of diagnostic accuracy with digital images when compared to photographs.

In a subsequent systematic review on the diagnostic efficacy of telemedicine, Hersh et al. (2006) reviewed 20 interactive video studies and 32 store-and-forward studies, published from January 2000 to June 2004. In this review, the most common specialties studied for interactive video telemedicine were ophthalmology, neurology, and psychiatry. With regard to the ophthalmology studies, diagnostic efficacy results were mixed; some revealed high levels of diagnostic agreement, whereas others found FTF consultations to be consistently more accurate than TMCs. Most studies in neurology and psychiatry revealed high levels of diagnostic agreement and accuracy using interactive video consultations. With regard to store-and-forward studies, the most common specialties evaluated were dermatology, wound care, and ophthalmology. However, Hersh et al. (2006) found that the quality of teledermatology studies were lower in quality in this review as compared to the previous review. One study showed complete diagnostic agreement, while most others revealed less concordance. In evaluating diagnostic accuracy, none of the studies included calculations of statistical significance but some concluded that store-and-forward teledermatology was less accurate than FTF dermatology consultations. Regarding the studies in wound care, most studies revealed a high degree of diagnostic efficacy of store-and-forward assessments; however, Hersh et al. (2006) deemed the quality of these studies too low to draw any solid conclusions. In the studies concerning store-and-forward ophthalmology, assessments largely revealed high levels of diagnostic accuracy, with the exception of one study that found lower concordance for severe diabetic retinopathy and particular abnormalities, indicating that not all ophthalmologic conditions may be amenable to evaluation using telemedicine. Hence, drawing from the reviews by Hersh et al. (2002, 2006), despite the weaknesses in the research design and methodologies in the reviewed studies, diagnostic accuracy and agreement may be largely dependent not only on medical specialties but also on specific medical conditions examined, and the type of telemedicine technology utilized (e.g., store-and-forward versus interactive video).

As opposed to the previous two concepts of diagnostic accuracy and agreement, the concept of diagnostic confidence is purely a subjective assessment of the decision making quality rendered in a medical consultation. Studies assessing physicians' diagnostic confidence in TMCs typically survey physicians who administer both TMCs and FTF consultations and compare perceptions of their decision making quality across both modalities. Some studies have revealed high levels of physician diagnostic confidence using TMCs (e.g. High et al. 2000; Krupinski et al. 1999; Lowitt et al. 1998; Nordal et al. 2001), while one study showed low perceptions of diagnostic confidence (Edison et al. 2008). In the latter study, the richness of the consultation medium contributed to levels of diagnostic confidence, with the richest medium (FTF) yielding the highest diagnostic confidence levels and the leanest medium (store-and-forward) yielding significantly lower diagnostic confidence levels (Edison et al. 2008).

While these studies are useful in identifying overall provider confidence levels in using TMCs for medical problem solving and decision making, they do not provide many insights explaining the factors that determine these confidence levels, other than image quality (Briggs et al. 1998; High et al. 2000; Krupinski et al. 1999; O'Sullivan et al. 1997) and media richness (Edison et al 2008). One exception is a study conducted by Randles and Thachenkary (2002), which reveals that referring/presenting physicians' diagnostic confidence is largely determined by the type of TMC and the physicians' own perceived knowledge gap. However, this study focuses on referring/presenting provider perceptions only and how telemedicine consultations with a specialist can help close the referring/presenting provider's knowledge gap and consequently increase diagnostic confidence.

In reviewing the healthcare literature, we can infer that objective and subjective diagnostic decision making are important areas to study in healthcare and have been studied extensively in the telemedicine context. However, for the most part, these studies focus exclusively on the single variable of diagnostic efficacy or confidence and do not explore the variable's antecedents or consequences. Given that diagnostic efficacy in telemedicine consultations is an important subject to investigate, it is equally essential to determine the factors that drive perceptions of diagnostic efficacy and how these perceptions influence telemedicine adoption decisions. To further develop these concepts, we draw from the literature in marketing and technology acceptance.

2.4.2. PERCEIVED TRIAL DIAGNOSTICITY

Because the focus of this dissertation is on providers' subjective perceptions of the medical consultation process used to diagnose health conditions, a theory that explores individuals' cognitions of an evaluative process provides a useful lens to develop the e-consultation diagnosticity construct. In the marketing literature, *perceived trial diagnosticity* is a concept used to describe consumer cognitions of a product trial process in evaluating a good or service. Perceived trial diagnosticity refers to consumers' perceived usefulness of a product trial experience in enabling consumers to evaluate product (good or service) attributes (Kempf and Smith 1998). Figure 3 represents a reduced version of Kempf and Smith's product trial model, which includes the perceived trial diagnosticity construct.

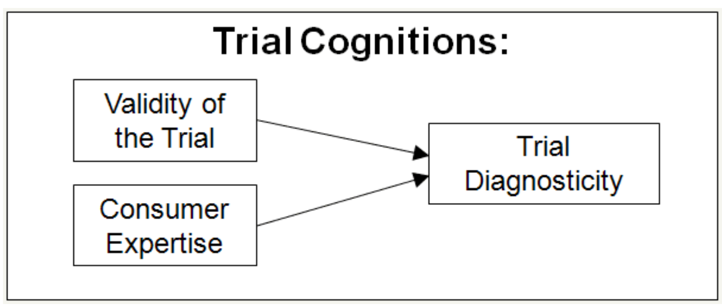


Figure 3. Trial Cognitions (Kempf and Smith 1998)

In order for a trial (i.e., the evaluation process) to be perceived as diagnostic, the consumer must perceive that the trial experience is valid. V*alidity of the trial* refers to how credible and representative a trial experience (i.e. the evaluation process) is perceived to be in conveying a product's true performance. Typically, perceptions of trial validity only arise when the validity is threatened by disruptive cues, such as having insufficient time to fully evaluate the product, observing unrealistic product performances, or not being able to directly assess all of the product's attributes. *Perceived consumer expertise* refers to the consumer's beliefs concerning his/her own ability to adequately process product information during a trial experience. Consumers that perceive that they have sufficient expertise in the product domain believe that they are better able to evaluate products.

In the IS literature, the construct of perceived trial diagnosticity has been adapted to e-commerce research to explain and predict phenomena concerning electronic, versus physical, evaluations of products, and perceived trial diagnosticity has been referred to as *perceived website diagnosticity* (Jiang and Benbasat 2004; Jiang and Benbasat 2007), *perceived product diagnosticity* (Pavlou and Fygenson 2006; Pavlou et al. 2007), and *perceived review diagnosticity* (Mudambi and Schuff 2010). In these studies, the definition of perceived diagnosticity remains relatively constant and refers to the perceived ability of a Web site to allow consumers to fully evaluate products online. Mudambi and Schuff (2010) refer to review diagnosticity as the helpfulness of the online review in aiding the online purchase decision making process. Thus, this definition is also consistent with the notion that perceived diagnosticity refers to the ability of technology-mediated information to facilitate decision making processes regarding a particular product. However, only three of these studies investigate the antecedents of perceived diagnosticity (Jiang and Benbasat 2004; Jiang and Benbasat 2007; Mudambi and Schuff 2010), and they are summarized next.

Within the context of online shopping, Jiang and Benbasat (2004) specify two antecedents of perceived diagnosticity: visual control and functional control. Visual control enables consumers to manipulate representations of online products using web animation features such as "rotate" and "zoom" in order to visualize a product in different ways. Functional control enables consumers to experience how an online product works by manipulating the behavior of online products—e.g. by clicking on functional buttons to observe how the product responds or by using an online mannequin or avatar to try on clothes. These controls provide richer and more comprehensive information to consumers, which increase their understanding of products and enable them to make more informed purchase decisions.

In another study concerning online shopping, Jiang and Benbasat (2007) posit that *interactivity* and *vividness* are antecedents to perceived diagnosticity and that perceived diagnosticity influences attitudes toward online shopping and, consequently, intentions to purchase products from an online store. Interactivity and vividness are concepts Jiang and Benbasat adopt from telepresence theory (Steuer 1992), and they utilize the original definitions of these constructs in their study. Interactivity is defined as "the extent to which users can participate in modifying the form or content of a mediated environment in real time" (Steuer 1992, p. 84), and vividness is defined as "the representational richness of a mediated environment as defined by its formal features; i.e., the way in which an environment presents information to the senses" (Steuer 1992, p. 81). Jiang and Benbasat (2007) argue that increased interactivity, through the use of functional and visual controls, enable the consumer to gain a better understanding of the product and how it works. Increased vividness conveys to consumers more information cues about a product and a greater sense of a realistic shopping experience, thereby engaging consumers in processing product information. Together, interactivity and vividness enhance consumer perceptions of product diagnosticity.

In a study on online consumer reviews, Mudambi and Schuff (2010) posit that information depth positively influences review diagnosticity by aiding in the decision making process and increasing the consumer's decision confidence. In other words, information that is more thorough concerning a product aids consumers in making confident purchase decisions.

While Jiang and Benbasat (2004, 2007) investigate online product representations in terms of images and animations of the goods, Mudambi and Schuff (2010) study online product representations in terms of consumer-generated feedback in the forms of textual review comments and star ratings.

2.4.3. PERCEIVED E-CONSULTATION DIAGNOSTICITY

We adapt the conceptualization of perceived diagnosticity used in IS research to develop a new construct, e-consultation diagnosticity, within the context of telemedicine consultation applications. *E-consultation diagnosticity* is defined as the perceived ability of the telemedicine system (technology and users) to enable consulting providers to understand and evaluate the health conditions of remote patients. In other words, e-consultation diagnosticity is the perceived ability of the telemedicine system to enable clinical evaluations of patients. Given that the medical diagnosis is a critical process in the medical consultation, we posit that perceptions of e-consultation diagnosticity will influence telemedicine adoption and use.

Given the importance of e-consultation diagnosticity in the scope of telemedicine acceptance, we are mainly interested in determining the antecedents of e-consultation diagnosticity. To summarize the literature on perceived diagnosticity, the following factors have been presented as determinants of perceived diagnosticity:

- *Validity of the trial:* how credible and representative the evaluation process is perceived to be in conveying a product’s true performance (Kempf and Smith 1998)
- *Consumer expertise:* the consumer’s beliefs concerning his/her own ability to adequately process product information during the evaluation process (Kempf and Smith 1998)
- *Interactivity:* the extent to which users can participate in modifying the form or content of a mediated environment in real time (Steuer 1992)

- *Vividness:* the representational richness of a mediated environment as defined by its formal features; i.e., the way in which an environment presents information to the senses (Steuer 1992)
- *Information depth:* the amount and completeness of information available about a product (Mudambi and Schuff 2010)

While subsets of these concepts have been used to predict perceived diagnosticity within the context of e-commerce, they also provide insights into antecedents of perceived diagnosticity within the context of telemedicine. For example, we believe that the representativeness, or representational richness (to include information depth), of the telemedicine technology will be an important factor in determining e-consultation diagnosticity. Furthermore, we believe that the expertise of the telemedicine consultation participants, and how they are able to interact with each other within a technology-mediated environment, will influence perceptions of e-consultation diagnosticity as well.

To organize these concepts using a more structured theoretical framework, we draw upon process virtualization theory (Overby 2008), which will help explain the extent to which the process of evaluating and diagnosing patients can be virtualized.

2.4.4. PROCESS VIRTUALIZATION THEORY

Process virtualization theory, which distinguishes between physical and virtual processes, provides a useful framework to identify the factors that can influence the virtualization of the medical consultation process. Physical processes involve physical interactions between people and/or objects, and virtual processes are those in which these *physical* interactions have been removed (Overby 2008). Thus, process virtualizability describes how amenable a process is to being conducted without physical interaction between people and/or objects (Overby 2008). Process virtualizability is defined and operationalized as a continuous variable and should be regarded in terms of degree, rather than on/off (Overby 2008). Within the context of telemedicine consultations, the virtualization of the medical consultation process (i.e., the transition to a TMC) is the extent to which the medical consultation process is amenable to removal of physical interactions between consulting providers and patients. Overby (2008) suggests that process virtualizability can be operationalized as adoption of the virtual process or the quality of the virtual process outcomes. In developing our conceptual model, we define the virtualizability of the medical consultation in terms of the latter; specifically, we define outcome quality subjectively in terms of the perceived quality of medical problem solving enabled by the TMC technology (i.e., e-consultation diagnosticity).

Figure 4 presents the process virtualization theory research model. Process virtualizability is a function of the sensory requirements, relationship requirements, synchronism requirements, and identification and control requirements of the process to be virtualized. The effects of these constructs on process virtualizability are positively moderated by the IT-specific capabilities of representation, reach, and monitoring. The main propositions of the process virtualization model are summarized next.

The *sensory requirements* of a process are the process participants' perception of the need to enjoy a full sensory experience within the process (Overby 2008). Sensory experience is a general term that encompasses all of the five senses (seeing, hearing, smelling, touching, and tasting) and the sensations experienced during a process. The sensory requirements of a process are posited to have a negative relationship with process virtualizability. Overby (2008) gives examples of processes that are sensory in nature and difficult to replicate in a virtual setting, such as manipulating clay in a sculpting class and experiencing the overall sensation and excitement in attending a live sporting event, to support this proposition. Likewise, within the context of medical consultations, there will be instances in which the clinical evaluation will require physical contact and interaction in order to conduct a thorough assessment. Thus, we believe that the degree to which the clinical evaluation relies on the sensory requirements will influence perceptions of e-consultation diagnosticity.

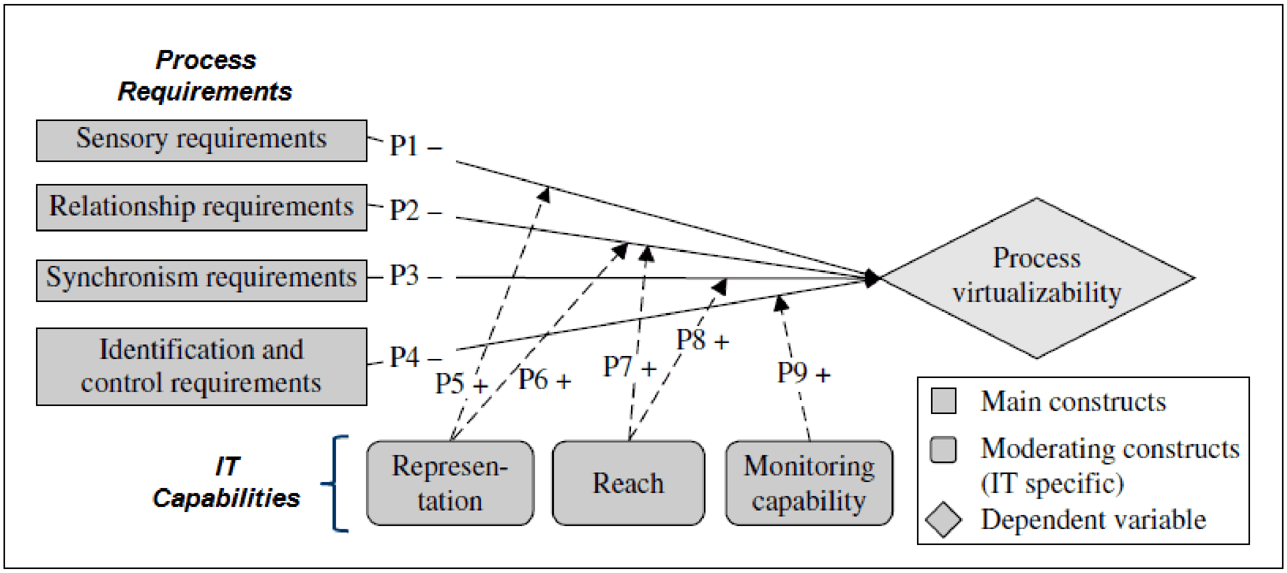


Figure 4. Process Virtualization Theory Research Model (Overby 2008)

The *relationship requirements* of a process are the process participants' perception of the need to interact with other process participants in a social or professional context (Overby 2008). According to Overby (2008), interactions in social and professional contexts often lead to knowledge acquisition, trust, and friendship development, and he posits that relationship requirements of a process have a negative relationship with process virtualizability. According to media richness theory (Daft and Lengel 1986) and social presence theory (Short et al. 1976), a broader range of communication cues (e.g., gestures, posture and inflection) can be transmitted via rich media, such as physical interaction in person, as opposed to lean media, such as email.

These various communication cues are instrumental in conveying interpersonal warmth and attentiveness, which are useful in developing relationships; thus, virtual environments that lack these cues will be less amenable to relationship development (Overby 2008). Likewise, within the context of medical consultations, patients who feel comfort and rapport with their consulting provider are more likely to disclose pertinent information about their current conditions and medical history. Thus, a trusting relationship between a provider and patient is often necessary in order to enable high quality information sharing.

Upon closer evaluation of Overby's definition and description of relationship requirements, we determined his conceptualization of this construct actually taps into two distinct concepts: *interaction requirements* and *trust requirements*. We thus developed these two constructs in conceptualizing relationship requirements. We define these two constructs within the medical consultation context, though they can be defined more broadly, as Overby does, for other research contexts. Interaction requirements is defined as the perceived need for process participants to interact with one another and exchange information in a medical consultation context, and trust requirements is defined as the perceived need for the advice-seeker to trust the advice-giver in a medical consultation context.

The *synchronism requirements* of a process are the process participants' perception of the need that the process activities must take place quickly and with minimal delay (Overby 2008). Synchronism requirements are posited to have a negative relationship with process virtualizability (Overby 2008). Overby (2008) gives examples of processes that have high synchronism requirements and are difficult to replicate in a virtual setting, such as shopping for perishable goods and achieving synchronous interaction in a classroom setting, to support this proposition. While he acknowledges that synchronism can be achieved in a virtual setting, he concludes that synchronism requires extra steps and effort to achieve in virtual environments, as opposed to physical settings, in which synchronism typically “comes ‘for free’” (Overby 2008, p. 282). Within the context of medical consultations, while not all health conditions are best evaluated via synchronous interaction between the provider and patient, synchronous communication facilitates the diagnostic process through the provision of constant immediate feedback between the process participants (Daft and Lengel 1987). Hence, the extent to which the medical evaluation requires immediate feedback will impact perceptions of e-consultation diagnosticity.

The *identification and control requirements* of a process are the process participants’ perception that the process needs to uniquely identify process participants and include functions to control or influence behavior (Overby 2008). Identification and control requirements are posited to have a negative relationship with process virtualizability (Overby 2008). Overby (2008) argues for this proposition by stating that virtual processes are susceptible to identity spoofing due to the difficulties in inspecting individuals to confirm their identities. Consequently, in virtual settings, it may be more difficult to discern who is engaging in certain activities and to control behaviors. Within the context of medical consultations, identity verification is an important requirement. Providers must be confident that the patients are who they say they are, and patients need to be sure that the provider whom they are consulting is indeed a healthcare provider with proper credentials.

Overby (2008) explains that processes can be virtualized without using IT and gives examples of mail-order shopping catalogs and correspondence courses. However, he proposes that advancements in IT, particularly the Internet, have contributed to the proliferation of virtual processes in recent years. In process virtualization theory, three IT capabilities are specified—

representation, reach, and monitoring—that positively moderate the relationship between the process requirements and process virtualizability.

Representation refers to "IT's capacity to present information relevant to a process, including simulations of actors and objects within the physical world, their properties and characteristics, and how we interact with them" (Overby 2008, p. 283). Because IT can be used to dynamically simulate certain sensory elements of physical environments (e.g. sights and sounds), the representation capability of IT can facilitate the integration of sensory requirements into IT-based virtual processes. Furthermore, IT can be used to simulate actors through the creation of highly descriptive personal profiles, and these profiles can be matched and connected in order to form and/or sustain relationships. Thus, the representation capability of IT can also facilitate the integration of relationship requirements into IT-based virtual processes. We believe the same propositions should hold true within the context of medical consultations.

Reach refers to IT's capability to allow for process participation across time and space (Overby 2008). Reach facilitates process participants' ability to interact with each other regardless of their geographic location, enabling the creation and sustenance of relationships. Thus, reach facilitates the virtualization of processes with high relationship requirements. Furthermore, Overby (2008) postulates that reach is enabled through real-time interactive communication, which also facilitates the virtualization of processes with high synchronism requirements. Within the context of medical consultations, we believe these propositions will also hold true.

Monitoring capability refers to IT's ability to authenticate process participants and track activities (Overby 2008). IT-based virtual processes enable the authentication of users though logins, security questions, or other similar methods in order to uniquely identify individuals. In addition, IT-based virtual processes can include the capability of tracking and analyzing user actions. Overby (2008) gives the example of online course systems. Thus, the monitoring capability of IT facilitates the virtualization of processes with high identification and control requirements. This proposition should also hold true within the context of medical consultations.

2.5. E-CONSULTATION DIAGNOSTICITY CONCEPTUAL MODEL

While process virtualization theory provides a useful framework to structure our research model, the process virtualization model is only comprised of two main components: process requirements and IT capabilities. In our review of the literature on perceived diagnosticity, concepts of user expertise and participant interaction also were important factors to consider. Within the context of telemedicine, we believe that concepts surrounding the process participants and the participants' interactions within an IT-mediated environment will be key drivers of e-consultation diagnosticity.

Overby (2008) alludes to the addition of participant-related factors in enabling process virtualizability; for example, when he discusses relationship requirements, he states: "Each of these examples suggests that processes with high relationship requirements can be virtualized, but that additional steps must be taken (e.g., incorporation of face-to-face meetings, gaining experience with a new medium) or certain conditions must either be present or developed (e.g., a shared identity)" (p. 281). He explains that these additional steps increase the amount of effort required to virtualize the process, thereby making the process more resistant to virtualization. However, we believe it is important to elucidate these "additional steps" and conditions that facilitate the virtualization of the medical consultation process in order to reflect a more holistic *information systems use* perspective of process virtualization, which involves user behaviors.

In defining *system usage*, Burton-Jones and Straub (2006) propose that system usage involves three elements: a user (i.e., the process participant using the IT), a system (i.e., the IT being used), and a task (i.e., the process function being performed). In other words, system usage encompasses a user's employment of IT in order to perform tasks that comprise a process. Process virtualization theory includes *IT capabilities* (system) and *process requirements* (task), but ignores the user. As such, our conceptual model of e-consultation diagnosticity (Figure 5), incorporates the *user* and posits that both user capabilities and *IT* capabilities are important in process virtualization. Therefore, our model reflects an information systems perspective of process virtualization rather than an IT perspective on process virtualization.

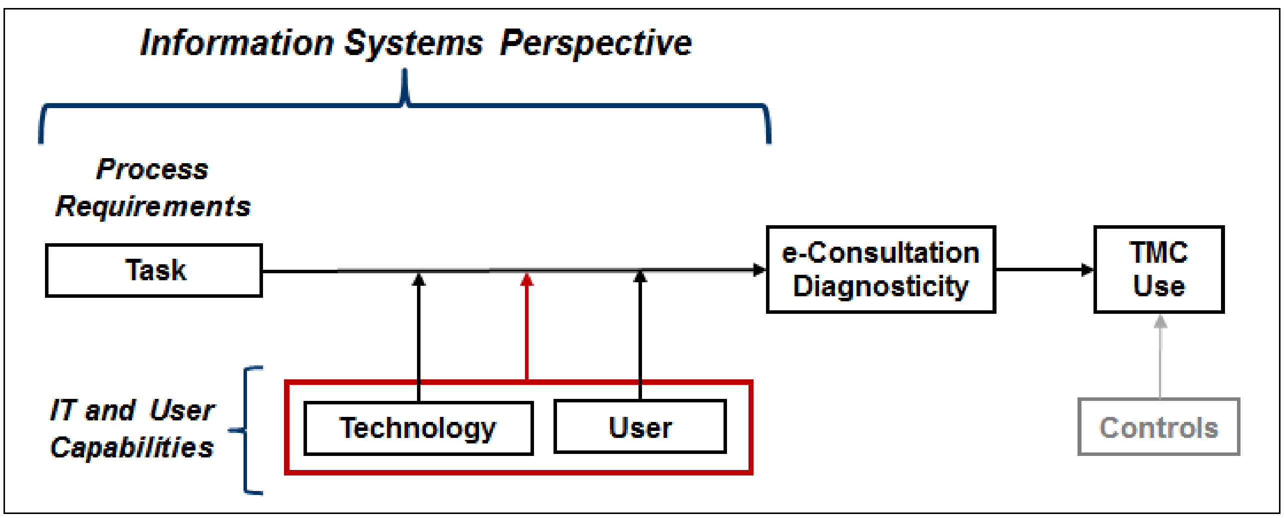


Figure 5. E-Consultation Diagnosticity Conceptual Model

Within the context of telemedicine consultations, this holistic perspective of the process is particularly relevant because the information system involved does not simply reflect a user interacting with a system, such as an online shopping website; rather, telemedicine involves at least two individuals interacting with each other through an IT-mediated system. Thus, in assessing virtual group processes, the capabilities of the process participants and how they interact with each other in an IT-mediated environment are key considerations in determining process virtualizability. These concepts are not explicitly included in Overby's process virtualization model. Hence, a key contribution of this dissertation is the extension of process virtualization theory to include constructs and propositions concerning the process participants' role in enabling process virtualizability.

In the next chapter, we will expound upon the conceptual model to develop our research model with hypotheses. The controls we incorporate will be largely based on relevant variables selected from the review on provider acceptance of telemedicine.

CHAPTER 3: RESEARCH MODEL AND HYPOTHESES

3.1. INTRODUCTION

This chapter builds upon the conceptual model to develop the research model and hypotheses for the dissertation. Along with theory, we will support our research model and hypotheses with qualitative data that we have collected for this study.

3.2. RESEARCH MODEL

Because e-consultation diagnosticity is a factor most salient to consulting providers, as indicated by our meta review, the research model (Figure 6) will be tested from the consulting provider perspective. Though e-consultation diagnosticity is a salient consideration for referring providers as well, since these providers are not necessarily directly engaged in the telemedicine medical consultation process, their perspectives may vary. As such, it is best to study consulting provider and referring provider perspectives on e-diagnosticity separately to avoid confounding effects. We also explore the phenomenon within the context of synchronous (interactive video) TMCs to narrow the scope of our study. Medical consultations through TMCs can occur both via interactive video as well as through store and forward capabilities where images (e.g., x-rays, photographs of dermatology problems) are sent to consulting physicians asynchronously for assessment. Though e-diagnosticity perceptions are important for both types of TMC consultations, our interest in this project is in synchronous TMCs. The choice of synchronous versus asynchronous consultations influences inclusion or exclusion of constructs in the research model. For instance, the constructs *synchronism requirements, identity and control requirements,* and *monitoring capability* are important in contexts where the technology varies in its ability to support synchronous interaction, confirm identity, and provide control and monitoring capabilities. Given that live video interaction through TMC is synchronous and uniformly provides identity, control, and monitoring capabilities, these factors are invariant in our context and thus excluded from the research model.

Furthermore, we do not believe that the IT capability of *reach*, which is IT's ability to permit process participation across time and space, will influence perceptions of e-consultation diagnosticity. Rather, perceptions of reach will underlie perceptions of access to healthcare, which will directly impact TMC adoption and use. Thus, reach is included as a dimension of perceived usefulness, which is used as a control variable and not as a direct antecedent of e-consultation diagnosticity.

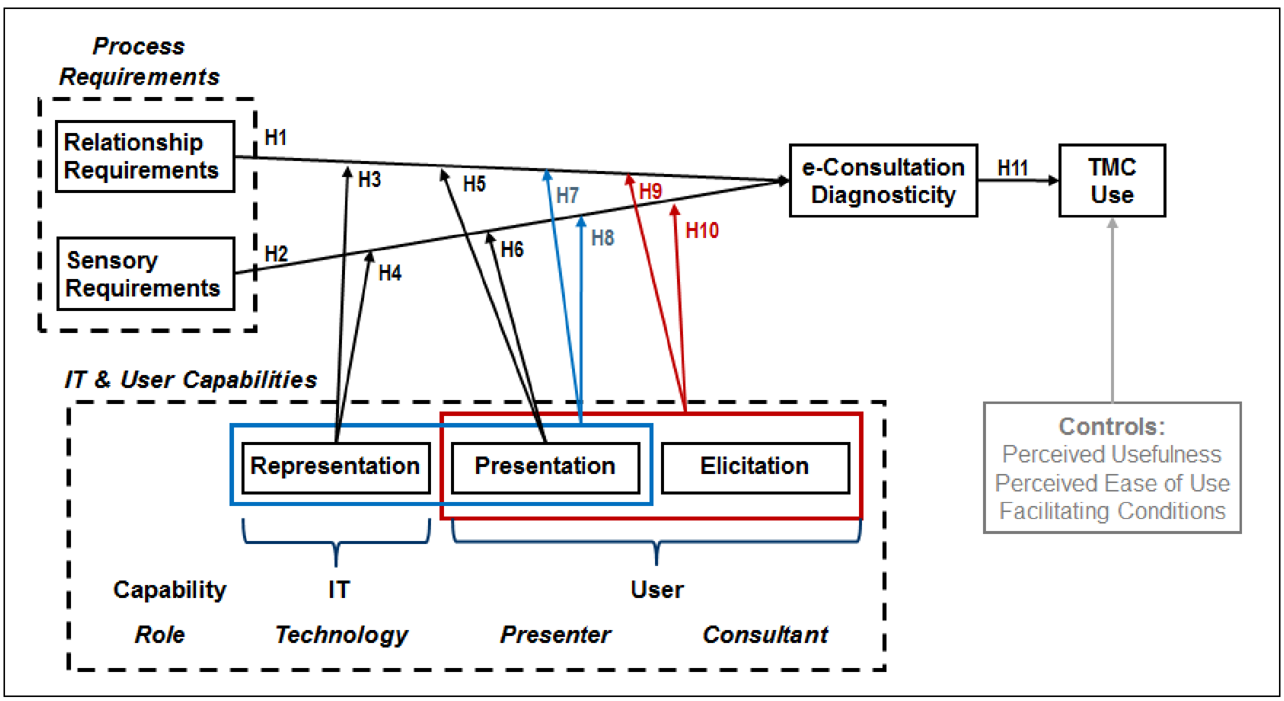


Figure 6. E-Consultation Diagnosticity Research Model

3.3. DEFINITIONS OF KEY CONSTRUCTS

In specifying our research model, we adapt some of the construct definitions from process virtualization theory. These definitions, along with definitions of new constructs in the research model, are provided in Table 1.

Two new constructs we introduce in our model are *presentation* and *elicitation.* These constructs reflect the user capabilities in facilitating the virtualization of the medical consultation process. The two user roles in a telemedicine consultation are the presenter and consultant. The presenter can be the patient and/or presenting provider, and the consultant is the consulting provider. Presenters have the capability of *presentation*, which reflects their ability to relay information relevant to the medical consultation process, through articulating pertinent information and executing steps that inform the process. Consultants possess the capability of *elicitation*, which reflects their ability to gather information relevant to the medical consultation process, through interviewing and instructing the presenter in a manner that informs the process. In a technology-mediated consultation process where a remote expert (in this case the consulting provider) engages in a dialog with a user (in this case patient or presenter) the ability to elicit information by asking pertinent questions (interviewing skills) and guiding the user in their responses or actions they have to take to derive the needed information (instruction skills) is critical to the quality of information that is produced to inform the diagnostic decision making process. Equally important is the ability of the patient or presenter to be able to clearly and accurately communicate symptoms and other pertinent information (articulation skills) and perform the diagnostic procedures (e.g., use scopes, palpate specific areas) necessary to derive the clinical information needed by the consulting provider (execution skills).

Table 1. Definitions of Key Constructs

Construct	Definition
Perceived e-Consultation Diagnosticity	The perceived ability of the telemedicine system (includes technology and users) to enable consulting providers to understand and evaluate the health conditions of remote patients
Interaction Requirements	The perceived need for process participants to interact with one another and exchange information in a medical consultation context
Trust Requirements	The perceived need for the advice-seeker to trust the advice-giver in a medical consultation context
Sensory Requirements	The perceived need for process participants to be able to enjoy a full sensory experience of the process and other process participants and objects in a medical consultation context (Overby 2008)
Representation	The telemedicine technology's capacity to present information relevant to a process, including simulations of actors and objects within the physical world, their properties and characteristics, and how process participants interact with them (Overby 2008)
Presentation	Presenters' capacity to relay information relevant to a process, based on their ability to articulate pertinent information and execute actions that inform the process
Elicitation	Consultants' capacity to obtain information relevant to a process, based on their ability to interview and instruct the presenter(s) in a manner that informs the process

3.4. HYPOTHESES

In this section, we hypothesize the main relationships of the research model. Specifically, we discuss the antecedents of e-consultations diagnosticity and the impact on telemedicine use.

3.4.1. MEDICAL CONSULTATION PROCESS REQUIREMENTS AND E-CONSULTATION DIAGNOSTICITY

3.4.1.1. Relationship Requirements and e-Consultation Diagnosticity

In our research model, we define *relationship requirements* in terms of the need for trust and interaction (i.e., information exchange) in a medical consultation context. Regarding the medical consultation process, patient information, primarily in the forms of medical history and current health status, is a critical input. In fact, the patient's medical history, as opposed to physical patient exams and tests, contributes the most relevant evaluative data to consulting providers in medical consultations (Hampton et al. 1975, Peterson et al. 1992). Moreover, “the knowing process and resultant trust is the pivotal and most important outcome of the clinical history” (DeMeyer 2009, p. 23). According to Overby (2008), interpersonal relationships based on trust often lead to higher knowledge acquisition. Patients who feel comfort and rapport with their consulting providers are more likely to disclose pertinent information about their current conditions and medical history. This notion is supported in the literature on doctor-patient relationships, which asserts that the interpersonal relationship between doctors and patients “provides the basis for establishing comfort and trust, for exchanging information that will be used to make health-care decisions and for negotiating patient and physician decision making roles” (Barnsley et al. 1999, p. 936). Thus, a trusting relationship between the consulting provider and patient is often necessary in order to enable high quality information sharing.

However, according to media richness and social presence theories, interpersonal relationships are more easily established through face-to-face interaction, a medium that most effectively enables synchronous verbal and nonverbal communication between process participants (Daft and Lengel 1986, Short et al. 1976). Kock (2004) developed media naturalness theory, which is based on evolutionary theories. A key tenant of this theory is that humans have evolved to communicate face-to-face as their primary communication medium, and the use of communication media that suppress features of face-to-face communication will pose challenges to communication. Empirically, there has been support for the notion that relationship development is more difficult to achieve in virtual collaboration environments (Jarvenpaa et al. 1998, Jarvenpaa and Leidner 1999, Jarvenpaa et al. 2004, Paul and McDaniel 2004). Therefore, the extent to which the medical evaluation requires a high level of interpersonal trust and interaction will influence perceptions of e-consultation diagnosticity.

Hypothesis 1: Relationship requirements of the medical consultation, in terms of interaction and trust, will be negatively related to e-consultation diagnosticity.

In some interviews we conducted, the consulting providers described the importance of establishing a trusting relationship with the patient in order to facilitate knowledge acquisition. They also explained that this type of interpersonal interaction is difficult to achieve via technology-mediated communication. Two providers' representative comments are provided to illustrate support for Hypothesis 1:

> *"It's going to be hard to build a relationship through telemedicine like that because you're not face-to-face. I mean, you are face-to-face but not physically face-to-face. [Building a relationship is important] in getting them to open up…and discuss the issues that they have." – Consulting Physician (Interview)*

> *"I think that patients might be more likely to open up more fully to a doctor that they know and trust. And a lot of times when I would come in with a patient at first, that I didn't know, they were kind of standoffish, a little wary of me. But once we had talked for a few minutes, then they seemed to kind of say okay, this looks like a person that I can trust, that really cares about why I'm here. And then they might go ahead and tell me stuff that they otherwise might not have…The telemedicine…I don't think it would ever be exactly as close or as warm or as perhaps as trusting as you would get in person." – Consulting Physician (Interview)*

3.4.1.2. Sensory Requirements and e-Consultation Diagnosticity

The *sensory requirements* of a process are the process participants' perception of the need to enjoy a full sensory experience within the process (Overby 2008). Sensory experience is a general term that encompasses all of the five senses (seeing, hearing, smelling, touching, and tasting) and the sensations experienced during a process. In a virtual environment, the senses of smelling, touching, and tasting are difficult to replicate, though there have been some advancements on this front in the realm of virtual reality. For example, a study by Sallnäs et al. (2000) found that the application of haptic force feedback in a virtual desktop environment increased perceived social presence. However, by and large, certain senses are not easily simulated in virtual settings, and this limitation has been cited as a challenge to virtualizing processes, such as relationship development and shopping (Overby 2008). In the case of a clinical evaluation, seeing, hearing, and touching are likely to be the most salient sensory requirements, with their relative importance being determined by the nature of a patient's health condition. Physicians evaluate specific patient symptoms through "touch and feel" (e.g. swelling or pain), through seeing (e.g. visually inspecting a rash or the inner ear, visually observing body language), and through hearing (e.g. listening to lung and heart sounds). Thus, the degree to which the medical evaluation relies on these sensory requirements will influence perceptions of e-consultation diagnosticity.

> ***Hypothesis 2: Sensory requirements of the medical consultation will be negatively related to e-consultation diagnosticity.***

In our interviews and the literature, several consulting providers mentioned sensory limitations, primarily the sense of touch, in virtual (interactive video and phone) consultations and how these limitations could impede the diagnostic process. These comments provide support for Hypothesis 2:

> *"There are times when there's no substitute for laying your hands on somebody and just seeing the temperature of their skin and things that just cannot be transmitted." – Consulting Physician (Interview)*

> *"It is impossible to do a trustworthy physical exam over a video screen. I could not possibly rule out appendicitis over the screen and therefore had to transfer this patient to the ER." – Consulting Physician (Survey)*

3.4.2. MODERATING EFFECTS OF REPRESENTATION

3.4.2.1. Representation and Relationship Requirements

Representation refers to "IT's capacity to present information relevant to a process, including simulations of actors and objects within the physical world, their properties and characteristics, and how we interact with them" (Overby 2008, p. 283). In an interactive video telemedicine context, representation reflects seamless interaction between consultants and presenters and simulations of sensory cues (e.g. visual, auditory, and tactile). Given the definition of representation, which encompasses the quality of information about actors and objects and the quality of interaction with them, we draw on the concepts of information quality (DeLone and McLean 1992) and media richness (Daft and Lengel 1986) to better understand the full conceptual scope of representation.

Information quality is defined as the quality of the information system output (DeLone and McLean 1992). In an interactive video TMC context, information quality encompasses video/image quality, audio quality, and the full range of diagnostic information that can be conveyed via the technology. The literature identifies several aspects of information quality (DeLone and McLean 1992, 2003); for this study, the attributes of accuracy and completeness are most relevant. This is because several of the other attributes of information quality (e.g. timeliness and objectivity) do not easily translate to the context of interactive video telemedicine consultations. *Accuracy* taps into the perceived correctness of the information transmitted and received through the telemedicine technology (DeLone and McLean 1992, 2003; Lee et al. 2002; Wixom and Todd 2006). In other words, there are no distortions in the video/image and audio that introduce misrepresentations of the patient data. *Completeness* refers to the full range of diagnostic information that can be conveyed through the telemedicine system. In other words, to the extent that the telemedicine system includes the needed peripheral devices (e.g. stethoscope, otoscope, dermascope, cameras, etc.) and the needed system features (e.g. ability to zoom in/out to obtain the needed range of view, the ability to adjust the audio volume, etc.) will define the completeness of information that is available. However, completeness does not fully capture the way in which the telemedicine technology can convey the quality of interaction between the process participants; therefore, we also refer to media richness theory to conceptualize representation.

Media richness is a medium's ability to convey rich information, with face-to-face being defined as the richest medium (Daft and Lengel, 1986; Daft et al. 1987). Media richness is based on the ability of the medium to provide instantaneous feedback; to convey multiple cues, such as physical presence, voice inflection, and body gestures; to provide language variety (e.g., numbers and natural language); and to enable the conveyance of personal feelings and emotions, also referred to as personal focus. In considering an interactive video telemedicine context, the attributes of instant feedback and language variety are features that are inherent to the telemedicine system. Thus, we only draw on the media richness attributes of multiple cues and personal focus in our conceptualization of representation. According to Kahai and Cooper (2003), the *multiple cues* of a communication medium include both verbal and nonverbal cues. Verbal cues can be represented linguistically, while nonverbal cues include communication attributes such as body language, paralanguage (e.g. yawning, voice inflection), and sensory cues (e.g., smell, touch). The *personal focus* of a communication medium refers to the medium's ability to convey the communication participants' personal feelings and emotions in the message (Daft and Lengel 1987).

According to social presence theory, communication media that enable the transmission of a wide range of communication cues are best represented in face-to-face environments, and these settings are more ideal for interpersonal tasks than settings representing leaner media (Short et al. 1976). Furthermore, Kock (2004) suggests that humans have biologically evolved to be predisposed to face-to-face communication, and deviations from this mode of communication increase the cognitive effort required to accomplish communication tasks. Studies concerning the use of interactive video for communication tasks largely support the notion that communication via interactive video increases the participants' cognitive workload by presenting challenges in conversation pacing and turn-taking, asymmetric personal distance, and heightened self-awareness (Ferran and Watts 2008, Ferran-Urdaneta and Storck 1997, O'Conaill et al. 1993, O'Malley et al. 1996, Storck 1995). However, some studies have revealed no differences in face-to-face and interactive video media in successfully completing social tasks (Ferran and Watts 2008). A systematic review of doctor-patient communication via telemedicine reveals more positive findings than negative findings with regard to perceptions of telemedicine communication; the only two exceptions found were the categories of nonverbal behavior and lack of touch (Miller 2001). Furthermore, the doctor-patient communication research in the telemedicine literature has highlighted the importance of the doctor-patient relationship in enabling information giving and seeking between physicians and patients and has shown that richer media are better suited to facilitate this information exchange (Miller 2002).

According to process virtualization theory, the greater the process participants perceive that the medium is able to simulate the physical world and participant interactions, the lesser the negative impact of relationship requirements on the virtualizability of the process. Hence, within a telemedicine context, representation facilitates the virtualization of medical consultations with high relationship requirements.

> ***Hypothesis 3: IT representation capability will moderate the relationship between relationship requirements and e-consultation diagnosticity, such that relationship requirements will have a weaker effect on e-consultation diagnosticity for consultations with higher representation capability than for those with lower representation capability.***

The extent to which consultants and presenters perceive the telemedicine medium to effectively enable natural communication and interaction will positively impact their perceptions of the ability to establish a trusting relationship with one another and exchange pertinent medical information. One of our interview respondents indicated the importance of the visual channel of telemedicine to simulate face-to-face communication and, thereby, facilitate feelings of comfort and rapport in the interaction between consulting provider and patient. This enhanced social presence prompts patients (who are the presenters in this case) to be truthful and open about their medical condition. A survey respondent also commented that the representation of the telemedicine technology was "real life" and he/she was able to communicate with the patient easily. These respondents' comments provide support for Hypothesis 3.

> ***Interviewer:*** *How important is the video component? Is it something you could just do over the phone?*
> ***Consulting Provider:*** *No. You need to see the person. You can't do it over the phone. You need to observe the person in order to do your physical psychiatric evaluation…You still need to be—visualize the person and have—because a part of a psychiatric evaluation is developing some rapport with the patient. The patient needs to feel comfortable with you, and you working with them, so that there's honesty and disclosure of what is going on, that kind of thing. So that's a little hard to do fully, I think, without being face-to-face with somebody.*
>
> *"Basically, the interview and evaluation was conducted almost exactly as I would have performed face-to-face. Audio and visuals were real life…and the patient communicated freely." – Consulting Physician (Survey)*

3.4.2.2. Representation and Sensory Requirements

The representation of the telemedicine system also facilitates the relationship between the sensory requirements of the medical evaluation and e-consultation diagnosticity. The sensory information of a process is captured in the multiplicity of cues attribute of media richness, as well as in the accuracy and completeness of information transmitted via the telemedicine system. In other words, the representation of the telemedicine system can enable the participants to see and hear one another in real-time, to gain accurate and wide-ranging representations of images and sounds, and to manipulate visuals and sounds through system features (e.g., zoom in/out, volume control). As mentioned previously, the most important sensory cues likely required in a medical consultation are the senses of touching, hearing, and seeing. While all of these cues may not be important for every medical consultation, the greater extent to which consultants and presenters perceive that the telemedicine medium can accurately and completely simulate relevant sensory cues that enable effective medical evaluations will lessen the negative impact of sensory requirements on e-consultation diagnosticity.

> ***Hypothesis 4:*** ***IT representation capability will moderate the relationship between sensory requirements and e-consultation diagnosticity, such that sensory requirements will have a less negative effect on e-consultation diagnosticity for consultations with higher representation capability than for those with lower representation capability.***

Interview data from our interviews and the literature provide support for this hypothesis. The following responses highlight the importance of the audio and video channels of telemedicine in representing the necessary sensory cues required in a medical evaluation:

> *"If I could listen to that patient on telemedicine, or if I could listen to their…They can't tell me…They'll say, 'Well, his pulse is a little irregular.' Well, if I could look at him on telemedicine and listen, I can tell you if it's A-Fib [atrial fibrillation] or PAC's [premature atrial contractions]…I can't tell that over the phone." – Consulting Physician (Interview)*

> *"We do sometimes need to watch a patient walk, zoom into the patient close or up close to their hands to make sure that they're not having—to their face or their hands or their feet or whatever to make sure that there aren't any kind of side effects from medications, that kind of thing. But we can usually do that very well from the camera." – Consulting Provider (Interview)*

While the sense of touch is not easily replicated electronically, some consulting providers explained that diagnostic imaging conducted via telemedicine could substitute for the need to touch, as illustrated in the following quote:

> *"Well, you know, anatomic defects that you were trying to feel, where it would be necessary to feel in order to evaluate would be difficult with telemedicine…but in that situation we could use an ultrasound. Usually, we could tell the same information in an ultrasound and would not need to feel." – Consulting Physician (Interview)*

3.4.3. MODERATING EFFECTS OF PRESENTATION

3.4.3.1. Presentation and Relationship Requirements

In our research model, we define *presentation capability* as a user's capacity to present information relevant to a process, based on his/her ability to articulate pertinent information and execute actions that inform the process. The following quotes from the telemedicine literature illustrate some of the qualities of presentation capability and how this capability contributes to the effectiveness of telemedicine consultations.

> Our respondents' willingness to rely on a human intermediary (a technician or a physician) was very low. One respondent suggested that referring [presenting] physicians using teleconsultation should be specifically trained as ''transmitters'' to learn what information is relevant, and how to present it. (LeHoux et al. 2002, p. 897)

> The referring [presenting] physician needs to have good communication skills, adequate clinical skills (which consist largely of the ability to undertake a careful joint examination) and the ability to perform soft-tissue and joint injections confidently…Consultants do not have direct physical contact with patients: they need to have confidence in the clinical skills of the referring [presenting] physicians and to rely on them to interpret physical findings and relay them. (Davis et al. 2001, p. S1:11)

These comments indicate that high presentation capability entails explicit and tacit knowledge. Explicit knowledge represents codified knowledge consisting of factual information and processes that are easily communicated, whereas tacit knowledge is more deeply rooted in context and difficult to capture and communicate (Nonaka 1994, Polanyi 1966). These types of knowledge are captured by the presenter's knowledge and skills (1) with effective articulation of important information, such as how to filter out irrelevant information and only express information pertinent to the process (we call this *articulation*) and (2) with hands-on execution of information-gathering activities, such as performing the patient examination and operating the telemedicine equipment and software (we call this *execution*). Medical evaluation processes that rely on high levels of tacit knowledge that are difficult to simulate via technology-mediated communication are more challenging to virtualize (Paul 2006), unless the presenter possesses the necessary tacit knowledge to capture the needed information and relay the information to the consultant. In this scenario, the need for rich communication media to convey multiple cues and completeness is reduced because the presenter would be able to observe the necessary patient information independently of the consultant and then effectively articulate the relevant information to the consultant. Thus, a leaner medium that enables articulation (e.g., phone) would be sufficient.

The capabilities of articulation and execution are developed through the medical knowledge and skills possessed by the presenter. Figure 7 illustrates the knowledge sources of these capabilities. Articulation reflects medical "know what" and execution reflects medical "know how." When initiating a telemedicine consultation, the presenter can either already possess a high level of medical expertise (often indicated by their level of medical education) or have the need to further develop medical expertise, which would take place over time, through learning processes. In both cases, the result is that the presenter's medical knowledge would more closely approach the level of medical expertise possessed by the consultant. In other words, the presenter and consultant would benefit from a *shared mental model,* which represents a shared understanding and a shared language between team members (Preston 2004). The following quote is an observation from a patient in a study conducted by LeRouge et al. (2007), and it represents the importance of presentation capability in facilitating information exchange in a telemedicine consultation.

> "It was also like she [presenting provider] knew exactly what he [consulting provider] wanted done…and good. And she did seem to know…when he said something...what he meant…without trying to…discuss it with him. The time was not taken away from my appointment so that they could have a little learning session. They already knew." **– *Patient (LeRouge et al. 2007, p. 1298)***

When the presenter has advanced medical expertise (articulation and execution knowledge), the presenter will be able to effectively articulate pertinent clinical information and, therefore, the relationship between patient and consulting physician as an enabler of open information exchange, will be less important. This will reduce the negative impact of relationship requirements on e-consultation diagnosticity.

Hypothesis 5: Presentation capability will moderate the relationship between relationship requirements and e-consultation diagnosticity, such that relationship requirements will have a less negative effect on e-consultation diagnosticity for consultations with higher presentation capability than for those with lower presentation capability.

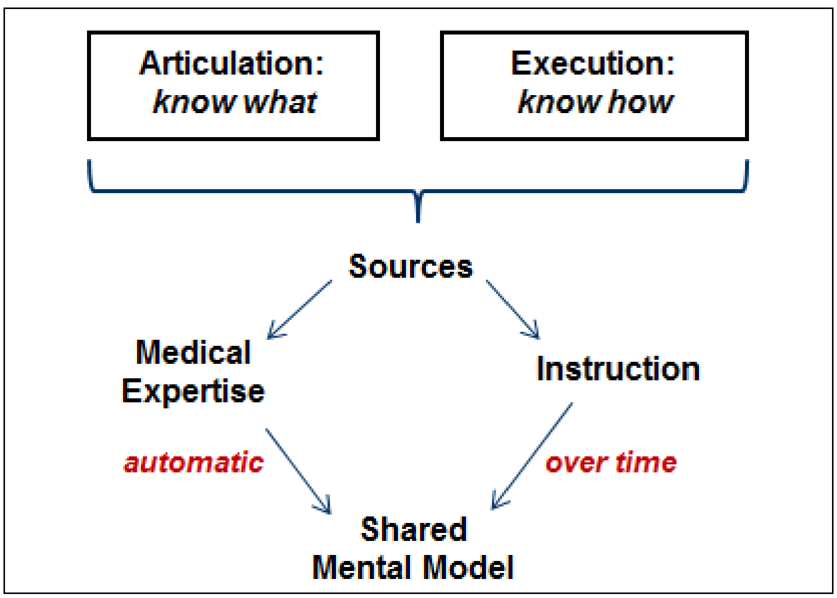


Figure 7. Presentation Medical Knowledge Sources

The following quotes from our interviews illustrate support for this hypothesis.

"An example that I had the other day is that…the history was very unclear and, you know, the family says he's [the patient] doing well, there's no problem. But then you talk to the occupational therapist and the occupational therapist is like, 'This child's [patient's] social skills are terrible…I'm fairly convinced that the child is autistic and the family doesn't think that there's anything wrong except that he can't talk.' So it's very

helpful in many cases for me to get information from the presenting provider." – Consulting Physician (Interview)

"You always welcome the higher—the more educated, because they contribute so much more. A nurse, a RN at the other end that can do a nursing assessment and give more input, or has seen that patient before is going to be a wealth of information to you…It works really well when we have a nurse that can—is just more knowledgeable and can provide more information." – Consulting Provider (Interview)
"If the patient couldn't give you answers and the presenter had to give you all the information…then I would rather have a doctor give me the information, or a very experienced nurse." – Consulting Physician (Interview)

The quotes indicate that consulting providers prefer highly trained healthcare providers to fill the role of presenting provider. In the first quote, the consulting provider explains that the presenting provider was a source of valuable clinical information when the patient (or patient's family) was not. The other comments suggest that when the presenting provider possesses advanced medical expertise, the interactions between the presenting site and consultant are more effective and result in enhanced clinical evaluations.

3.4.3.2. Presentation and Sensory Requirements

Advanced presentation capability also facilitates the presenter's ability to gather sensory related patient information independently of a consulting provider's observations and relay this information to the consulting provider. Irrespective of the medium available for the medical consultation, the sensory information needed by the consulting provider often can be provided by the presenter, particularly when the presenter is a healthcare provider trained to convey this information. When sensory information is communicated by the presenter, the need for the consulting provider to personally observe the patient is reduced. Thus, consulting providers who are able to interact with a skilled presenter who can help meet the sensory requirements of the clinical evaluation are likely to perceive the telemedicine consultation to be more diagnostic.

Hypothesis 6: Presentation capability will moderate the relationship between sensory requirements and e-consultation diagnosticity, such that sensory requirements will

have a less negative effect on e-consultation diagnosticity for consultations with higher presentation capability than for those with lower presentation capability.

Based on the insights we gained from interviewing consulting providers, oftentimes, when there is shared understanding between the consultant and presenter, the consultant is more apt to rely on the presenter's observations (e.g., touching, hearing, seeing) of the patient. As illustrated in Figure 7, this shared understanding may be a result of advanced medical training and credentials or from a pre-existing working relationship in which the consultant trained the presenter over time. In either case, the presenter is able to provide physical sensory information about the patient to the consultant (often automatically) and thus facilitate the clinical evaluation, as illustrated in the following interview quotes:

> *I would say that the sites that I work with much more often, it's just a much more comfortable relationship…they know what I want. They know to get the vitals every time for every patient. – Consulting Physician (Interview)*

> *Because she [presenter] is a physician, even though she's not a psychiatrist, I can still ask her about certain observations that maybe another person wouldn't do. – Consulting Provider (Interview)*

3.4.4. MODERATING EFFECTS OF THE INTERACTION OF PRESENTATION AND REPRESENTATION

In the previous quotes from interviews and the literature, many providers commented on how the telemedicine system can provide quality representations of the senses of seeing and hearing. However, the sense of touch is currently not available via the richest medium for telemedicine, interactive video. Aside from lack of touch, oftentimes, it is also difficult to observe nonverbal behaviors in an interactive video medium, which can impede a consulting provider's ability to evaluate a patient (Miller 2003). Furthermore, information transmitted over a network via a telemedicine system may be subject to network delays which could potentially distort the video and audio transmitted to each site. For processes that require seamless synchronicity and the senses of seeing, hearing, and touching, limitations of the telemedicine medium can lead to low representation of the process. According to process virtualization theory, in such situations, the process is less amenable to virtualization, unless additional steps are taken to facilitate the virtualization (Overby 2008). We posit that these extra steps will be driven by the process participants during the telemedicine consultations. The users with presentation capability can compensate for representational limitations of the technology by conveying sensory information to the consulting providers and by being trusted mediators of information between the patients and consulting providers.

3.4.4.1. Presentation-Representation and Relationship Requirements

Presenting providers with high presentation capability will have a solid understanding of the patients' conditions and medical histories, how to work with the patients they present, and how to articulate the patients' conditions. Using this knowledge and these skills, presenting providers are able to compensate for limitations in the telemedicine technology in a manner that facilitates information exchange and trust in a telemedicine consultation.

When the consulting provider is not able to adequately convey communication cues that facilitate trust with the patient due to the inherent limitations of the medium, the presenting provider can do so in the physical presence of the patient. For example, through using warm facial expressions and paying close attention to the patient's concerns, the presenting provider is able to establish the trust and rapport with the patient that is necessary in facilitating information exchange. Further, when the presenting provider has a pre-existing relationship with the patient, there is already a level of trust and rapport with a patient that will translate into facilitated information sharing in the telemedicine consultation. Using the telemedicine medium to develop a trusting relationship may be challenging for the consulting provider when the technology is not able to transmit the communication cues and personal focus necessary in relationship development. At times, the consulting provider may also need the presenting provider to interview the patient on his/her behalf in order to get the needed information.

Therefore, we hypothesize that the presenter's presentation capabilities and the TMC representation capabilities function in a compensatory manner such that limitations in technological capabilities can be compensated by presentation skills.

> ***Hypothesis 7: There is a three-way interaction between IT representation, presentation capability, and relationship requirements such that the negative effect of relationship requirements on e-consultation diagnosticity is weaker in the presence of either high IT representation or high presentation capability and stronger when both IT-representation and presentation capability are low.***

The following quotes from our interviews illustrate the compensatory role of presentation capability in telemedicine consultations:

> *"[The presenting provider]…helps in the rapport building by being who she is and doing what she does…[she] makes the experience more comfortable, makes them [patients] feel less awkward talking to a television screen. And I would like to think that they would be more honest and forthright because they feel comfortable. I mean, if they're more awkward, if they feel more anxious about the situation, I feel like they might not be as forthcoming and not as trusting with me." – Consulting Physician (Interview)*

> *"Also one of the sites has a physician present, and I think that her presence during the appointments is nice for a couple of reasons. One, she interacts with the family and with the child, so sometimes she can give me observations that I can't always get a good sense of. Or let's say…we ask the child [patient] to step outside, the site coordinator or the [presenting] physician will give me insight as to what the child's behavior was like outside of the examining room. Because those would all be things that in an in-person appointment, when I go out to the waiting room, many times I can observe the patient out there…With telemedicine, I don't get that piece so it's nice to have the physician or site coordinator, so they can give me that feedback." – Consulting Physician (Interview)*

These comments show that the information exchange and trust between the presenting provider and patient are instrumental in relaying the most relevant information to the consulting provider. In extreme cases, a patient may not be able to speak for him/herself and, consequently, the presenter must act as the primary mediator of information between the consulting provider and patient. In less extreme scenarios in which patients can speak for themselves, the presenter can still facilitate information exchange with the consulting provider by facilitating the patient's information sharing and being a trusted source of information him/herself.

3.4.4.2. Presentation-Representation and Sensory Requirements

Presenters are also able to compensate for the lack of sensory cues available in the virtual environment. In this case, the manner in which presentation capability can substitute for limitations in IT representation can be explained by compensatory adaptation theory (Kock 2001, 2004, 2007, 2008). According to this theory, virtual communication media, when compared to face-to-face communication, pose challenges to effective communication between collaborators and, consequently, increase cognitive effort and communication ambiguity. When faced with these limitations and challenges, collaborators will engage in compensatory adaptation, whereby communication participants are able to modify their behaviors in order to overcome these obstacles. For example, when speaking on the telephone, a medium that lacks visual cues, communication participants verbally express agreement or disagreement rather than using head nods (Kock 2008). Regarding interactive video telemedicine consultations, the presenter can "touch and feel" for the consultant and relay the findings and allow the consultant to observe patient reactions. Furthermore, if medical scopes (e.g. stethoscope, otoscope) are required to examine the patient, the presenter is able to physically operate these devices to obtain the needed information and then convey this information to the consultant. In these examples, ideally, the presenter would be knowledgeable of how to perform these tasks so that relevant information related to the medical evaluation is presented to the consulting provider.

Therefore, we hypothesize that the presenter's presentation capabilities and the TMC representation capabilities function in a compensatory manner such that limitations in technological capabilities can be compensated by presentation skills.

Hypothesis 8: There is a three-way interaction between IT representation, presentation capability, and sensory requirements such that the negative effect of sensory requirements on e-consultation diagnosticity is weaker in the presence of either high IT representation or high presentation capability and strongest in the presence of low IT representation and low presentation capability.

The following quotes from out interviews and review of the literature portray the importance of relying on the presenting provider to facilitate patient observations and information gathering, through fulfilling some of the sensory requirements of the medical consultation. For example, the presenting provider often has to palpate or focus a camera or scope on an area of the patient to convey sensory information to the consulting provider.

> *"For example, somebody comes in for abdominal pain, which is a most common problem… Those are the ones that are **hard to do in telemedicine**. So you'll want to feel is there a tenderness somewhere, you know?...There is a condition called rebound. When you press on it, there, the muscle is going to spasm. That's called the rebound tenderness. That one, **unless the other person tells you, 'Okay, I feel a rebound here; there's rebound tenderness,' you can't tell on this one**." – Consulting Physician (Interview)*

> *"The eye exam, there is a **scope available**, but it is, again, you've got to really know…the **other person has to be really technical** to be able to see inside the eye so that you're seeing it on the camera. That's going to be a little harder unless the other person is actually trained properly, so let's say a guy comes to you: 'Well, I suddenly lost half of my vision in my eye.' So there's a way to examine the eye, but the other person has to be technically adequate to focus the light properly to the eye." – Consulting Physician (Interview)*

> *"You really do have to rely on the expertise of the person on the other end. For example, it is important to know what the liver and spleen are doing because, once again, if you have a recurrence of leukemia, it is going to show up in the liver and spleen. You will have a big liver and spleen. **So you can't actually touch the patient yourself, so you have to rely on the person at the other end**. And if that person is a pediatrician, chances are they are going to do an okay job. If they are nurses, they may well do a great job, but you just don't know. And so it is very important in management (of the disease) whether or not the liver is big. If you don't have great confidence that the nurses are well trained enough to do the exam and tell you 'yes, that this liver is not enlarged.' There were a lot of times when the nurse would say 'I don't know. Maybe it is, maybe it isn't. I just can't tell.' Well, all of the sudden, you just can't make any decisions." – Consulting Physician (Paul 2000, pp. 295-296)*

3.4.5. MODERATING EFFECTS OF THE INTERACTION OF ELICITATION AND PRESENTATION

3.4.5.1. Elicitation-Presentation Interaction and Relationship Requirements

Just as the presenter in a telemedicine consultation possesses a certain level of presentation capability that facilitates the medical evaluation, the consultant also possesses an instrumental capability—that of elicitation. In this dissertation, we define *elicitation capability* as a user's capacity to gather information relevant to a process, based on his/her ability to interview and instruct the presenter(s) in a manner that informs the process. Recall that the presenter role can be filled by the patient and/or presenting provider (if a presenting provider is involved).

One of the key components of any medical consultation is the medical interview. Consulting providers can elicit more relevant information from presenters through the employment of linguistic devices, such as continuers (e.g. asking "What else?" to prompt the presenter to elaborate) and open-to-closed cones (Lipkin et al. 1995). The latter refers to using open questions in the exploratory phases of the interview and closed questions in the confirmatory phases of the interview. Additionally, consulting providers can develop specific interviewing skills as they relate to examining pediatric patients (Lewis and Pantell 1995), geriatric patients (Mader and Ford 1995), and psychotic patients (Mance and Cohen-Cole 1995). Research on the medical interview and history taking reveals that there are particular behaviors consulting providers must learn to avoid as well, such as interrupting patients. In reviewing 74 recorded office visits, Beckman and Frankel (1984) observed that in 69% of the visits, physicians interrupted patients within the first 18 seconds of the encounter and in only one of these visits was the patient given the opportunity to finish his/her opening statement. Thus, the interviewing skill of the consulting provider is a pivotal driver of the quality of information elicited during the medical consultation. Another capability of the consulting provider is instructing skills—the consulting provider can teach and guide the presenters to covey to him/her the information that is needed during a clinical evaluation.

In a telemedicine consultation, a consulting provider with high elicitation capability will be able to compensate for limitations in presentation capability. Previously, we mentioned the importance of presentation capability in overcoming limitations of the technology representation. However, in cases in which presentation capability is low, the elicitation capability of consulting providers can overcome this limitation to some degree through the use of effective interviewing and instructional techniques. The interaction of elicitation capability and presentation capability facilitates information exchange and trust among consultants and presenters and, thus, reduces the negative effect of relationship requirements on e-consultation diagnosticity.

> ***Hypothesis 9: There is a three-way interaction between presentation capability, elicitation capability and relationship requirements such that the negative effect of relationship requirements on e-consultation diagnosticity is weaker in the presence of either high presentation capability or high elicitation capability and strongest in the presence of low presentation capability and low elicitation capability.***

The following quotes from our interviews reveal the significance of the consultant's elicitation capabilities in enabling information exchange in the telemedicine consultation by compensating for limitations in presentation capabilities.

> *"And I think sometimes the rural areas, they're [patients] less sophisticated…that would be a good word that I would use to describe them…and thus making, I think, the interview a lot harder…I end up having to ask a whole lot more questions, and a lot more directed questions and very specific questions." – Consulting Physician (Interview)*

> *"I think just knowing some basic physical exam and things is helpful. And it could be done—it would be laborious—but it could be done with someone who was completely ignorant of the process, too. I know there's one—not to be personal—but one nurse at the nursing home that will just kind of go on and on about things, and I'm just like, 'Just let me ask you a few questions, and then we'll be able to get this accomplished more efficiently.'" – Consulting Physician (Interview)*

3.4.5.2. Elicitation-Presentation Interaction and Sensory Requirements

The elicitation capability of consultants also enables the conveyance of sensory information required during the telemedicine consultation. In the interviewing process, the consulting provider can gather sensory information by asking the presenter to describe how a patient condition looks in appearance or how it feels to the touch. Another capability of the consulting provider is the ability to instruct presenters to perform tasks that inform the medical evaluation. Within the context of telemedicine consultations, the consulting provider is not able to perform many of the physical tasks he/she normally would in a face-to-face visit. Therefore, the consulting provider, in many cases, must instruct the presenter(s) to carry out these tasks (e.g. applying a stethoscope to listen to lung and heart sounds). Some physical tasks are more complex than others; hence, a consulting provider's ability to communicate instructions clearly to the presenter(s) will facilitate the medical evaluation. In the case of a presenter who lacks the skills to carry out the tasks, the consulting provider can relay specific prompts to guide the presenter in his/her observations of patient conditions. Hence, in this way, the consulting provider is able to overcome the knowledge gap of the presenter in many cases.

> ***Hypothesis 10: There is a three-way interaction between presentation capability, elicitation capability and sensory requirements such that the negative effect of sensory requirements on e-consultation diagnosticity is weaker in the presence of either high presentation capability or high elicitation capability and strongest in the presence of low presentation capability and low elicitation capability.***

The elicitation capability of instructing is particularly helpful in acquiring the necessary sensory information in a telemedicine consultation, as illustrated by the following quotes.

> *"Mine was a patient that had a swollen leg. And all I had to do was look at the leg and I asked the nurse to measure its circumference compared to the other leg and found that, I think it was the right leg, was two inches farther around than the left." – Consulting Provider (Interview)*

"The normal thing you'd feel would be, in almost all cases, the abdomen. Or you might be palpating for injury, if the patient fell. So what I would want to do is to tell the person there, 'Please push on their belly. I want to look at their face while you're pushing on their belly.' So if the nurse pushes on the belly and the patient [makes a face of someone grimacing] like that, then I can guess, that probably hurt." – Consulting Provider (Interview)

"If I think there's something important in the physical examination that I really feel I need to probe further, I'll ask for it in [the presenting provider]. The doctors [presenting providers] will actually do it and they'll demonstrate to me something and I'll see it, or else I'll say, 'Would you listen to the heart for something-or-other?'" – Consulting physician (Paul 2000, p.263)

3.4.6. E-CONSULTATION DIAGNOSTICITY AND TMC USE

Up until this point, we have explored hypotheses that posit the antecedents of perceived e-consultation diagnosticity. Ultimately, the relevance of perceived e-consultation diagnosticity is that it will influence use of telemedicine systems. The evaluation of patients' health conditions is a critical process in the medical consultation. If a consulting provider perceives that a telemedicine consultation is not sufficient to adequately assess a patient, then he/she is less likely to use telemedicine consultations as a means to evaluate patients.

Hypothesis 11: Perceptions of e-consultation diagnosticity will be positively related to use of telemedicine consultations.

3.4.7. CONTROL VARIABLES

Based on our meta review of provider acceptance of telemedicine (Serrano and Karahanna 2011) and the technology acceptance literature in general, we incorporate the following control variables in predicting telemedicine use: perceived usefulness (Davis 1986, 1989), perceived ease of use (Davis 1986, 1989), and facilitating conditions (Triandis 1980, Thompson et al. 1991, Venkatesh et al. 2003). We will also collect demographic data from our respondents, to include the respondents' age, sex, medical specialty, geographic location, and years of experience using telemedicine.

3.5. LIMITATIONS

As with all studies, there are limitations to the proposed research model in this study. One limitation is that we do not consider the impact of anonymity on facilitating information exchange in a medical consultation. Instead, based on the theories described in our study, we assume that information exchange and trust will be enhanced through rich media as opposed to lean media. In a medical evaluation, it is possible that patients would feel more comfortable using lean media that inhibits their identification and, consequently, would be more apt to share relevant medical information with consulting providers, particularly if the patients have stigmatized symptoms (Miller 2003). However, because most of the empirical evidence in telemedicine studies indicates otherwise, we adopted the more widely-held and supported proposition that rich media are better suited in facilitating trust and rapport in provider-patient interactions.

CHAPTER 4: RESEARCH METHODOLOGY

4.1. RESEARCH DESIGN

For this dissertation study, we employed a mixed methods research design. Both qualitative and quantitative methods were used to collect and analyze data to test the research model. The data we collected focused on perceptions of consulting providers from a variety of medical disciplines. Qualitative methods primarily included interviews but also incorporated direct observations and a thorough review of the qualitative literature on telemedicine adoption. While qualitative methods were initially used to refine and later to provide support for the research model, we also employed a survey methodology to test the research model using a nationwide sample of consulting providers.

We selected both qualitative and quantitative methods to capitalize on their relative strengths and to yield more comprehensive insights into the phenomenon. Qualitative methods allow researchers to gain a deeper understanding of the context under study, though generalizability of research findings is limited (Gable 1994). Compared to qualitative methods, the survey methodology is considered better suited in verifying hypotheses and yielding generalizable results (Attewell and Rule 1991). However, the survey methodology is not ideal for discovering the underlying nature and complexity of processes under study (Gable 1994). In light of the relative strengths and weaknesses of quantitative and qualitative methods, we combined both methods in order to gain a more complete understanding of our research phenomenon than what we would be able to gain by using a single method alone (Kaplan and Douchon 1988).

This chapter describes the methodology used for both the qualitative and quantitative portions of the study. First, we will discuss the qualitative methods employed in this dissertation, followed by an elaboration of the survey methodology that we used, to include the procedures we followed to develop the scales for the instrument and design the survey.

4.2. QUALITATIVE METHODS

4.2.1. INTERVIEW METHODOLOGY

The constructs and relationships in the research model were developed based on a review of the telemedicine literature and concepts that emerged from a previous exploratory qualitative study on telemedicine acceptance (Serrano and Karahanna 2009). From June 2009 to November 2010, we conducted 39 semi-structured interviews in order to heighten our understanding of the context and to refine and later provide support for the research model. At the same time, we left room for the possibility of discovering new concepts and relationships not theorized a priori. This is one of the strengths of the interview methodology, as opposed to survey methodology (Gable 1994), and the main reason that we chose to incorporate the interview methodology into the research design.

In the spring of 2009, we contacted the Georgia Partnership for Telehealth (GPT), which is a non-profit organization that oversees the telemedicine network in the state of Georgia. GPT is responsible for consulting with healthcare provider clients in order to implement telemedicine systems at their sites and to provide ongoing technical support, maintenance, and training. After a meeting with the Executive Director and one of GPT's regional liaisons, we were given permission to contact providers within their network and to collect data from any of their pilot projects underway or forthcoming. The regional liaison sent a mass email to all providers in GPT's telemedicine network to make them aware that GPT had given us access to their contact information and to encourage them to participate in our data collection process.

Based on our research model, we developed interview guides to use for consulting providers, presenting providers, health care administrators, and the GPT telemedicine consultants. Several questions were included in the interview guide in order to elicit detailed information about the context under study as well as the hypotheses in the research model.

After receiving IRB approval to collect data from providers in GPT's network, we commenced contacting providers and scheduling interviews. Whenever possible, we attempted to schedule face-to-face (FTF) interviews, but geographic limitations prompted us to schedule phone interviews in some cases. Most prospective respondents were initially contacted via email, with a few having to be contacted via phone, in order to schedule the interview. In the email communication with prospective respondents, the researchers and their affiliation were identified, the purpose of the study was described, and it was emphasized that the interview would be scheduled at the provider's convenience in his/her mode of preference (FTF or phone). When prospective respondents expressed their interest in participating in an interview, a follow up email was sent to schedule the interview and to share (as attachments) the informed consent letter (Appendix B) and the interview protocol (Appendix C).

4.2.2. INTERVIEW SAMPLE

From June 2009 to November 2010, we interviewed a total of 35 respondents affiliated with GPT in 35 separate interviews. Some interviews were conducted with a group (2-3 respondents) and some respondents were interviewed multiple times (2-3 times). In addition to interviewing GPT providers and staff, we also interviewed two physicians who are non-users of telemedicine and two physicians who oversee telemedicine consulting firms and have several years of telemedicine consulting expertise. In total, we interviewed 39 respondents: 14 consulting providers, 10 presenting providers, 8 health care administrators, and 7 telemedicine consultants. Most interviews lasted 45 minutes to an hour, with the shortest interview being 17 minutes and the longest being 2 hours and 20 minutes.

While we have collected interview data from multiple perspectives, the focus of the dissertation is on the consulting provider perspective. Hence, other perspectives gathered have assisted us in providing a deeper understanding of the context and informing the development of our constructs. The qualitative data analysis presented in this dissertation focuses on the consulting provider perspective.

A complete list of the interviews are included in Table 2. The number under the heading "No." reflects the interview ID. Each interview was given a unique ID, which reflects the chronological order of the interviews conducted. Repeat ID numbers indicate an interview that involved a group of respondents. Other details included in the table are the general titles of the respondents, the date of the interview, the mode (FTF or phone), the format (digitally recorded or hand-written field notes), the length of the interview, and the number of interviewers who actively participated in the interviews.

Table 2. List of Interviews

Consulting Providers					
Title	**Date**	**Mode**	**No.**	**Format/Length**	**# Interviewers**
Primary Care Physician 1	6/2/2009	FTF	1	DR, 1:23:12	2
Pediatrician / Clinical Geneticist	6/4/2009	FTF	2	DR, 1:06:54	2
Endocrinologist	6/4/2009	FTF	3	DR, 2:20:19	2
Primary Care Physician 2/ Nursing Home Medical Director	6/29/2006	Phone	5	DR, 0:41:18	1
	10/26/2009	FTF	21	DR, 1:26:22	1
Mental Health Professional	7/7/2009	FTF	7	DR, 1:04:37	1
Emergency Physician	7/14/2009	FTF	9	DR, 0:54:45	1
	12/9/2009	FTF	27	DR, 0:48:06	2
Primary Care Physician 3/ Nursing Home Medical Director	7/16/2009	FTF	11	DR, 0:56:50	1
	12/10/2009	FTF	28	DR, 0:54:13	2
Primary Care Physician 4/ Nursing Home Medical Director	12/21/2009	Phone	32	DR, 0:31:34	1
Primary Care Physician 5/ Nursing Home Medical Director	3/19/2010	Phone	34	DR, 0:42:16	2
Pediatric Psychiatrist	8/26/2010	FTF	35	DR, 1:01:20	1

Primary Care Physician	8/30/2010	FTF	36	DR, 0:45:59	1
Adult/Geriatric Psychiatrist	9/8/2010	Phone	37	DR, 0:30:00	1
Optometrist	11/11/2010	Phone	38	DR, 0:45:43	1
Obstetrician/Gynecologist	11/31/2010	Phone	39	DR, 0:17:27	1
Presenting Providers					
Title	**Date**	**Mode**	**No.**	**Format/Length**	**# Interviewers**
Primary Care Physician	7/2/2009	Phone	6	DR, 0:48:51	1
Nursing Director	10/19/2009	FTF	18	DR, 1:29:01	3
Nursing Director	10/19/2009	FTF	19	DR, 1:08:38	3
	12/2/2009	FTF	25	DR, 0:22:23	2
	2/16/2010	Phone	33	DR, 0:29:12	2
Nursing Director	10/26/2009	FTF	20	DR, 1:36:11	3
Nursing Director	11/19/2009	FTF	24	DR, 0:54:11	3
Nursing Director	12/11/2009	FTF	29	DR, 0:27:18	1
Social Worker	11/19/2009	FTF	24	DR, 0:54:11	3
Nurse	10/26/2009	FTF	20	DR, 0:41:31	3
Nurse	10/26/2009	FTF	20	DR, 0:41:31	3
Nurse	12/11/2009	FTF	30	DR, 0:40:27	1
Health Care Administrators					
Title	**Date**	**Mode**	**No.**	**Format/Length**	**# Interviewers**
Parent Organization Administrator	6/5/2009	Phone	4	DR, 0:39:29	2
	12/16/2009	FTF	31	DR, 0:59:42	2
Telemedicine Coordinator	7/14/2009	FTF	10	DR, 0:39:26	1
Nursing Home Administrator	10/19/2009	FTF	18	DR, 1:29:01	3
Nursing Home Administrator	10/19/2009	FTF	19	DR, 1:08:38	3
	12/2/2009	FTF	25	DR, 0:22:23	2
	2/16/2010	Phone	33	DR, 0:29:12	2
Nursing Home Administrator	10/26/2009	FTF	20	DR, 1:36:11	2
Nursing Home Administrator	10/29/2009	FTF	22	HW, 1:00:00	2
Nursing Home Administrator	11/18/2009	FTF	23	DR, 0:41:37	2
Nursing Home Administrator	11/19/2009	FTF	24	DR, 0:54:11	3
Telemedicine Consultants					
Title	**Date**	**Mode**	**No.**	**Format/Length**	**# Interviewers**
Executive Director	8/3/2009	FTF	15	DR, 0:21:49	1
Scheduling Coordinator	8/3/2009	FTF	16	DR, 0:47:34	1
IT Administrator	8/3/2009	FTF	14	DR, 0:43:20	1
Liaison 1	7/13/2009	FTF	8	DR, 0:44:16	1
	10/19/2009	FTF	19	DR, 1:08:38	3
	12/2/2009	FTF	26	DR, 0:22:23	2
Liaison 2	7/27/2009	Phone	12	DR, 0:44:10	1
	10/19/2009	FTF	18	DR, 1:29:01	3
Liaison 3	7/27/2009	Phone	13	DR, 0:37:21	1
Liaison 4	8/4/2009	Phone	17	DR, 0:32:49	1

FTF = Face to Face
No. = Interview ID
DR = Digitally Recorded
HW = Hand-written notes, almost verbatim
Length is presented in H:MM:SS

While not all interviews had the benefit of more than one interviewer, approximately 44 percent (n=17/39) of the interviews did involve more than one interviewer. When conducting interviews, the quality of the data obtained is primarily dependent on the skills of the interviewer(s). Thus, it is useful when more than one interviewer is present to assist with the multi-tasking of eliciting data from respondents and observing cues in their responses that require further prompting or elaboration (Patton 2002). However, the tradeoff in having multiple interviewers present is that respondents may feel more intimidated during the interview; thus, the ability to establish strong trust and rapport with the respondents is pivotal. We made concerted attempts to establish a trusting relationship with respondents by using ice-breakers and positioning ourselves as “less than expert” in that we were in need of the respondents’ expertise and knowledge of the context.

4.2.3. FIELD OBSERVATIONS

In addition to interviews, we conducted direct observation and recorded field notes of our observations at two GPT practitioner conferences as a form of data collection. The conferences were held in March 2010 and March 2011, and over 100 providers and administrators in the GPT network attended each conference. During the conference sessions, several individual and panel presentations took place that reflected perceptions of consulting providers. Detailed field notes of observational data from the conference were analyzed in MaxQDA.

4.2.4. QUALITATIVE META ANALYSIS

Because there is a wealth of data published in qualitative telemedicine studies, we thoroughly explored the telemedicine literature for published qualitative data in the forms of interview quotes and observational notes. Using an approach referred to as “qualitative meta analysis” (Berente 2008), which is based on Noblit and Hare’s (1988) concept of a meta-ethnography, we treated published qualitative data as primary data. In doing so, we were able to reinterpret and reanalyze the qualitative data for the purposes of testing our research model. Chapter 3 includes some of the quotes that we have gathered as part of our qualitative meta analysis; all collected data for the qualitative meta-analysis were analyzed in MaxQDA.

4.2.5. OPEN-ENDED SURVEY QUESTIONS

Another source of qualitative data was open-ended questions on the survey that we administered to consulting providers (described in the next section). Two of these questions asked respondents to recall a specific telemedicine consultation and describe the experience, to include their interactions with the technology, the patient, and the presenting provider (if applicable), as well as to describe the medical condition they evaluated. Respondents were also asked to identify their various uses of telemedicine. Responses to these open-ended questions were analyzed in MaxQDA to further inform the research model.

4.3. QUANTITATIVE METHODS

4.3.1. SURVEY METHODOLOGY

As previously noted, despite many of the strengths of qualitative research, there are limitations in terms of generalizability and hypothesis testing (Attewell and Rule 1991). Thus, we employed the survey methodology using an online survey that targeted consulting providers who have current and/or former experience using telemedicine for clinical evaluations. Because consulting providers generally have very busy professional schedules and, therefore, are relatively inaccessible, an online method of survey delivery was chosen to yield a higher response rate by enabling respondents to complete the survey at their own convenience. We used the online survey software Qualtrics to administer the survey.

The following sections proceed as follows. The next several sections describe the instrument development process including unit of analysis and operationalization of the various constructs in the research model. We end the chapter by describing the sampling method used to administer the survey.

4.3.2. INSTRUMENT DEVELOPMENT PROCESS

In developing the survey instrument, we adhered to established guidelines to develop scales for constructs in our main model (Hinkin 1995, Netemeyer et al. 2003, Straub 1989). First, we examined existing scales and included items in the candidate item pool that captured the theoretical definition of the constructs in our study. We then developed new items for these constructs as well as remaining constructs in our research model for which no validated scales exist in the literature. During this process, we paid close attention to the content validity of the constructs. Content validity, which ensures that measures for a construct capture the universal domain of the construct's definition, was examined throughout the scale development process by assessing the operational meaningfulness of the constructs (Bagozzi 1979). In other words, we made sure that measures mapped directly to the conceptual definitions of the constructs and, as a set, represented the full domain of the construct definitions. Content validity was further assessed in an item rating process, which is described next.

For most constructs in our study, it was necessary to develop new scales because validated scales did not exist for these constructs. It is worth noting that, in addition to measuring items reflectively, we also developed scales to measure the antecedents of e-consultation diagnosticity formatively by identifying dimensions of these constructs based on our qualitative data analysis and by developing measures for each dimension. This was an exploratory part of the dissertation and these measures are not used in our hypotheses testing. As such, the discussion that follows focuses only on reflective measures of our constructs; a list of the exploratory formative dimensions of these constructs and their items is included in Appendix D.

Appendix E details the list of items we developed through the instrument development process (a total of 55 items[1] in the initial pool) and also identifies items that were dropped, including the reasons for their exclusion. According to Netemeyer et al. (2003), there are no formally agreed-upon rules for the actual number of an initial pool of items for a single construct because guidelines vary according to whether the construct is narrowly defined (unidimensional) or multidimensional. For narrowly defined constructs, DeVellis (1991) recommends an initial pool that is at least twice the size of the final pool of items. Multidimensional constructs will require a much larger pool of initial items; some researchers recommend up to 250 items (e.g., Robinson et al. 1991). Regardless, Netemeyer et al. (2003) recommend erring on the side of larger pools for initial items because "overinclusiveness is more desirable than underinclusiveness" (p. 102).

The scales were validated by (a) items being rated on how well they represented the specific construct based on the construct definition provided, (b) item sorting where items were classified under the construct the raters believed they represented (to qualitatively assess convergent and discriminant validity), (c) a pre-test where physicians provided feedback on the survey, (d) an exploratory factor analysis (EFA), (e) a scale validation process in PLS, and (f) a CFA in covariance-based SEM. The first three steps of our scale development process are described next and the factor analysis steps are described in the next chapter. The table in Appendix E shows how items fared through this scale validation process and what items were deleted and retained at each step. The table also indicates the final items that were retained for data analysis after we validated the scales. Unless otherwise noted, all constructs were measured using a 7-point Likert scale where 1="Strongly Disagree" and 7="Strongly Agree."

[1] A total of 55 items was initially developed for testing Hypotheses 1-10. The total number of items in the initial pool to test all hypotheses is 67. Including items for exploratory constructs, the total initial pool was 132 items.

4.3.2.1. Unit of Analysis

The unit of analysis for our model is a specific consultation. Because respondents' perceptions can vary depending on the particular medical condition under evaluation, we had to assess perceptions about system capabilities and e-consultation diagnosticity for a specific medical consultation they had experienced. For example, consulting providers would likely perceive differing requirements of a medical consultation when evaluating a patient for symptoms of depression versus evaluating a patient for symptoms of an upper respiratory tract infection. Furthermore, consulting providers' perceptions about the technology and user capabilities will vary depending on the performance of the technology and users during a specific telemedicine consultation.

To test the hypotheses in the research model we, therefore, instructed respondents first to recall a specific telemedicine consultation experience to evaluate a particular medical condition. To ensure respondents would anchor to a particular telemedicine experience, they were then asked to describe the particular medical condition they evaluated for the specific telemedicine consultation. Following this open-ended question, respondents were instructed to answer a series of questions based on the specific telemedicine consultation experience that they just recalled. To assess the process requirements, which reflect the requirements of a process (irrespective of whether it has been virtualized), respondents were asked to assess the typical requirements of the clinical evaluation process when evaluating medical conditions such as the one they recalled and described.

Hypothesis 11, however, examines how general perceptions of e-consultation diagnosticity (across consultations) influence use. As a result, to test Hypothesis 11 our unit of analysis is the telemedicine system. As such, it was necessary to assess respondents' perceptions, *in general*, of e-consultation diagnosticity, telemedicine usage, and the control variables.

As illustrated in Figure 8, perceptions concerning e-consultation diagnosticity were measured twice on the survey: once at the consultation level for a specific telemedicine consultation experience (encounter-level e-consultation diagnosticity) and then again later to assess perceptions of e-consultation diagnosticity in general, across a number of telemedicine consultation experiences (general-level e-consultation diagnosticity).

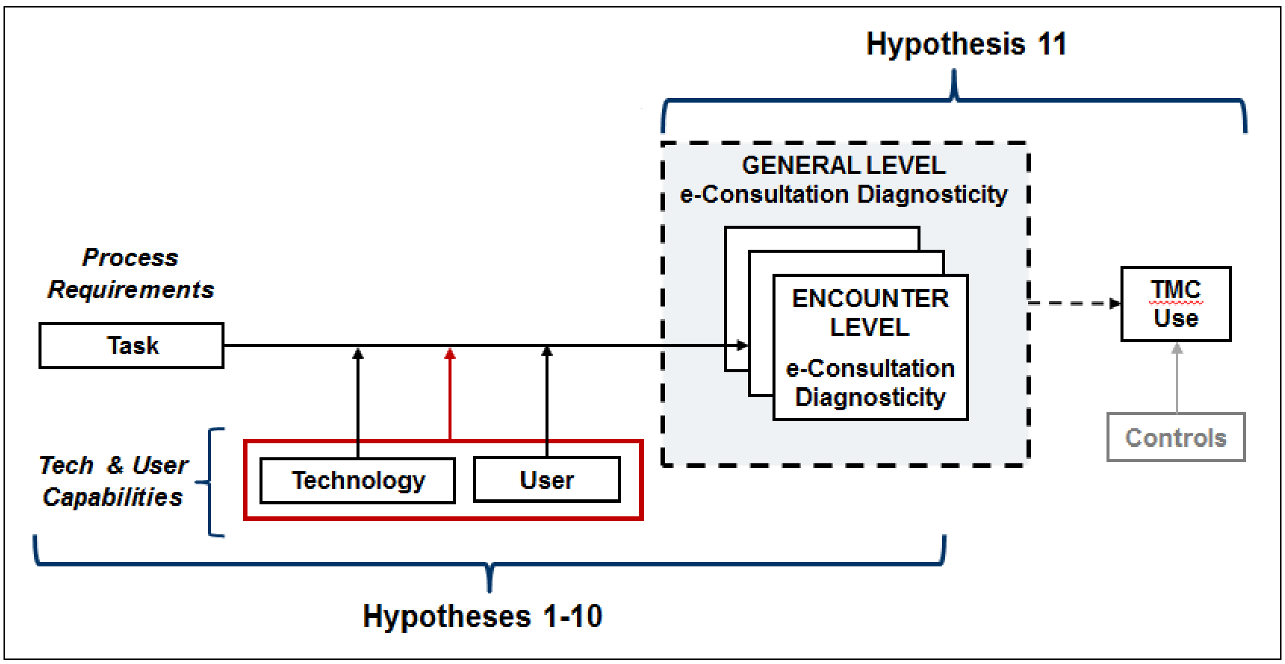


Figure 8. Two Levels of e-Consultation Diagnosticity

4.3.3. ITEM RATING AND SORTING PROCEDURES

As previously mentioned, we first developed a list of items for each construct based on a review of the relevant literature and existing validated scales and our understanding of the theoretical definitions of the constructs. In the next phases of instrument development, we followed Netemeyer et al. (2003) as well as MacKenzie et al. (2011) using prioritization and categorization exercises. For the prioritization task, we employed an item rating procedure using four IS doctoral students as judges. All judges had successfully completed a research methodology course that covered topics related to construct development and validation. The judges were presented with construct names and corresponding theoretical definitions and items in an Excel spreadsheet. The judges were instructed to rate each item according to their perception of how representative each item was of the overall construct and to type their responses, including any comments, in the provided spreadsheet. They used a scale of 1=”Not Representative of the Construct” to 3=”Very Representative of the Construct.” Results of the item rating task are presented in Appendix F. Based on the item rating results and feedback, several items were reworded, five items were dropped and one new item was developed.

In the next phase of scale development, we employed a categorization task, an item sorting exercise, which facilitated our initial assessment of construct validity for the scales we created. We recruited eight judges to participate in this exercise. Three judges were IS faculty, two were IS doctoral students, one was a Marketing doctoral student, and one was an IT professional. For the item sorting task, we supplied the construct names and definitions but randomized the items we developed. Judges were asked to match each item to the construct that it most closely fit. This process helped us qualitatively assess convergent and discriminant validity. Items that were consistently matched to their construct can reflect, to some degree, convergent validity of the construct and discriminant validity with other constructs (Moore and Benbasat 1991). Results of the item sorting exercise are presented in Appendix G. We randomly assigned the initials A-G for the judges and recorded these initials to indicate their categorization responses. The responses for the eighth judge were systematically inconsistent from all other judges' responses, so we regarded this judge's responses as outliers and discarded them.

We carefully reviewed all items for which at least two judges did not categorize the items in concordance with our categorization scheme. In some cases, we determined that rewording items would improve the item measure. For other cases, we discarded the items entirely, paying close attention to maintaining content validity when dropping the items. A total of eight items were dropped due to poor item sorting results. This prompted us to create new items for some constructs (e.g., representation, elicitation capability, sensory requirements) so that a sufficient number of items could be included in the candidate pool of items for the pre-test. We then further discarded six items that we deemed were unnecessarily redundant to shorten the instrument.

4.3.4. PRE-TEST

The pre-test was completed in two stages: (1) administering a pen-and-paper version of the survey at the second professional conference of the Georgia Partnership for Telehealth in March 2011 and, after making changes to the survey, (2) asking two consulting providers to review the complete instrument and provide feedback on the survey design and item wording.

At the GPT conference, there were approximately 30 consulting providers with telemedicine experience in attendance, and approximately 10 consulting providers agreed to complete the survey. We offered the participation incentive that all respondents would receive a copy of the research findings if they submitted a business card in our survey collection box. Though we were given the opportunity to speak to the full audience prior to administering the survey and had the endorsement of the organization hosting the conference, the pre-test resulted in only four completed surveys and one which was half-completed.

Based on the pre-test results at the conference, we determined that the survey length was inducing respondent fatigue and subsequently eliminated several items we deemed to be unnecessarily redundant and moved one open-ended question to the end of the survey. Three items were dropped that related to testing Hypotheses 1-10, and three items for control variables used to test Hypothesis 11 were dropped.

Next, we created the online survey using the Qualtrics software. The complete online survey is shown in Appendix H. We emailed a link to the survey to two physicians to review for survey design and item wording. Based on the feedback we received from these two physicians, we altered the wording for some items and survey instructions. For example, we changed "medical evaluation" to "clinical evaluation" and revised "telemedicine encounter" to instead read "telemedicine consultation." Additionally, we added and emphasized survey instructions that explained that some questions on the survey would appear similar, but respondents should still answer all questions.

Additionally, results from the pre-test suggested that we needed to offer a motivating participation incentive to obtain a usable sample size for our study. An interesting observation we made at the GPT conference was that consulting providers appeared to be motivated to enter a drawing to win an iPad. In order to be entered into this drawing at the conference, conference attendees had to visit all vendors' kiosks and have each vendor record a signature on a document provided by GPT. Conference attendees who submitted a document complete with all vendors' signatures were entered in the drawing. This inspired us to add a lottery drawing for an iPad 2 as a participation incentive for our study. In order to modify our study with this research incentive, it was necessary to submit an IRB amendment to be reviewed by the Human Subjects Office at the University of Georgia, and after IRB approval, we administered a field test of the survey.

4.3.5. OPERATIONALIZATION OF MAIN CONSTRUCTS

Table 3 contains a list of the constructs and their theoretical definitions, as used in this study. We first describe our operationalization of the encounter-level constructs (Hypotheses 1-

10), followed by how we operationalized the general-level constructs used to test Hypothesis 11 (telemedicine use and control variables).

Table 3. Definitions of Key Constructs

Construct	Definition
Perceived e-Consultation Diagnosticity	The perceived ability of the telemedicine system (includes technology and users) to enable consulting providers to understand and evaluate the health conditions of remote patients
Interaction Requirements	The perceived need for process participants to interact with one another and exchange information in a medical consultation context
Trust Requirements	The perceived need for the advice-seeker to trust the advice-giver in a medical consultation context
Sensory Requirements	The perceived need for process participants to be able to enjoy a full sensory experience of the process and other process participants and objects in a medical consultation context (Overby 2008)
Representation	The telemedicine technology's capacity to present information relevant to a process, including simulations of actors and objects within the physical world, their properties and characteristics, and how process participants interact with them (Overby 2008)
Presentation	Presenters' capacity to relay information relevant to a process, based on their ability to articulate pertinent information and execute actions that inform the process
Elicitation	Consultants' capacity to obtain information relevant to a process, based on their ability to interview and instruct the presenter(s) in a manner that informs the process

4.3.5.1. Perceived e-Consultation Diagnosticity

Perceived e-consultation diagnosticity is defined in this study as the perceived ability of the telemedicine system (including the technology and users) to enable consulting providers to understand and evaluate the health conditions of remote patients. The encounter-level measure of the construct measures this in the context of a specific medical consultation encounter. Though there are a number of measures in the literature for perceived trial diagnosticity or perceived product diagnosticity (see Appendix I), we contextualize our definition of perceived diagnosticity to the medical consultation domain. Most of the existing measures for perceived diagnosticity use language such as "judge" the quality or attribute of a product or "to get a real feel" for the product. Because we are focusing on the process of clinical evaluations of patients rather than products, this language did not seem appropriate. Instead, we opted to use wording such as *evaluate, assess,* and *observe.* Therefore, in reviewing existing scales for perceived diagnosticity, we chose to adapt one measure from the literature that uses the language "carefully evaluate" in operationalizing diagnosticity (Kempf and Laczniak 2001; Pavlou and Fygenson 2006) and developed eight new measures for the remaining items. Table 4 includes the final set of items included on the survey.

Table 4. Final Survey Items for Perceived e-Consultation Diagnosticity

DIAG1	During this particular telemedicine consultation, the telemedicine consultation allowed me to carefully evaluate the health condition of the patient.
DIAG2	During this particular telemedicine consultation, the telemedicine consultation allowed me to thoroughly assess the health condition of the patient.
DIAG3	During this particular telemedicine consultation, the telemedicine consultation allowed me to accurately evaluate the patient's health condition.
DIAG4	During this particular telemedicine consultation, the telemedicine consultation allowed me to Perform all of the assessment tasks necessary to evaluate the patient's condition

4.3.5.2. Representation Capability

Representation is defined in this study as the telemedicine technology's capacity to present information relevant to a process, including simulations of actors and objects within the physical world, their properties and characteristics, and how process participants interact with them (Overby 2008). Currently, representation in the IS literature has been operationalized largely in terms of information completeness (Overby 2008, Burton-Jones and Grange 2010). When evaluating the theoretical definition of this construct, we determined that the technology's capacity to present complete information only narrowly captures the meaning of the construct. Therefore, we adapted one information completeness item developed by Overby (2008) and constructed seven additional items to represent this construct. Table 5 includes the final set of items included on the survey.

Table 5. Final Survey Items for Representation Capability

REP1	During this particular telemedicine consultation, the telemedicine technology provided a realistic representation of a traditional face-to-face medical consultation.
REP2	During this particular telemedicine consultation, the telemedicine technology transmitted audio and video feedback that was adequate for the clinical evaluation.
REP3	During this particular telemedicine consultation, the telemedicine technology transmitted all of the relevant information I needed for the clinical evaluation.

4.3.5.3. Presentation Capability

Presentation capability is defined as the presenters' capacity to relay information relevant to a process, based on their ability to articulate pertinent information and execute actions that inform the process. In other words, this construct reflects the ability of the patient or presenting provider to be able to clearly and accurately communicate symptoms and other pertinent information (articulation skills) and perform the diagnostic procedures (e.g., use scopes, palpate specific areas) necessary to derive the diagnostic information needed by the consulting provider (execution skills). The definition stems heavily from concepts that emerged from the qualitative data analysis highlighting the important capabilities of the individual presenting information about the patient's medical condition during the telemedicine consultation. Recall that the presenter can be the patient and/or the presenting provider. Thus, on the survey, the presentation capabilities questions were presented twice: once to capture the patient's presentation capabilities and once to assess the presenting provider's capabilities, if applicable. Given the features available with the Qualtrics software, respondents were only presented with questions regarding the presenting provider if they responded that a presenting provider was present during the telemedicine consultation. For simplicity, the items in Table 6 are presented with the generic wording "presenter," though the survey specified either the patient or the presenting provider for the items representing presentation capabilities. A total of four items were developed for this construct, and the final set of items included in the survey is listed in Table 6.

Table 6. Final Survey Items for Presentation Capability

PRE_CAP1	During this particular telemedicine consultation, the presenter was able to communicate the patient's pertinent clinical information to me.
PRE_CAP2	During this particular telemedicine consultation, the presenter was able to perform the necessary steps to relay the important clinical information to me.
PRE_CAP3	During this particular telemedicine consultation, the presenter was able to complete the tasks necessary to present me with the information I needed.

4.3.5.4. Elicitation Capability

Elicitation capability is defined as the consultants' capacity to obtain information relevant to a process, based on their ability to interview and instruct the presenter(s) in a manner that informs the process. In a technology-mediated consultation process where a remote expert (in this case the consulting provider) engages in a dialog with a user (in this case the patient or presenting provider) the ability to elicit information by asking pertinent questions (interviewing skills) and guiding the user in their responses or actions they have to take to derive the needed information (instruction skills) is critical to the quality of information that is produced to inform the diagnostic decision making process. Our conceptual definition of elicitation capability draws primarily from the literature on the medical interview, telemedicine usage, and insights derived from our qualitative data analysis. Items were developed to specifically capture the consulting provider's ability to draw out information from the presenter that was relevant to the clinical evaluation of the patient's medical condition. A total of five items were developed for this construct, and the final set of items included in the survey is listed in Table 7.

Table 7. Final Survey Items for Elicitation Capability

ELI_CAP1	During this particular telemedicine consultation, I was able to elicit from the patient and/or presenting provider all essential information about the patient's condition.
ELI_CAP2	During this particular telemedicine consultation, I was able to elicit from the patient and/or presenting provider the entire range of clinical information that could be provided to me.
ELI_CAP3	During this particular telemedicine consultation, I was able to elicit from the patient and/or presenting provider every important detail that I needed to know concerning

	the patient's health status.
ELI_CAP4	During this particular telemedicine consultation, I was able to elicit from the patient and/or presenting provider the relevant information I needed in terms of the patient's medical history and current symptoms.

4.3.5.5. Interaction Requirements

Rather than focus on relationship requirements as defined in Process Virtualization Theory, we more narrowly theorize this concept as two separate process requirements: interaction and trust requirements. Interaction requirements are defined in this study as the perceived need for process participants to interact with one another and exchange information in a medical consultation context. Because no measures currently exist for this construct, we developed seven new items that specifically focus on the need for the consulting provider to interface with the patient and acquire health-related information from the patient during the medical consultation process. Table 8 includes the final set of items included on the survey.

Table 8. Final Survey Items for Interaction Requirements

INT_REQ1	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that the patient and I exchange a lot of information.
INT_REQ2	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that there is a high level of interaction between me and the patient.
INT_REQ3	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I obtain a large amount of medical information from the patient.

4.3.5.6. Trust Requirements

We define trust requirements as the perceived need for the advice-seeker to trust the advice-giver in a medical consultation context. In other words, trust requirements refer to the consulting provider's perception that the patient needs to trust him/her during the medical consultation process. While trust is a bi-directional concept, in our context, the main source of critical medical information for the clinical evaluation is the patient. Therefore, it is important that the patient (the trustor) believes he/she trusts the consulting provider (the trustee) in order to open up and share relevant medical information with the consulting provider.

In defining trust, we draw upon work from Mayer et al. (1995), who define trust as “the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party” (p. 712). According to Mayer et al.’s integrated model of trust, trust is determined by one’s trusting beliefs concerning the trustee, or the object of trust. These trusting beliefs are the trustee’s ability, benevolence, and integrity. Ability refers to the degree of aptitude and competencies that the trustee possesses to perform a particular task. Benevolence reflects the goodwill of the trustee—i.e., the extent to which the trustee will do good to the trustor, will not take advantage of the trustor or otherwise act opportunistically. Integrity refers to the belief that the trustee will adhere to the principles perceived to be acceptable by the trustor. In our context, we determined that the two most relevant trusting beliefs concerning the consulting provider, as they relate to perceived e-consultation diagnosticity, are his/her ability and integrity. Therefore, we operationalized trust requirements in terms of the perceived need that the patient trusts the consulting provider in general and specifically in terms of the trusting beliefs of ability and integrity (see Table 9).

Table 9. Final Survey Items for Trust Requirements

TRU_REQ1	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that the patient believes he/she can have confidence in my abilities.
TRU_REQ2	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that the patient feels that he/she can trust me.
TRU_REQ3	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that there is a trusting relationship with the patient.
TRU_REQ4	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that the patient believes I am acting in his/her best interest.

4.3.5.7. Sensory Requirements

Sensory requirements are defined in this study as the need for process participants to be able to enjoy a full sensory experience of the process and other process participants and objects. Based on our interviews and review of the literature, the sensory requirements of a medical consultation typically involve the senses of touching, hearing, and seeing. We adapted measures from Overby (2008) in developing items for this construct. Overby (2008) uses item wording such as “physically inspect” and “touch/see/hear.” The term “inspect” may be more appropriate when describing assessments of objects or physical materials, versus patients. Thus, to contextualize the “physically inspect” item more appropriately, we instead used the wording “physically examine,” “physically evaluate,” and “physically observe.” Table 10 includes the final set of items included on the survey.

Table 10. Final Survey Items for Sensory Requirements

SEN_ REQ1	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I physically observe the patient during the clinical evaluation.
SEN_ REQ2	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I physically examine the patient during the clinical evaluation.

While the specific items we included on the survey are reflective measures of the first-order construct of sensory requirements, we believe that the construct of sensory requirements encompasses multiple dimensions, as there are multiple human senses that can be required of any process. Through the qualitative data analysis, we determined that the main sensory requirements in a medical consultation are touching, seeing, and hearing. Even Overby (2008) included an item for sensory requirements (“touch/see/hear”) that taps into these three dimensions. However, rather than combine these dimensions into a single item, or a second-order multidimensional construct, we separated them into three distinct first-order reflective constructs (touching requirements, hearing requirements, and seeing requirements) and developed items to represent each construct. We did this because different senses are required for different medical conditions and the telemedicine technology allows representations of some sensory requirements, but not all. Hence, it makes sense to capture the unique influence of each of these sensory requirements. Table 11 includes the final set of survey items for these three sensory requirements.

Table 11. Final Survey Items for Touching, Hearing, and Seeing Requirements

Touching Require-ments	TOU_ REQ1	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I employ the sense of touch during the clinical evaluation.
	TOU_ REQ2	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I obtain tactile feedback concerning the patient's condition during the clinical evaluation.
	TOU_ REQ3	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I employ palpation and percussion techniques during the clinical evaluation.*
	TOU_ REQ4	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I touch the patient during the clinical evaluation.
Hearing Require-ments	HEAR_R EQ1	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I use auscultation techniques to evaluate patient organ systems during the clinical evaluation.**
	HEAR_R EQ2	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I listen to the patient (or patient representative) speak during the clinical evaluation.
	HEAR_R EQ3	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I hear the patient's heart, lung, and gastrointestinal sounds during the clinical evaluation.
Seeing Require-ments	SEE_ REQ1	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I visually observe how the patient behaves during the clinical evaluation.
	SEE_ REQ2	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I visually observe the patient's reactions during the clinical evaluation.
	SEE_ REQ3	In general, when conducting clinical evaluations for medical conditions such as this one, it is necessary that I visually inspect certain parts of the patient's body during the clinical evaluation.

* Palpation refers to feeling parts of the body, and percussion refers to tapping parts of the body to produce vibrations/sounds.
** Auscultation refers to using a stethoscope to listen to sounds of the body (e.g., the heart, lungs, and intestines).

4.3.6. OPERATIONALIZATION OF USE AND CONTROL VARIABLES

Hypothesis 11 focuses on how general perceptions of e-consultation diagnosticity (rather than encounter-specific perceptions) influence use. Therefore, the measures used to test this hypothesis focus on overall assessments of both e-consultation diagnosticity as well the control variables. The same measures were used for general e-consultation diagnosticity as for encounter-level but the wording was slightly modified to account for the change in level of analysis (e.g., “During this particular telemedicine consultation, the telemedicine consultation allowed me to carefully evaluate the health condition of the patient” was changed to “In general, telemedicine consultations allow me to carefully evaluate the health condition of a patient.”)

The control variables we included in our study are ones that have been widely employed in technology acceptance research: perceived usefulness (Davis 1986, 1989), perceived ease of use (Davis 1986, 1989), and facilitating conditions (Triandis 1980; Thompson et al. 1991; Venkatesh et al. 2003). Conceptual definitions of these constructs are included in Table 12.

Previously validated scales were adapted to operationalize these constructs. However, for the sake of survey brevity, we determined that we could only use a short list of items for these scales and selected items that have been commonly and successfully used in previous technology acceptance studies.

Table 12. Definitions of Control Variables

Construct	**Definition**
Perceived Usefulness	“the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis 1989, p.320)
Perceived Ease of Use	“the degree to which a person believes that using a system would be free from effort” (Davis 1989, p.320)
Facilitating Conditions	“the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system” (Venkatesh et al. 2003, p. 453)

4.3.6.1. Perceived Usefulness

In the IS literature, the Technology Acceptance Model (TAM) (Davis 1986, 1989) has been a widely employed model to explain and predict technology adoption behaviors (e.g., Davis et al. 1989; Gefen et al. 2000; Taylor and Todd 1995; Venkatesh et al. 2003), including telemedicine adoption (e.g., Chau and Hu 2002; Croteau and Vieru 2002). According to TAM, perceived usefulness and perceived ease of use are key predictors of users' intention to use technology.

Many technology acceptance scholars have acknowledged that the construct of perceived usefulness overlaps greatly with Rogers' (1995) construct of relative advantage (Moore and Benbasat 1999; Venkatesh et al. 2003). Furthermore, relative advantage can be conceptualized as a multidimensional construct (Choudhury and Karahanna 2008). Along these lines, we also measured perceived usefulness as a multidimensional concept. In the healthcare context, the three major professional performance goals of a consulting provider would align with what is referred to as the "triple aim" in healthcare: improving patients' health, improving access to healthcare, and reducing costs (Berwick et al. 2008). Note that telemedicine's ability to improve access to healthcare is also captured by the concept of reach in Process Virtualization Theory (Overby 2008). We thus adapted a measure of reach from Overby (2008) to represent improved access to healthcare and developed two new items to capture improved health and reduced costs.

Table 13. Final Survey Items for Perceived Usefulness

PU1	In general, using the telemedicine system for telemedicine consultations allows me to achieve quality patient health outcomes.
PU2	In general, using the telemedicine system is a cost-effective way to clinically evaluate patients.
PU3	In general, using the telemedicine system allows me to consult with patients I wouldn't otherwise have the opportunity to meet with face-to-face. (Overby 2008)

4.3.6.2. Perceived Ease of Use

Perceived ease of use is defined as the degree to which the user believes that using the system is effortless (Davis 1989). For this construct, we adapted validated measures from Davis (1989), listed in Table 14.

Table 14. Final Survey Items for Perceived Ease of Use

PEOU1	In general, I find it easy to get the telemedicine system to do what I want it to do.
PEOU2	In general, the telemedicine system is easy to use.

4.3.6.3. Facilitating Conditions

The construct of facilitating conditions is defined as the degree to which the user believes that there are existing organizational and technical resources available to support use of the system (Venkatesh et al. 2003). While some scholars (e.g., Taylor and Todd 1995) have conceptualized facilitating conditions to be comprised of both internal factors (e.g., self-efficacy) and external factors, we conceptualize facilitating conditions in terms of the external factors or resources that are available to enable system use, as proposed by Triandis (1980) and Thompson et al. (1991). In the context of using telemedicine, two external resources that have been identified in the literature as being important are technical support (e.g., Barton et al. 2007, Cohn & Goodenough 2002, Hopp et al. 2007) and assistance with scheduling telemedicine appointments (e.g., Helitzer et al. 2003, Karp et al. 2000, Lehoux et al. 2002). Table 15 includes the final set of items for facilitating conditions that we included on the survey.

Table 15. Final Survey Items for Facilitating Conditions

FC1	In general, I receive the necessary technical support services when problems arise with the telemedicine system.
FC2	In general, the necessary resources are available to help me with scheduling telemedicine consultation appointments.

4.3.6.4. Telemedicine Use

System use has long been used as a success measure in IS research (DeLone and McLean 1992; 2003) but recently IS scholars have emphasized the need to conceptualize and measure system use in a richer fashion (Burton-Jones and Straub 2006; DeLone and McLean 2003). Often, IS researchers have chosen “lean” measures of system use, such as duration and frequency, without considering the nature of system use to accomplish the underlying tasks germane to the usage context (Burton-Jones and Straub 2006). Thus, we operationalized system use to represent consulting providers' use of telemedicine to accomplish relevant tasks, such as diagnosing and monitoring patients' health conditions. Table 16 includes the final set of items for rich telemedicine use that we included on the survey.

Table 16. Final Survey Items for Telemedicine Use (Rich)

USE1_R	In general, I use the telemedicine system to diagnose patients' health conditions.
USE2_R	In general, I use the telemedicine system to monitor patients' health conditions.
USE3_R	In general, I use the telemedicine system to accomplish a variety of tasks (e.g., diagnosing and monitoring patient conditions, physician assistant oversight, distance education, etc.).
USE4_R	In general, I use the telemedicine system across a number of telemedicine initiatives.

In addition to rich measures of telemedicine use, we included traditional lean measures of system use. Primarily, we developed different measures that captured the extent of telemedicine use, and these items are listed in Table 17. For these questions, respondents were instructed to type their answers in the fields provided next to the questions.

Table 17. Final Survey Items for Telemedicine Use (Lean)

USE1_L	On average, how many hours per week do you spend using the telemedicine system?
USE2_L	On average, how many patients do you see per week via telemedicine?
USE3_L	On average, what percentage of your patients do you see via telemedicine versus face-to-face (traditional) only?

4.3.7. FIELD TEST: SAMPLING METHOD

The population of interest includes practicing consulting providers in the United States. To obtain a sample from this target population, we employed purposive sampling techniques because we were interested in respondents who met very specific criteria (i.e., consulting providers with current and/or former experience using live video telemedicine for clinical evaluations). We contacted individuals based on two criteria: (1) they were identified as a key contact within a telemedicine network or program, or (2) they were identified as a current or former consulting telemedicine provider. In some cases, the individuals we contacted met both criteria. The main sources of informing these two criteria were Web searches of telemedicine networks, organizations, programs, and research centers, as well as Web searches of news articles identifying telemedicine initiatives within the U.S. Additionally, the American Telemedicine Association membership directory was searched extensively to identify both key contacts and respondents for the study. Furthermore, consulting provider membership directories were obtained for telemedicine networks in both Missouri and Georgia.

We contacted a total of 45 key contacts within U.S.-based telemedicine networks or organizations and 254 consulting providers with telemedicine consultation experience. The key contacts within telemedicine networks and organizations were informed about the dissertation study and asked to email a link to the online survey to consulting telemedicine providers in their network or organization. Those who were identified as current and/or former telemedicine providers were contacted directly and invited to participate in the online survey. With key contacts, one follow up request was sent if the contacts did not reply to the initial request. Follow up contact with targeted respondents was initiated via survey reminders.

A total of 11 key contacts responded affirming they would distribute a link to the online survey to known consulting providers in their telemedicine networks and programs. Of these, six responded to report the number of providers to whom they sent the link. A total of 30 providers were contacted via these six key contacts. However, based on demographic information provided by respondents, we can infer that some key contacts shared a link to the online survey but did not formally report that they did so. Due to incomplete communication with the key contacts, we were not able to obtain an objective report of the total number of consulting providers who were invited to participate in the survey via the key contacts, so an overall response rate cannot be determined. However, we can calculate a response rate based on the individuals we directly contacted to participate in the online survey, as this is a metric that can be calculated utilizing the Qualtrics software.

Data were collected via the online survey spanning a month during spring 2011. A total of 125 completed surveys were received. Direct email invitations to participate in the survey were sent to 254 consulting providers via the Qualtrics mailer. Of these, a total of 89 consulting providers completed the survey, yielding a 35% response rate for those whom we directly contacted to participate in the study. The remaining 36 respondents were invited to participate in the study by one of the telemedicine key contacts we identified.

After screening the observations for outliers, two observations were dropped. Closer inspection of these two observations revealed that they may have misread the questions regarding the dependent variable, perceived e-consultation diagnosticity, because both responded that they perceived low e-consultation diagnosticity, despite responding favorably to other aspects of the medical consultation (e.g., representation, presentation, and elicitation), and their qualitative feedback to open-ended questions also contradicted their responses to the scales for e-consultation diagnosticity. One additional observation was dropped after reviewing the survey completion times that are recorded via the Qualtrics software. The respondent completed the survey in three minutes when the average completion time for the online survey was approximately 15 minutes. The pre-test of the survey at the GPT conference also yielded an average response time of approximately 15 minutes. Thus, we concluded that this respondent did not complete the survey conscientiously and was a good candidate for omission. Removal of the three observations yielded a total sample size of 122 respondents.

CHAPTER 5: DATA ANALYSIS AND RESULTS

This chapter presents the data analysis and results from both the qualitative and quantitative methods employed in the study. The qualitative data analysis and results are presented first followed by a discussion of the data analysis and results for the field survey.

5.1. QUALITATIVE DATA ANALYSIS

Using qualitative methods, we collected data from 39 respondents in 39 separate interviews, from field notes taken at two practitioner telemedicine conferences, from a qualitative meta-analysis that we conducted, and from open-ended comments provided on the field survey we administered (described later in this chapter).

The qualitative data collection yielded 712 pages of interview transcripts, 17 pages of field notes, 10 pages of provider quotes in the meta-analysis, and 107 pages of usable survey comments. In total, the qualitative data collection yielded 846 pages of transcripts and notes. However, because this study focuses on consulting providers' perceptions of telemedicine consultations, we limited our data analysis to transcripts and field notes that represent consulting providers' perspectives. Thus, we analyzed the transcripts from the interviews of 14 consulting providers, survey comments from 107 consulting providers, and data from field notes and the qualitative meta-analysis. In total, we analyzed 460 pages of transcripts and notes in MaxQDA.

5.1.1. CODING PROCESS

The first part of our qualitative data analysis was creating a coding scheme. There are different approaches to coding based on the research objectives; some approaches are more inductive and others more deductive. Following a deductive approach, we developed a list of codes based on a priori theorizing of constructs and hypothesized relationships in our research model, though we left room to discover new themes and patterns that emerged through the course of our data analysis. This approach is useful in both explaining and validating quantitative data collected from the same context (Miles and Huberman 1994).

Our coding scheme included a combination of master codes and sub-codes to capture broad concepts and their subcategories. We created a code for each construct and hypothesis in our research model. Additionally, we created codes for new constructs that emerged through the qualitative data analysis that we later included for exploratory purposes on the survey. Using the text analysis software tool MaxQDA, we imported all transcripts and notes that reflected consulting providers' perspectives into the software and coded each one based on the coding scheme, which consisted of 102 codes.

Because we captured not only constructs but also hypothesized relationships in our coding of the data, we determined that using the analytical technique of frequency counting would be an apt approach to further analyze the data. In qualitative data analysis, employing frequency counting is a sound approach to assess "what you have" in a large set of data, to verify hypotheses, and to protect against bias by keeping the researchers "analytically honest" (Miles and Huberman 1994, p. 253). Representative quotes from the qualitative data to support hypotheses in the research model are presented in Appendix J as well as Chapter 3.

5.2. QUALITATIVE DATA ANALYSIS RESULTS

Results of the frequency counting are presented in Figure 9. Frequency counts in qualitative data analysis can, in part, reveal concepts and patterns that are relatively more important by highlighting themes that are most recurrent. Furthermore, frequency counts allow researchers to ascertain the robustness of their a priori conceptualizations by also revealing results that may contradict previously held expectations (Miles and Huberman 1994).

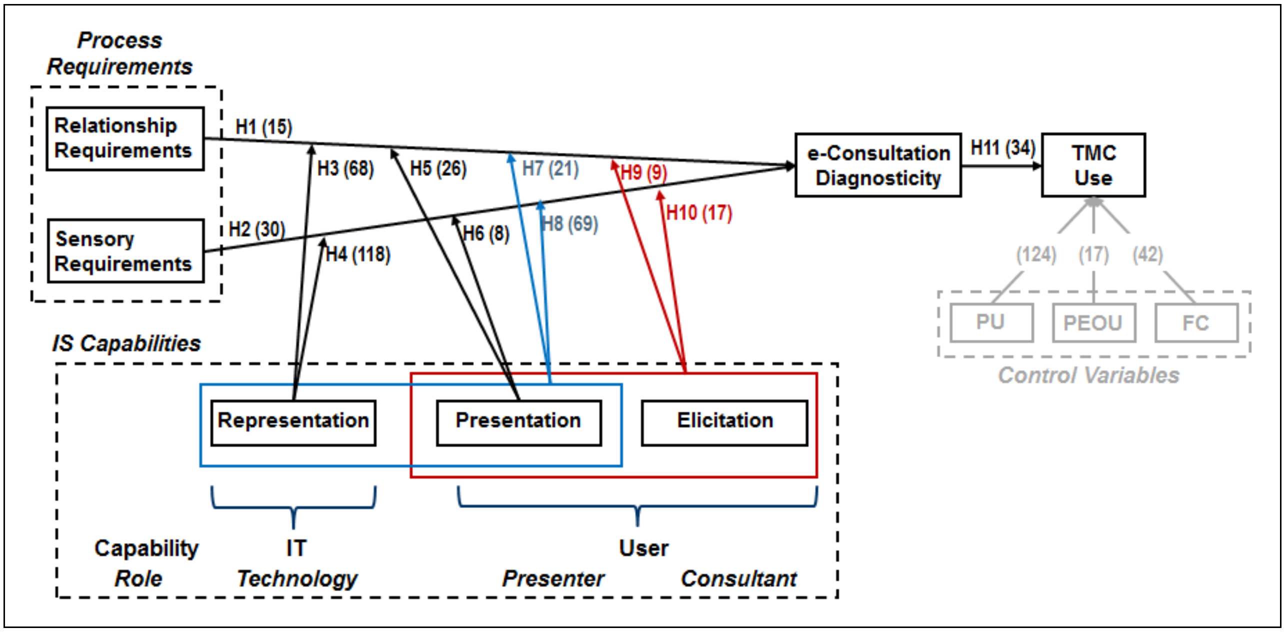


Figure 9. Qualitative Data Analysis Results: Frequency Counts

The frequency count analysis shows that there is some level of support for all hypotheses in our research model, particularly those that posit moderating effects. While not reflective of "hard" statistical analysis, the frequency counts do allow us to "see the general drift of the data more easily" (Miles and Huberman 1994, p. 253). Interpreting the results in this vein, we can draw some interesting insights from the qualitative data analysis.

In short, our research model states that medical consultations with high interaction and trust requirements and high sensory requirements are more likely to be perceived as less amenable to enabling clinical evaluations. However, telemedicine allows for these negative relationships to be attenuated in a few different ways. The process requirements of a medical consultation can be met by either the technology or the presenter. When the technology is limited, the presenter can compensate for the limitations and still allow the process requirements to be fulfilled. Likewise, when the presenter is lacking in presentation knowledge and skills, the consultant can substitute for these weaknesses through coaching and asking guiding questions.

The results of the qualitative data analysis suggest that consulting providers recognize the supporting role of technology in meeting the process requirements—particularly the sensory requirements—of a medical consultation and thus enabling successful clinical evaluations over telemedicine (H3 and H4). In particular, respondents often emphasized how the interactive video technology, along with the telemedicine system's peripheral devices (e.g., stethoscope) enabled them to see and hear everything they needed in order to clinically evaluate the patient. Furthermore, the rich interactive video medium allowed respondents to interact in a simulated face-to-face mode, and many viewed this medium as comparable to an in-person encounter, which helps fulfill the relationship requirements of the medical consultation. These perspectives are less pronounced when considering the role of the presenter alone in meeting the requirements of the process (H5 and H6), though it appears that the presenter alone is better at meeting the relationship requirements, as opposed to the sensory requirements, of a medical consultation. However, the presenter does play a large role in compensating for limitations in the technology in fulfilling the sensory requirements of the medical consultation and thereby facilitating the virtual clinical evaluation (H6), and this is more evident than the presenter's role in substituting for the technology in meeting the relationship requirements of the medical consultation (H7). In terms of sensory requirements, consulting providers repeatedly noted that the technology is not able to transmit the sense of touch, so it is frequently necessary for the presenter to relay tactile feedback to the consulting provider during a telemedicine consultation. Respondents did not often mention their own role in facilitating the virtual medical consultation through their elicitation capabilities; when they did, they most often discussed their abilities in instructing the presenters to execute tasks to relay the necessary sensory information for the clinical evaluation (H10).

Since most respondents were specifically targeted because they had experience using telemedicine for clinical evaluations, many of them did not explicitly identify perceived e-consultation diagnosticity as one of the reasons they utilize telemedicine; in a sense, this motivation was already understood. Thus, we coded the relationship between e-consultation diagnosticity and TMC use when respondents happened to note their decision to use telemedicine because of a need to clinically evaluate a patient—or in a few cases, when the respondent noted a situation in which they did not believe they could adequately assess a patient via telemedicine and thus did not use telemedicine in that particular instance. Many respondents did note their motivations to use telemedicine in terms of the triple aims of healthcare—improving access to healthcare, enhancing quality health outcomes, and reducing healthcare costs—which we capture as perceived usefulness. There were also supporting comments in terms of ease of use and facilitating conditions determining use of TMCs. Altogether, based on the qualitative feedback from our respondents, the data analysis also indicated a level of support for Hypothesis 11, that e-consultation diagnosticity will lead to TMC use.

5.3. SURVEY: DESCRIPTION AND MEASUREMENT VALIDATION

The data analyses for the quantitative study are presented in order of the hypotheses in the research model. Specifically, we test the hypotheses in two separate models; we refer to the first one as the Encounter-Level Diagnosticity Antecedents Model (Figure 10), which includes Hypotheses 1-10, and the second one as the General-Level Diagnosticity Consequences Model

(Figure 11[2]), which includes Hypothesis 11. We use hierarchical linear regression and the procedure suggested by Aiken and West (1991) to test Hypotheses 1-10 which involve two-way and three-way interactions. To test Hypothesis 11, we use partial least squares (PLS) analysis.

The section on survey data analysis proceeds as follows. First, we discuss our process for screening the data for outliers. Then we discuss the demographic characteristics of the respondents and our procedures for assessing non-response bias. Afterward, we describe the steps we followed for measurement validation, including an examination of common method bias, and conclude with a discussion of our data analysis and results for the hypothesis testing.

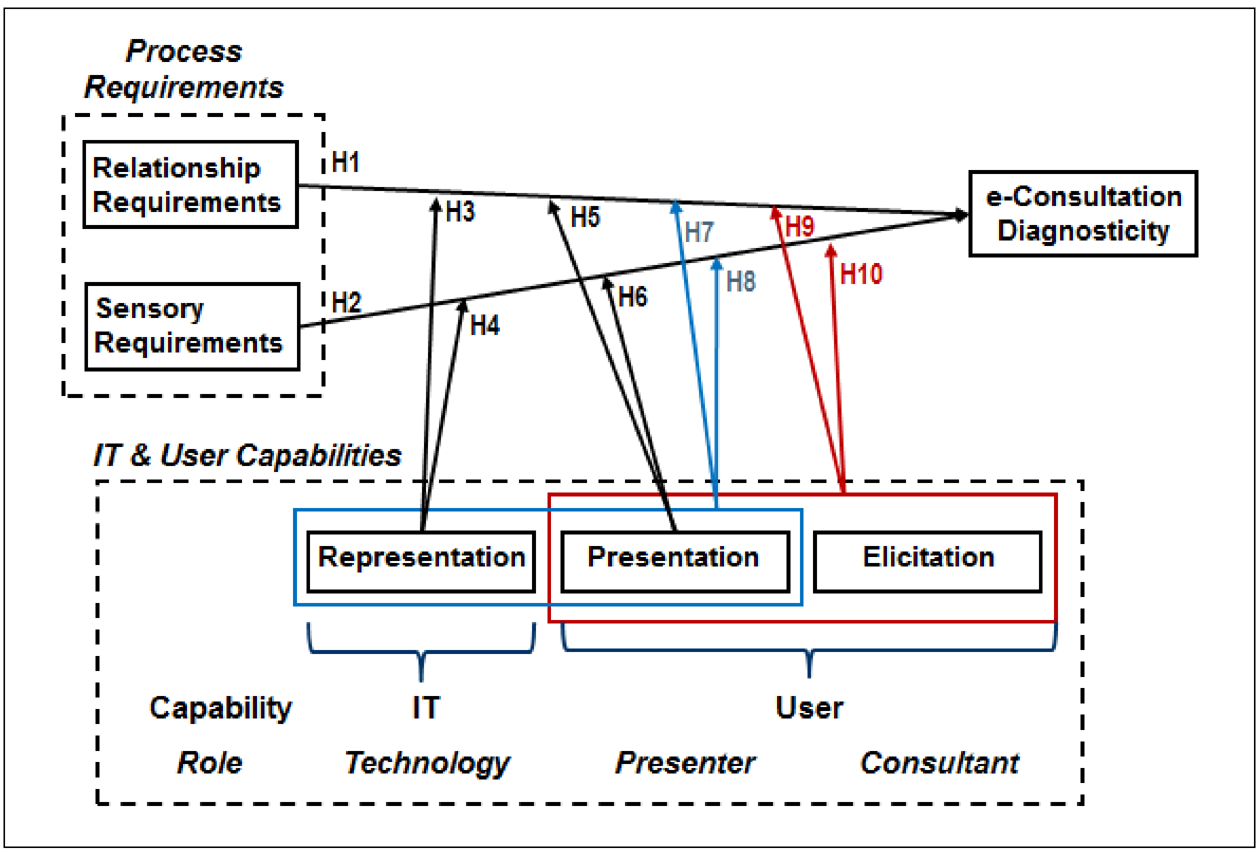


Figure 10. Encounter-Level Diagnosticity Antecedents Model

[2] Though Figure 11 shows Facilitating Conditions as one of the control variables included in the General-Level Diagnosticity Consequences Model, the measurement validation process resulted in dropping this construct.

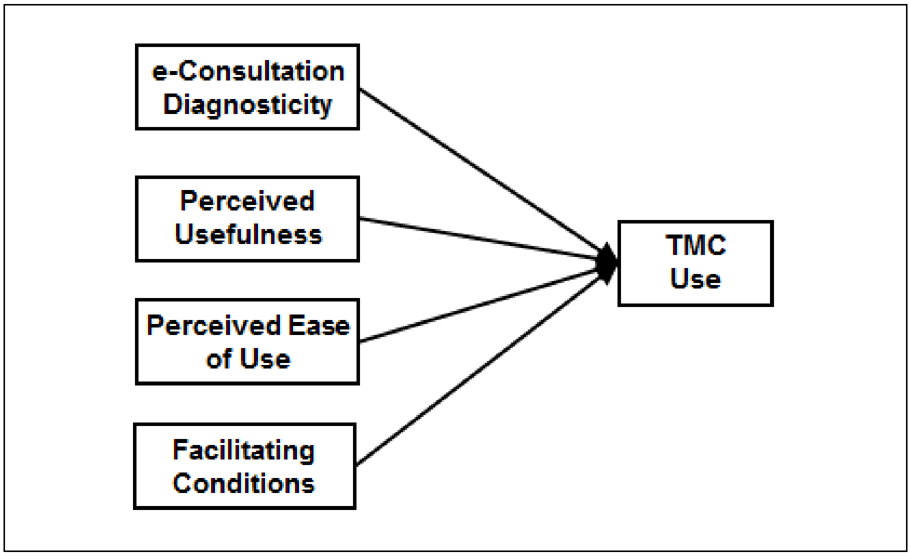


Figure 11. General-Level Diagnosticity Consequences Model

5.3.1. DATA SCREENING

As mentioned in Chapter 4, the quantitative study resulted in a total of 125 completed surveys. The data were first screened for outliers by reviewing the values for the studentized residuals, which indicate the influence of data points on the fitted model. The values with the largest influence are the outliers. Based on this screening, we identified two observations with high residual values (-5.354 and -4.893) that warranted investigation. Closer inspection of these two observations revealed that the respondents may have misread the questions regarding the dependent variable, perceived e-consultation diagnosticity, because both responded that they perceived low e-consultation diagnosticity, despite responding favorably to other aspects of the medical consultation (e.g., representation, presentation, and elicitation), and their qualitative feedback to open-ended questions also contradicted their responses to the scales for e-consultation diagnosticity. One additional observation was dropped after reviewing the survey completion times that are recorded via the Qualtrics software. The respondent completed the survey in three minutes when the average completion time for the online survey was approximately 15 minutes. The pre-test of the survey at the GPT conference also yielded an average response time of approximately 15 minutes. Thus, we concluded that this respondent did not complete the survey conscientiously and was a good candidate for omission. Removal of the three observations yielded a total sample size of 122.

Furthermore, we performed analyses to assess the assumptions of regression (normality, linearity, homoscedasticity, and singularity) (Mendenhall and Sincich 2003), and our results showed that the assumptions hold.

5.3.2. DEMOGRAPHIC CHARACTERISTICS

Demographic characteristics of the respondents are shown in Table 18. Approximately 44 percent of the respondents are female, and approximately 56 percent are male. Most respondents fall within an age range of 35-54 years, though over 25 percent of respondents are above the age of 55 years. While respondents' geographic residence span 27 U.S. states, 27.9 percent of the respondents reside in Georgia, and 20.5 percent of the respondents live in Missouri. While the respondents practice in a number of medical specialties and sub-specialties, the most frequently reported medical specialties by the respondents are Pediatrics (18.9%) and Psychiatry (24.6%).

Table 18. Descriptive Statistics: Respondent Demographics

Age (yrs)	**Percent**	**Medical Specialty**	**Percent**
25-34	7.4	Burn/Wound Surgery	1.6
35-44	28.7	Cardiology	0.8
45-54	36.9	Clinical Psychology	3.3
55-64	17.2	Dermatology	4.9
65+	9.8	Dietetics/Nutrition	2.5
Sex		Emergency Medicine	7.4
Male	55.7	Endocrinology	1.6
Female	44.3	Family Medicine	2.5
State		Gastroenterology/Hepatology	0.8
Arizona	0.8	Genetics	2.5
Arkansas	4.9	Infectious Disease	1.6
California	1.6	Internal Medicine	6.6
Georgia	27.9	Neurology	6.6
Hawaii	0.8	Obstetrics/Gynecology	4.9

Illinois	0.8	Orthopedic Surgery	0.8
Indiana	2.5	Pediatrics	18.9
Kansas	3.3	Physical Medicine and Rehabilitation	0.8
Kentucky	4.9	Psychiatry	24.6
Louisiana	1.6	Pulmonology	1.6
Maryland	1.6	Speech-Language Pathology	1.6
Massachusetts	2.5	Transplant Surgery	2.5
Minnesota	0.8	Urology	1.6
Missouri	20.5	**Sub-Specialty**	
Nebraska	1.6	Adult Psychiatry	1.6
New Mexico	2.5	Child/Adolescent Psychiatry	9.0
New York	2.5	Geriatrics	1.6
Oregon	0.8	Maternal-Fetal Medicine	2.5
Rhode Island	0.8	Pediatric Cardiology	0.8
South Carolina	2.5	Pediatric Child Protection	1.6
South Dakota	0.8	Pediatric Critical Care	3.3
Tennessee	1.6	Pediatric Endocrinology	1.6
Texas	1.6	Pediatric Immunology	0.8
Virginia	7.4	Pediatric Nephrology	2.5
Washington	0.8	Pediatric Rheumatology	0.8
Wisconsin	0.8	Pediatric Urology	0.8
Wyoming	1.6	Rheumatology	1.6
		Stroke Medicine	0.8

One of the criteria for participation in the survey is that the respondent had to have experience using telemedicine for clinical evaluations prior to completing the survey. Descriptive statistics for respondents' telemedicine use are summarized in Table 19. The most frequent responses for respondents' years of telemedicine usage are 1-3 years (37.7%) and 4-6 years (26.2%). Approximately eight percent of the respondents reported less than one year of experience with telemedicine, and approximately 17 percent of the respondents reported to have more than 10 years of experience using telemedicine. In terms of the extent of respondents' telemedicine use, the majority responded that they use telemedicine either less than one hour per week (16.4%) or between one to five hours per week (59%). In terms of the extent of patients seen via telemedicine, approximately 20 percent of the respondents see less than one patient per week and approximately 44 percent of the respondents see 1-5 patients per week. Furthermore, 23 percent of the respondents reported that less than one percent of their patients are seen via telemedicine versus traditional face-to-face visits, and approximately 38 percent of the respondents report that their percentage of telemedicine patients is 1-5 percent. Thus, while most respondents report multiple years of experience using telemedicine, for most of them, telemedicine use for clinical purposes represents a small portion of their overall professional activities. Only one respondent reported that 100 percent of his/her patients are seen via telemedicine.

Table 19. Descriptive Statistics: Respondent Telemedicine Usage

Years of Telemedicine Use	Percent
<1	8.2
1-3	37.7
4-6	26.2
7-9	10.7
10+	17.2
Hours of Telemedicine Use Per Week	**Percent**
<1	16.4
1-5	59.0
6-10	9.8
11-15	6.6
16-20	2.5
21-25	3.3
41-45	1.6
51-55	0.8
Number of Telemedicine Patients Per Week	**Percent**
<1	19.7
1-5	44.3
6-10	10.7
11-15	11.5
16-20	2.5
21-25	4.9
26-30	3.3
31-35	1.8
36-40	1.6
51-55	0.8
Percentage of Telemedicine Patients Per Week	**Percent**
<1	23.0
1-5	37.7
6-10	9.0

11-15	1.6
16-20	4.9
21-25	1.6
26-30	6.6
36-40	1.6
46-50	5.7
56-60	0.8
66-70	2.5
71-75	0.8
86-90	0.8
91-95	0.8
96-100	2.5

5.3.3. NON-RESPONSE BIAS

One of the potential biases in survey research is that of non-response bias, which refers to a type of bias that exists when responses collected are not representative of the responses that could be collected from the total sample of respondents and non-respondents (Hansen and Hurwitz 1946). In our study, non-response bias was assessed by following a procedure recommended by Armstrong and Overton (1977) that treats late responders as proxies for non-responders. After receiving the initial survey invitation, each consulting provider who was identified as a non-responder via the Qualtrics online survey software was sent a total of two reminders inviting them to complete the survey, at approximately one week after the initial invitation and at approximately two weeks after the initial invitation. Those respondents who completed the survey after receiving a reminder likely share characteristics with non-responders. If they are similar to the group of initial responders then non-response bias concerns are reduced (Armstrong and Overton 1977).

Of the 122 respondents in our sample, a total of 77 were initial responders and a total of 45 completed the survey after receiving a reminder. Comparing the two groups using unpaired t-tests, we found that the initial responders and post-reminder responders did not differ significantly according to various demographic factors (age, gender, education level, geographic location, and medical specialty), extent of telemedicine use, and responses for independent and dependent variables. We thus conclude that non-response bias is not a significant concern with our sample of respondents.

5.3.4. MEASUREMENT VALIDATION FOR ENCOUNTER-LEVEL DIAGNOSTICITY ANTECEDENTS MODEL

5.3.4.1. Exploratory Factor Analysis

Because the majority of scales are newly developed, we first screened the items using exploratory factor analysis (EFA) in SPSS. Specifically, we performed principal axis factoring analyses using promax rotation and specified the number of factors expected to emerge based on our theorizing. Following the more conservative guideline to perform EFA using 10 items per observation (Netemeyer et al. 2003), we employed different combinations of a maximum of approximately 12-13 items per EFA. We conducted EFA initially to identify whether there were any glaring issues with items relating to their theoretical factor. The rule of thumb we employed was that items should load on their respective factors at a coefficient level of 0.60 or higher and that loadings below 0.40 indicate problematic measures (Hair et al. 1998).

The results of the EFA revealed that most items loaded on their respective factors at a level of 0.60 or higher. However, we observed that certain items could be problematic, given their loadings between 0.40-0.60. These items were DIAG4, ELIC_CAP1, and ELIC_CAP4. Given that their loadings were not below 0.40, we retained them for the confirmatory factor analysis (CFA), which we explain in the next section.

However, the most revealing discovery of the EFA was that our measurement items for the sensory requirements of touching, hearing, and seeing did not converge into three separate factors as theoretically expected. Instead, item HEAR_REQ2 loaded onto a factor with SEE_REQ1 and SEE_REQ2, and items HEAR_REQ1 and HEAR_REQ3 loaded onto a factor with all touching requirements items. Additionally, SEE_REQ3 did not relate to either of these two factors (see Table 20).

Table 20. Initial EFA Results for Sensory Requirements

	Component		
	1	**2**	**3**
SEE_REQ1		.866	
SEE_REQ2		.872	
SEE_REQ3			.917
HEAR_REQ1	.847		
HEAR_REQ2		.779	
HEAR_REQ3	.631		.402
TOU_REQ1	.834		
TOU_REQ2	.841		
TOU_REQ3	.867		
TOU_REQ4	.660		

After inspecting the item wording for all sensory requirements items more closely, we realized that the items were converging into two predominant factors: one that captures passive sensory observation requirements and one that relates to active sensory observation that requires physical contact with the patient. Passive sensory observation requirements involve visually observing the patient and hearing him/her speak. Active sensory observation, in contrast, requires that there is physical contact with the patient during the clinical evaluation—e.g., palpating or applying a stethoscope to hear heart and lung sounds. We thus combined the items into these two overarching concepts and dropped items HEAR_REQ2 and SEE_REQ3. Results of the final EFA are shown in Table 21. However, given that passive observation (SEE_REQ1, SEE_REQ2, and HEAR_REQ2) is uniformly provided to consulting providers via real-time audio/video-conferencing in our context, we eliminated passive observation requirements from further investigation and only retained the physical contact requirements construct to assess the sensory requirements of the medical consultation.

Table 21. Final EFA Results for Sensory Requirements

	Component	
	1	**2**
SEE_REQ1		.907
SEE_REQ2		.916
HEAR_REQ2		.782
HEAR_REQ1	.860	
HEAR_REQ3	.846	
TOU_REQ1	.748	
TOU_REQ2	.811	
TOU_REQ3	.839	
TOU_REQ4	.772	

5.3.4.2. Confirmatory Factor Analysis

We used confirmatory factor analysis (CFA) in partial least squares (PLS) to examine the factorial validity of our constructs in terms of convergent validity and discriminant validity. As opposed to EFA, a CFA involves the pre-specification of the pattern of item loadings onto the latent constructs in the model (Gefen and Straub 2005).

Discriminant validity was assessed by examining item loadings and the AVE. In regards to item loadings, constructs show discriminant validity when items load more highly on their respective construct than on other constructs in the model. While no established thresholds exist for item loadings and cross-loadings, Gefen and Straub (2005) recommend at least a .10 difference. We used a slightly more conservative estimate of .15 for the difference between item loadings and cross-loadings. Given this criterion, the same items that presented as problematic in the EFA violated the .15 difference rule in the CFA. After carefully reviewing the theoretical definitions for e-consultation diagnosticity and elicitation capability, we determined that dropping these problematic items (DIAG4, ELI_CAP1, and ELI_CAP4) would not compromise the content validity of the constructs; thus, we eliminated these three items from further analysis. Table 22 shows the results of the CFA after these items were dropped.

Table 22. Item Loadings and Cross-Loadings (PLS-CFA)

	E-DIAG	REP CAP	PRES CAP	ELIC CAP	INT REQ	TRUST REQ	PHYS CON REQ
DIAG1	0.940	0.681	0.687	0.720	0.399	0.382	-0.096
DIAG2	0.957	0.643	0.584	0.722	0.448	0.353	-0.097
DIAG3	0.934	0.756	0.665	0.663	0.268	0.199	-0.175
REP1	0.644	0.894	0.565	0.647	0.191	0.182	-0.232
REP2	0.673	0.897	0.659	0.688	0.231	0.167	-0.185
REP3	0.658	0.896	0.585	0.646	0.378	0.365	-0.139
PRE_CAP1	0.596	0.602	0.925	0.592	0.161	0.276	-0.128
PRE_CAP2	0.702	0.702	0.959	0.647	0.139	0.252	-0.158
PRE_CAP3	0.593	0.555	0.888	0.558	0.109	0.180	-0.093
ELI_CAP2	0.753	0.721	0.619	0.966	0.351	0.377	-0.146
ELI_CAP3	0.674	0.696	0.631	0.957	0.320	0.369	-0.132
INT_REQ1	0.348	0.276	0.147	0.343	0.881	0.629	0.084
INT_REQ2	0.337	0.242	0.092	0.298	0.884	0.433	0.205
INT_REQ3	0.356	0.268	0.149	0.284	0.879	0.471	0.170
TRU_REQ1	0.352	0.281	0.242	0.403	0.518	0.918	-0.055
TRU_REQ2	0.310	0.259	0.223	0.385	0.605	0.947	-0.055
TRU_REQ4	0.216	0.159	0.240	0.239	0.453	0.874	-0.017
TOU_REQ1	-0.023	-0.134	-0.073	-0.084	0.216	0.058	0.676
TOU _REQ2	0.002	-0.119	-0.027	0.008	0.095	-0.032	0.729
TOU _REQ3	-0.146	-0.153	-0.133	-0.124	0.164	0.009	0.883
TOU _REQ4	-0.119	-0.178	-0.149	-0.122	0.146	-0.011	0.808
HEAR_REQ1	-0.083	-0.214	-0.099	-0.137	0.112	-0.177	0.840
HEAR_REQ3	-0.057	-0.166	-0.037	-0.099	0.107	-0.081	0.825

* Item TRU_REQ3 dropped after covariance-based (SEM) CFA

Another indicator of discriminant validity is when the square root of the AVE is larger than inter-construct correlations (Chin 1998; Gefen and Straub 2005). As presented in Table 23, the square root of the AVE for all constructs is greater than inter-construct correlations. Thus, we conclude that our constructs demonstrate reasonable discriminant validity.

Table 23. Inter-Construct Correlations

	Composite Reliability	E-CON DIAG	REP CAP	PRES CAP	ELIC CAP	INT REQ	TRUST REQ	PHYS REQ
E-CON DIAG	0.96	0.94						
REP CAP	0.92	0.74	0.90					
PRES CAP	0.95	0.69	0.67	0.93				
ELIC CAP	0.96	0.74	0.74	0.65	0.96			
INT REQ	0.91	0.40	0.30	0.15	0.35	0.88		
TRUST REQ	0.94	0.33	0.27	0.26	0.39	0.58	0.91	
PHYS REQ	0.91	-0.13	-0.20	-0.14	-0.15	0.17	-0.05	0.80
The shaded values on the leading diagonal are the square root of the average variance extracted (AVE). Off diagonal values are the correlations among constructs. For discriminant validity, values on the leading diagonal should be larger than off-diagonal values.								

Convergent validity was assessed by examining item loadings and the AVE. In terms of item loadings, values greater than .70 indicate that over half of the variance in the items is captured by the latent construct (Chin 1998) and are typically considered acceptable (Forknell and Larcker 1981). As can be seen in Table 22, with the exception of one item, all item loadings are above .70. The item TOU_REQ1/PHY_REQ1 has a loading of .676, which is very close to the recommended threshold of .70; thus, we retained this item. Additionally, for convergent validity all AVE values have to exceed .50 (Fornell and Larcker 1981). AVE for our constructs range from .63 to .92 providing additional evidence for convergent validity. Furthermore, all composite reliability scores for the constructs are greater than .70, indicating that all constructs demonstrate high internal consistency.

As a final assessment of factorial validity, we performed a CFA using covariance-based SEM in AMOS and examined the goodness of fit metrics. The initial analysis of the measurement model indicated a borderline fit (CFI=0.898, RMSEA=0.092, and CMIN/DF=2.015). Closer inspection of the error terms revealed that the item of TRU_REQ3 was an issue. After examining the item wording for TRU_REQ3, we determined that it was not a good measure of trusting requirements and that removing the item would not compromise content validity; hence, we dropped TRU_REQ3. We then re-analyzed the measurement model and the results revealed an improved fit (CFI=0.934, RMSEA=0.083, and CMIN/DF=1.843).

Table 24 shows the final scales used to assess the structural model. The descriptive statistics for the final constructs and items are shown in Table 25. While respondents, on average, responded on the higher end of the 7-point Likert scale (i.e., “Agree” to “Strongly Agree”), responses varied in range across all constructs, according to the minimum and maximum responses recorded for all items. Additionally, respondents indicated that, on average, there are high relationship requirements (i.e., interaction and trust requirements) but low sensory (i.e., physical contact) requirements for the particular medical condition they evaluated via telemedicine.

Table 24. Final Constructs and Items for Encounter-Level Diagnosticity Antecedents Model

Perceived e-Consultation Diagnosticity	
DIAG1	The telemedicine consultation allowed me to carefully evaluate the health condition of the patient.
DIAG2	The telemedicine consultation allowed me to thoroughly assess the health condition of the patient.
DIAG3	The telemedicine consultation allowed me to accurately evaluate the patient's health condition.
Representation Capability	
REP1	The telemedicine technology provided a realistic representation of a traditional face-to-face medical consultation.
REP2	The telemedicine technology transmitted audio and video feedback that was adequate for the clinical evaluation.
REP3	The telemedicine technology transmitted all of the relevant information I needed for the

	clinical evaluation.
Presentation Capability	
PRE_ CAP1	The presenter was able to communicate the patient's pertinent clinical information to me.
PRE_ CAP2	The presenter was able to perform the necessary steps to relay the important clinical information to me.
PRE_ CAP3	The presenter was able to complete the tasks necessary to present me with the information I needed.
Elicitation Capability	
ELI_ CAP1	I was able to elicit from the patient and/or presenting provider all essential information about the patient's condition.
ELI_ CAP2	I was able to elicit from the patient and/or presenting provider the entire range of clinical information that could be provided to me.
Interaction Requirements	
INT_ REQ1	It is necessary that the patient and I exchange a lot of information.
INT_ REQ2	It is necessary that there is a high level of interaction between me and the patient.
INT_ REQ3	It is necessary that I obtain a large amount of medical information from the patient.
Trust Requirements	
TRU_ REQ1	It is necessary that the patient believes he/she can have confidence in my abilities.
TRU_ REQ2	It is necessary that the patient feels that he/she can trust me.
TRU_ REQ4	It is necessary that the patient believes I am acting in his/her best interest.
Physical Contact Requirements	
TOU_ REQ1	It is necessary that I employ the sense of touch during the clinical evaluation.
TOU_ REQ2	It is necessary that I obtain tactile feedback concerning the patient's condition during the clinical evaluation.
TOU_ REQ3	It is necessary that I employ palpation and percussion techniques during the clinical evaluation.
TOU_ REQ4	It is necessary that I touch the patient during the clinical evaluation.
HEAR _REQ1	It is necessary that I use auscultation techniques to evaluate patient organ systems during the clinical evaluation.
HEAR _REQ3	It is necessary that I hear the patient's heart, lung, and gastrointestinal sounds during the clinical evaluation.

Table 25. Descriptive Statistics for Constructs and Items

Construct and Items	Mean	St. Dev.	Min	Max
e-Consultation Diagnosticity	5.80	1.091	1	7
DIAG1	5.94	1.078	1	7
DIAG2	5.65	1.253	1	7
DIAG3	5.82	1.136	1	7

Representation Capability	5.74	1.089	1	7
REP1	5.60	1.277	1	7
REP2	5.94	1.116	1	7
REP3	5.69	1.254	1	7
Presentation Capability	5.99	1.008	1.33	7
PRE_CAP1	6.07	1.030	1	7
PRE_CAP2	6.09	1.037	1	7
PRE_CAP3	5.84	1.209	2	7
Elicitation Capability	5.78	1.228	1	7
ELI_CAP2	5.81	1.229	1	7
ELI_CAP3	5.75	1.326	1	7
Interaction Requirements	5.85	1.171	1	7
INT_REQ1	6.07	1.278	1	7
INT_REQ2	5.88	1.352	1	7
INT_REQ3	5.61	1.358	1	7
Trust Requirements	6.27	0.900	1.67	7
TRU_REQ1	6.29	0.848	2	7
TRU_REQ2	6.26	1.066	1	7
TRU_REQ4	6.27	1.029	1	7
Physical Contact Requirements	3.45	1.719	1	7
TOU_REQ1	3.95	2.024	1	7
TOU_REQ2	3.72	2.062	1	7
TOU_REQ3	3.16	2.105	1	7
TOU_REQ4	3.17	2.150	1	7
HEAR_REQ1	3.51	2.175	1	7
HEAR_REQ3	3.21	2.156	1	7

5.3.5. COMMON METHOD BIAS

With survey-based research, there is the potential for common method bias. Common method variance refers to method effect that produces a level of variance that is shared across all measures assessed using the same method (Spector 2006). This shared variance can be attributed to factors such as the measurement context (e.g., measuring independent and dependent variables using the same medium at a single point in time), item characteristics (e.g., common scale formats and anchors), and common rater effects (e.g., social desirability and consistency motif) (Podsakoff et al. 2003).

We conducted two tests to assess common method bias in our study. First, in SPSS, we conducted Harman's single factor test (Harman 1967) by examining the results of an unrotated exploratory factor analysis using items for all constructs in our research model (Hypotheses 1-10). If a substantial portion of common method variance is present, either one factor will emerge, or more than half of the variance will be attributed to a single factor (Podsakaff and Organ 1986). Results of the Harman's single factor test revealed that the most variance explained by a single factor is 34.75%, which does not account for the majority of the variance and thus alleviates some concern that common method bias exists in our study.

To conduct a more robust test of common method bias, we assessed the properties of the measurement model both with and without a common method factor, thereby controlling for the effects of the common method factor (Podsakoff et al. 2003). Using AMOS, we conducted a confirmatory factor analysis (CFA) allowing all items to load on their own construct and the latent common method factor. The model fit statistics for the measurement model without the common method factor (CFI=0.934, RMSEA=0.083, and CMIN/DF=1.843) are slightly improved over the fit statistics for the model measured with the common method factor (CFI=0.924, RMSEA=0.085, and CMIN/DF=1.871). Furthermore, results of the CFA with the common method factor showed that item loadings on their own construct were significant, whereas item loadings on the common method factor were non-significant. We calculated the average variance extracted (AVE) for the trait factors as well as the common method factor and found that all trait factors' AVE exceed 50 percent, and the AVE for the common method factor is only 8.4 percent (see Table 26). Therefore, we conclude that common method bias is not a significant issue in this study.

Table 26. Average Variance Extracted with and without Common Method Factor

	AVE w/ CF	AVE w/o CF
INT_REQ	0.525	0.654
TRU_REQ	0.536	0.763
PHY_REQ	0.592	0.574
REP_CAP	0.698	0.701
PRE_CAP	0.787	0.789
ELI_CAP	0.814	0.850
DIAG	0.815	0.838
CF	0.084	

5.3.6. MEASUREMENT VALIDATION FOR GENERAL-LEVEL DIAGNOSTICITY CONSEQUENCES MODEL

We used similar techniques in PLS to validate the measures of constructs[3] explored in the General-Level Diagnosticity Consequences Model to test Hypothesis 11. Using the same criteria as specified in the previous section, we found that there were issues with convergent and discriminant validity with perceived e-consultation diagnosticity and perceived usefulness. Regarding e-consultation diagnosticity, the same item, DIAG4 ("Telemedicine consultations allow me to perform all of the assessment tasks necessary to evaluate the patient's condition"), that was problematic in the measurement model for the Encounter-Level Diagnosticity Antecedents Model was also an issue in the General-Level Diagnosticity Consequences Model and was thus omitted from the PLS analysis because doing so does not compromise the content validity of perceived e-consultation diagnosticity. Regarding perceived usefulness, the item PU1 ("Using the telemedicine system for telemedicine consultations allows me to achieve quality patient health outcomes") loads onto perceived e-consultation diagnosticity nearly as highly as it does on its own construct, and the square root of AVE for perceived usefulness is less than the

[3]Our measures for perceived e-consultation diagnosticity in the Diagnosticity Consequences Model were worded to capture perceptions of telemedicine consultations in general, versus a specific telemedicine consultation, as specified in the Diagnosticity Antecedents Model. To shorten the survey length, we omitted DIAG3 from the survey because it is similarly worded as DIAG1.

inter-construct correlation with e-consultation diagnosticity. We determined that, indeed, the item taps at general perceptions of e-consultation diagnosticity and, thus, dropped it from the data analysis[4]. Item loadings and inter-construct correlations can be found in Tables 27 and 28.

Table 27. Item Loadings and Cross-Loadings

	E-CON DIAG	PEOU	PU	USE (RICH)	USE (LEAN)
DIAG1	0.969	0.696	0.550	0.238	0.728
DIAG2	0.970	0.757	0.591	0.254	0.711
PEOU1	0.746	0.961	0.537	0.145	0.648
PEOU2	0.692	0.958	0.493	0.113	0.632
PU2	0.513	0.610	0.842	0.079	0.543
PU3	0.458	0.264	0.810	0.228	0.467
R-USE1	0.580	0.391	0.521	0.249	0.759
R-USE2	0.565	0.453	0.417	0.140	0.752
R-USE3	0.591	0.694	0.491	0.252	0.823
L-USE1	0.141	-0.022	0.075	0.687	0.090
L-USE2	0.215	0.118	0.167	0.861	0.281
L-USE3	0.243	0.211	0.183	0.827	0.274

Table 28. Inter-Construct Correlations

	Composite Reliability	E-CON DIAG	PEOU	PU	USE (LEAN)	USE (RICH)
E-CON DIAG	0.97	0.97				
PEOU	0.96	0.75	0.96			
PU	0.81	0.59	0.54	0.83		
USE (LEAN)	0.84	0.25	0.13	0.18	0.80	
USE (RICH)	0.82	0.74	0.67	0.61	0.28	0.78
The shaded values on the leading diagonal are the square root of the average variance extracted. Off diagonal values are the correlations among constructs. For discriminant validity, values on the leading diagonal should be larger than off-diagonal values						

5.4. SURVEY: HYPOTHESIS TESTING

In this section, we detail the results of our hypothesis testing. We used stepwise regression using mean-centered coefficients for all variables to test Hypotheses 1-10. Results of

[4] After re-running the PLS analysis (discussed in a later section) with the omission of PU1, we found that the results are the same as when the item is retained.

the regression analyses are presented in Tables 29-35. To test Hypothesis 11, we used PLS-analysis, and results of this analysis are shown in Figure 15.

Because of the complexity of our main research model, we ran stepwise regression analyses for four different categories of hypotheses: the effects of representation and presentation on relationship requirements (i.e., interaction and trust requirements[5]), the effects of representation and presentation on sensory requirements (i.e., physical contact requirements), the effects of presentation and elicitation on relationship requirements (i.e., interaction and trust requirements), and the effects of presentation and elicitation on sensory requirements (i.e., physical contact requirements). In Tables 29-31, we present the results of the regression analyses to test the effects of representation and presentation, individually and jointly. In Tables 34 and 35, we show the results of the regression analyses to test the impacts of presentation individually (also shown in Tables 29-31) and the joint effects of presentation and elicitation. For the stepwise regression, we followed the procedure suggested by Aiken and West (1991) for testing interactions: we first ran a main effects model and then added interaction effects in each subsequent model until a full set of hypothesized interaction effects were tested.

In our initial run of the stepwise regression, we found that several two-way and three-way interaction variables exhibited high multicollinearity, as shown by the high (above 10) VIF scores. To address the issue of multicollinearity, we transformed the interaction effect variables using a partial Gram-Schmidt procedure to orthogonalize the regressors (Burrill 1997). The idea behind this approach is that each interaction effect is "orthogonalized with respect to lower order terms…and may be thought of as a 'pure interaction' effect at its own level" (Burrill 1997, p. 5), as each interaction effect has no correlation with any lower order terms. Using the orthogonalized interaction terms in the regression analyses alleviated multicollinearity concerns

[5] As explained later in the chapter, trust requirements was dropped from the model and all regression analyses.

by reducing the majority of high VIF scores to below four, with the highest score being 5.38. However, a closer inspection of VIF scores combined with condition indices near or above 5 and variance proportions above 0.50 for some of the interaction terms prompted us to combine IT and/or user capabilities in some of our regression analyses, and we explain this in greater detail in the discussion of results.

To test Hypothesis 11, we employed PLS analysis using SmartPLS with a 500 sample bootstrapping method. We used PLS because it is a structural equation modeling (SEM) technique, and we incorporated a mediating relationship in the model; multiple regression does not permit the analysis of a full model with mediating relationships. We modeled perceived usefulness as a mediator between perceived e-consultation diagnosticity and telemedicine use because it makes theoretical sense that consulting providers who perceive high e-consultation diagnosticity will perceive telemedicine consultations to be useful. Results of the PLS analysis are presented in Figure 15.

5.5. SURVEY: DISCUSSION OF RESULTS

We organize our discussion of results around the hypotheses posited in the study. Figure 24 presents a pictorial representation that summarizes our data analysis findings from the field survey (including post-hoc analysis, described at the end of the chapter). Results for testing hypotheses 1-10 are presented in Tables 29-35. Our main effects model indicates that interaction requirements, representation, presentation, and elicitation all have significant positive effects on e-consultation diagnosticity explaining 68.5% of its variance.

5.5.1. H1: Negative Relationship between Relationship Requirements and e-Consultation Diagnosticity

As we discussed in the previous chapter, relationship requirements were assessed using two constructs: interaction requirements (that assessed the extent of required information exchange between the consultant and presenter) and trust requirements. Therefore, our testing of hypothesis 1 consists of two parts. In the main effects model (presented in all Tables 29-35), which explains 68.5% of the variance in perceived e-consultation diagnosticity, the only *process requirement* that is statistically significant in explaining e-consultation diagnosticity is interaction requirements (γ=0.199, $p<.005$). However, the relationship between interaction requirements and e-consultation diagnosticity is positive, rather than negative as we hypothesized, across both main effect and interaction models (the bivariate correlation between interaction requirements and e-consultation diagnosticity is also positive and significant (correlation=.40)).

The second aspect of relationship requirements, trust requirements, had no significant effects on e-consultation diagnosticity in the main effects and the interaction models. Therefore, H1 is not supported because neither trust requirements nor interaction requirements are statistically significant as originally hypothesized.

In terms of relationship requirements, it appears that the need for interaction and information exchange, as opposed to the need for the patient to trust the consultant, is more critical in determining perceptions of e-consultation diagnosticity. Our qualitative data analysis and literature review revealed that trust is likely most crucial for enabling information exchange. Therefore, it is possible that the effect of trust on e-consultation diagnosticity is not direct but rather that it is mediated by its effect on interaction requirements (the correlation between trust requirements and interaction requirements=.58). To assess the presence of this mediating relationship, we performed the Sobel test for mediation and found that there is significant mediation by interaction requirements in the relationship between trust requirements and e-consultation diagnosticity (z-value=2.794, p=.005). Therefore, we dropped trust requirements from all subsequent regression analyses. Regression analysis results presented in Table 29 are presented again in Table 30 excluding trust requirements from all models.

5.5.2. H2: Negative Relationship between Sensory Requirements and e-Consultation Diagnosticity

The relationship between sensory (i.e., physical contact) requirements and e-consultation diagnosticity, though negative as hypothesized, is non-significant across all regression models. Thus, H2 is not supported. Because we asked consulting providers to report on a telemedicine encounter they had experienced, it is possible that providers typically use the system in situations that do not involve high sensory requirements. This is corroborated by the low mean value for the construct (though responses span the range for the scale). As a result, due to this selection, sensory requirements may not be a concern for these consultations. This may have resulted in the non-significant effects.

5.5.3. H3: Moderating Effect of Representation on the Relationship between Relationship Requirements and e-Consultation Diagnosticity

When testing the moderating effects of representation and relationship requirements—i.e., interaction requirements—on perceived e-consultation diagnosticity, we found that the two-way interaction between representation and interaction requirements is non-significant (Table 30, Model 2. However, power calculations indicate that there is low statistical power (.37) with our sample size, and it may be that the non-significant effect is due to insufficient power.

Table 29. Representation and Presentation: Moderating Effects on Relationship Requirements (with Trust Requirements)

	Main Eff		Model 1		Model 2		Model 3		Model 4		Model 5	
Predictors:	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**
IntReq	.199	.005**	.247	.001***	.228	.002**	.183	.010**	.211	.005**	.239	.002**
TrustReq	-.050	.466	-.041	.532	-.102	.164	-.024	.733	-.079	.321	-.044	.574
PhysReq	-.028	.619	-.036	.513	.002	.978	-.026	.654	-.003	.961	-.005	.925
Rep	.259	.003**	.240	.005**	.325	.001***	.239	.007**	.339	.001***	.346	.001***
Pres	.287	.000***	.291	.000***	.239	.003**	.291	.000***	.239	.003**	.262	.001***
Elic	.312	.000***	.310	.000***	.283	.002**	.322	.000***	.264	.005**	.213	.024*
RepXPres			-.155	.005**							-.144	.028*
RepXIntReq					.117	.031*			.159	.081	.100	.293
RepXTrustReq					-.074	.324			-.017	.843	.067	.515
PresXIntReq							.114	.112	.040	.622	.004	.963
PresXTrustReq							-.102	.144	-.103	.188	-.083	.291
RepXPresXIntReq											.001	.996
RepXPresXTrustReq											.075	.398
Sig. F Change	N/A		.005** (from Main Eff)		.080 (from Main Eff)		.238 (from Main Eff)		.146 (from Main Eff)		.057 (from Model 4)	
R^2	.685		.707		.699		.693		.704		.724	
Adj. R^2	.669		.689		.678		.671		.677		.690	
Power	0.9		0.803		.359		.104		.240		.443	
*** p<0.001 **p<0.01 *p<0.05												

Table 30. Representation and Presentation: Moderating Effects on Relationship Requirements (without Trust Requirements)

	Main Eff		Model 1		Model 2		Model 3		Model 4		Model 5	
Predictors:	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**
IntReq	.171	.004**	.225	.000***	.168	.004**	.171	.004**	.168	.005**	.220	.000***
PhysReq	-.021	.701	-.030	.573	.010	.866	-.013	.811	.010	.867	-.003	.954
Rep	.268	.002**	.247	.004**	.333	.000***	.252	.005**	.333	.001***	.320	.001***
Pres	.280	.000***	.286	.000***	.247	.002**	.288	.000***	.247	.002**	.249	.002**
Elic	.301	.000***	.301	.000***	.254	.004**	.308	.000***	.255	.006**	.251	.005**
RepXPres			-.156	.004**							-.150	.006**
RepXIntReq					.111	.065			.110	.119	.108	.116
PresXIntReq							.053	.330	.001	.993	-.025	.693
RepXPresXIntReq											.040	.427
Sig. F Change	N/A		0.004**		.065		.330		.184		.018*	
R^2	.684		.706		.693		.686		.693		.714	
Adj. R^2	.670		.690		.677		.671		.674		.691	
Power	0.9		.804		.371		.083		.174		.632	
*** p<0.001 **p<0.01 *p<0.05												

Table 31. Representation and Presentation: Moderating Effects on Sensory Requirements

	Main Eff		Model 1		Model 2		Model 3		Model 4		Model 5	
Predictors:	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**
IntReq	.171	.004**	.225	.000***	.235	.000***	.194	.001***	.227	.001***	.242	.001***
PhysReq	-.021	.701	-.030	.573	-.037	.501	-.029	.590	-.035	.518	-.035	.517
Rep	.268	.002**	.247	.004**	.270	.002**	.231	.008**	.260	.005**	.259	.005**
Pres	.280	.000***	.286	.000***	.278	.000***	.290	.000***	.281	.000***	.281	.000***
Elic	.301	.000***	.301	.000***	.271	.001***	.319	.000***	.282	.002**	.282	.002**
RepXPres			-.156	.004**							-.113	.099
RepXPhysReq					.146	.010**			.114	.333	.087	.464
PresXPhysReq							.129	.015*	.035	.755	-.010	.930
RepXPresXPhysReq											-.023	.657
Sig. F Change	N/A		.004** (from Main Eff)		.010** (from Main Eff)		.015* (from Main Eff)		.033* (from Main Eff)		.227 (from Model 4)	
R^2	.684		.706		.702		.700		.702		.710	
Adj. R^2	.670		.690		.686		.684		.684		.687	
Power	0.9		.804		.707		.647		.535		.143	
*** p<0.001 **p<0.01 *p<0.05												

5.5.4. H4: Moderating Effect of Representation on the Relationship between Sensory Requirements and e-Consultation Diagnosticity

When testing the interaction effect between representation and physical contact requirements on e-consultation diagnosticity, we found this two-way relationship to be significant (γ=0.146, p=.010) in the absence of other moderating relationships (Table 31, Model 2). To interpret the significant interaction effect, we followed procedures suggested by Aiken and West (1991) to plot the interaction effect and conduct a t-test to determine whether the simple slope of e-consultation diagnosticity on physical contact requirements differs at high and low values of representation (shown in Figure 12). We followed similar procedures for interpreting the remaining significant interaction effects in our study.

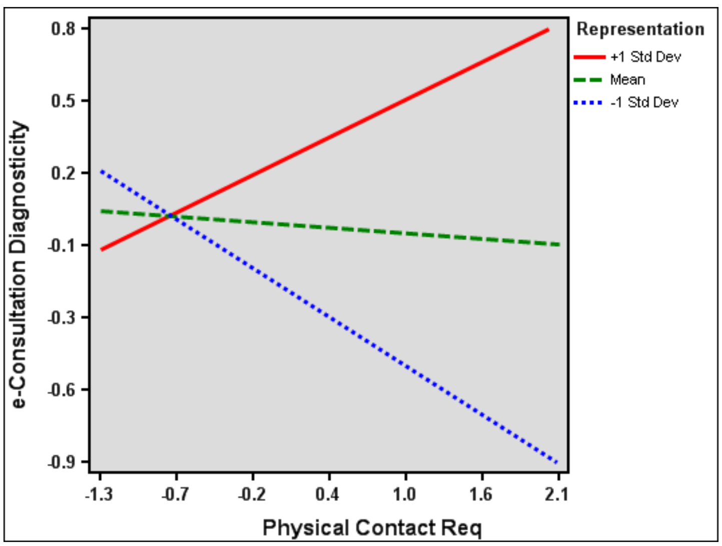


Figure 12. Moderating Effect of Representation on Sensory Requirements and e-Consultation Diagnosticity

According to the interaction plot, there is a negative relationship between sensory (i.e., physical contact) requirements and e-consultation diagnosticity when the representation capabilities of the technology are low (t=-3.242, p=0.002). In other words, higher sensory requirements make diagnosis through telemedicine more difficult. As hypothesized, this negative relationship is mitigated in the presence of high representation capabilities. In other words, sensory requirements of the medical consultation no longer negatively impact perceptions of e-consultation diagnosticity (t=2.44, p=0.016). High representation capability of the telemedicine technology fulfills the sensory requirements of the clinical evaluation process and positively impacts e-consultation diagnosticity. These findings are consistent with hypothesis 4. However, because this interaction effect was not significant in models 4 and 5 in Table 31, we cannot definitively conclude that this hypothesis is supported.

5.5.5. H5: Moderating Effect of Presentation on the Relationship between Relationship Requirements and e-Consultation Diagnosticity

Across all regression models, the interaction effect between presentation and relationship (i.e., interaction) requirements is non-significant. However, in regression model 3 in Table 34, the interaction effect between elicitation and relationship requirements is significant (γ=-0.146, p=.045). Hence, while we had not initially hypothesized this effect, it is possible that elicitation capabilities, rather than presentation capabilities, meet the needs for relationship requirements. In other words, if for example, interaction requirements are high then the consulting provider's elicitation capabilities become critical to e-consultation diagnosticity.

When evaluating the plot of elicitation capability as a moderator of relationship requirements and e-consultation diagnosticity, the results showed that high elicitation capability has no significant impact on the relationship between interaction requirements and e-consultation diagnosticity, whereas in the presence of low elicitation capability, there is an increasingly positive relationship between interaction requirements and e-consultation diagnosticity (t=2.461, p=0.015). In other words, when elicitation skills are poor, the more interaction and information exchange that is required during the clinical evaluation, the higher the perceptions of e-consultation diagnosticity. Intuitively, this interpretation is unexpected and does not make sense.

Thus, to explore the interaction effect relationship further, we plotted interaction requirements as a moderator of elicitation capability and e-consultation diagnosticity and show the results in Figure 13. The findings suggest that, in the presence of high interaction requirements during a medical consultation, higher levels of elicitation capability will positively influence perceptions of e-consultation diagnosticity (t=2.309, p=0.023) but when interaction requirements are low, elicitation capabilities do not matter (i.e., the simple slope test is non-significant) in influencing perceptions of e-consultation diagnosticity. Intuitively, this interpretation makes sense because a consultant's ability to elicit information during a clinical evaluation could positively impact perceptions of e-consultation diagnosticity and would likely be more important in predicting e-consultation diagnosticity when there is a greater need to interact and exchange information during the medical consultation.

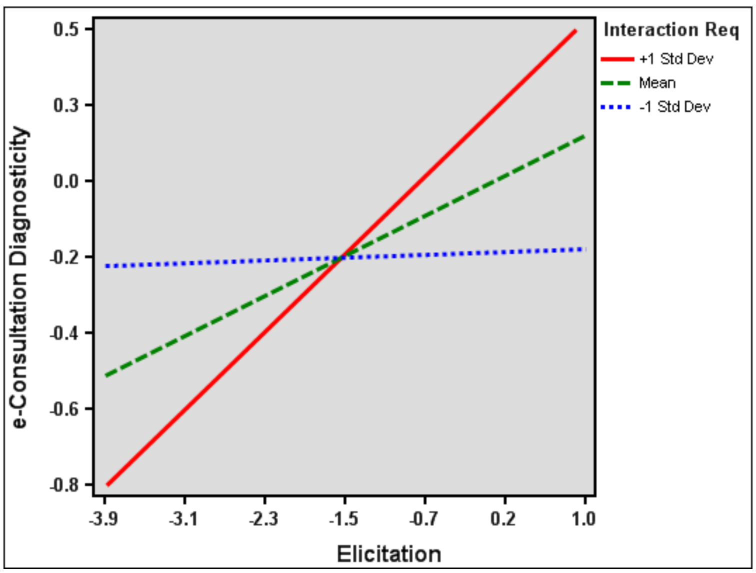


Figure 13. Moderating Effect of Relationship Requirements on Elicitation and e-Consultation Diagnosticity (Exploratory)

While we proposed presentation capabilities as a facilitator of interaction requirements, it seems that consulting providers may perceive that their own capabilities are most relevant.

5.5.6. H6: Moderating Effect of Presentation on the Relationship between Sensory Requirements and e-Consultation Diagnosticity

When investigating the interaction effect of presentation and sensory (i.e., physical contact) requirements, we found support for this moderating relationship. In the regression model that added this interaction effect to the main effects model, the results showed that the interaction effect was statistically significant (γ=0.129, p=.015), supporting H6 (see Table 31, Model 3 or Table 35, Model 2). However, when added to a regression model with the two-way interaction of representation and sensory requirements, the interaction effect of presentation and physical contact requirements was non-significant. The same was found when this interaction term was added to models with three-way interactions between representation, presentation and sensory requirements, and between elicitation, presentation, and sensory requirements. This is likely due to multicollinearity and power issues, discussed in more detail later in the chapter.

We plotted the significant interaction effect, displayed in Figure 14, to make better sense of this relationship. According to the interaction plot, sensory requirements has a negative impact on e-consultation diagnosticity when presentation capability is low (t=-3.578, p<0.001). This negative impact is mitigated when there is high presentation capability in that sensory requirements of the medical consultation longer have a negative influence on perceptions of e-consultation diagnosticity (t=2.949, p=0.004). Hence, as hypothesized, sensory requirements has a less negative effect on perceived e-consultation diagnosticity when presentation capabilities are high. These findings support hypothesis 6. However, because this interaction effect was not significant in models 4 and 5 in Table 31, we cannot affirm that this hypothesis is supported.

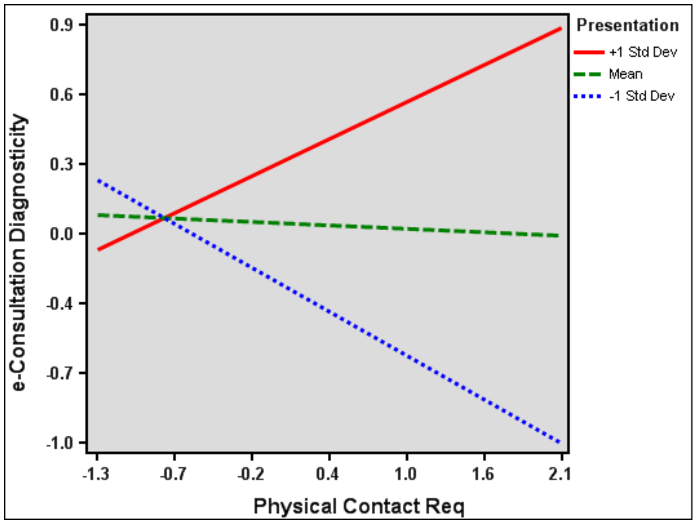


Figure 14. Moderating Effect of Presentation on Sensory Requirements and e-Consultation Diagnosticity

When assessing the moderating relationships of presentation and representation on the relationship between sensory requirements and e-consultation diagnosticity, we determined that multicollinearity could still be a concern, despite the improvements in the multicollinearity statistics that resulted from orthogonalizing the interaction terms. For example, regression models 4 and 5 in Table 31 yielded maximum VIF scores of 5.622 and 5.745 and maximum condition indices of 5.886 and 6.038, respectively, along with more than one variance proportion above 0.50 in a single dimension. Examining the collinearity statistics and correlation table, there was evidence of multicollinearity between the interaction terms RepXPhysReq and PresXPhysReq in both models. Thus, we combined representation and presentation into a single construct, referred to as Rep-Pres, and re-ran the regression analyses using this combined construct. Regression results are shown in Table 32 and suggest that the combined capabilities of representation and presentation do, in fact, moderate the relationship between sensory requirements and e-consultation diagnosticity (γ=0.144, p=.010). Hence, in addition to finding support that the separate capabilities of representation and presentation significantly impact the relationship between sensory requirements and e-consultation diagnosticity, we find that the combined capabilities of representation and presentation significantly moderate the relationship between sensory requirements and e-consultation diagnosticity.

Table 32. Combined Representation and Presentation: Moderating Effects on Sensory Requirements

	Main Eff		Model 1	
Predictors:	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**
IntReq	.170	.004**	.212	.000***
PhysReq	-.021	.707	-.024	.646
Rep-Pres	.503	.000***	.457	.000***
Elic	.300	.000***	.293	.000***
Rep-PresXPhysReq			.144	.010**
Sig. F Change	N/A		.010** (from Main Eff)	
R^2	.684		.701	
Adj. R^2	.673		.689	
Power	0.9		.711	
*** p<0.001 **p<0.01 *p<0.05				

Similar multicollinearity concerns were found for PresXPhysReq and ElicXPhysReq in regression model 3 in Table 35. For this model, the maximum VIF was 3.805 and the maximum condition index was 4.558, which was combined with two variance proportions exceeding 0.50. Thus, we combined the user capabilities of presentation and elicitation into a single construct, referred to as Pres-Elic, and assessed its interaction with physical contact requirements. The results of this analysis are displayed in Table 33. Regression findings reveal that the combined user capabilities of presentation and elicitation do, in fact, moderate the relationship between sensory requirements and e-consultation diagnosticity (γ=0.122, p=.031). Hence, while we find support that presentation capability significantly impacts the relationship between sensory requirements and e-consultation diagnosticity, we also find that the combined user capabilities of presentation and elicitation significantly moderate the relationship between sensory requirements and e-consultation diagnosticity.

Table 33. Combined Presentation and Elicitation: Moderating Effects on Sensory Requirements

Predictors:	Main Eff		Model 1	
	St. Beta	**Sig.**	**St. Beta**	**Sig.**
IntReq	.181	.002**	.219	.000***
PhysReq	-.023	.707	-.027	.621
Rep	.278	.001***	.229	.009**
Pres-Elic	.517	.000***	.525	.000***
Pres-ElicXPhysReq			.122	.031*
Sig. F Change	N/A		.031* (from Main Eff)	
R^2	.682		.695	
Adj. R^2	.672		.682	
Power	0.9		.503	
*** p<0.001 **p<0.01 *p<0.05				

5.5.7. H7-H10: Three-Way Interaction Effects

None of the hypothesized three-way interactions were found to be significant in the regression models. This may be due to a few different reasons. The first reason is that these relationships are, indeed, non-significant. However, it is also possible that these interactions were non-significant because of multicollinearity and power concerns, which are common causes of failure to detect significant interaction effects (Aiken and West 1991, Jaccard et al. 1990).

Recall that we discovered concerns of multicollinearity, particularly with the interaction effects, when initially running our regression analyses. In an attempt to alleviate these concerns, we orthogonalized all interaction terms using a partial Gram-Schmidt procedure (Burrill 1997). While this may have helped reduce the issues associated with multicollinearity in our data analysis to a large degree, this approach may not have eliminated the impact that multicollinearity could have on detecting significant interaction effects.

Because power may also be a reason for the non-significant interaction effects, we conducted a power analysis for the hierarchical regression models, and the results are displayed along with our results in Tables 29-35. According to Cohen (1988), a level of .80 or higher is a typical standard in achieving sufficient power to detect significant effects. However, the results of our power analysis reveal that we fall short of this level for all of the regression models that test our hypotheses. Hence, it may be that we did not have a sufficient sample size to detect significant effects for the two-way and three-way interactions.

Table 34. Presentation and Elicitation: Moderating Effects on Relationship Requirements

	Main Eff		Model 1		Model 2		Model 3	
	St. Beta	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**
IntReq	.171	.004**	.211	.001***	.171	.004**	.123	.001***
PhysReq	-.021	.701	-.035	.517	-.013	.811	-.045	.422
Rep	.268	.002**	.216	.014*	.252	.005**	.288	.004**
Pres	.280	.000***	302	.000***	.288	.000***	.344	.000***
Elic	.301	.000***	.310	.000***	.308	.000***	.226	.017*
PresXElic			-.129	.020*			-.117	.041*
PresXIntReq					.053	.330	.086	.175
ElicXIntReq							-.146	.045*
PresXElicXIntReq							.002	.967
Sig. F Change	N/A		.020* (from Main Eff)		.330 (from Main Eff)		.035* (from Model 2)	
R^2	.684		.698		.686		.710	
Adj. R^2	.670		.683		.671		.686	
Power	0.9		.613		.083		.498	
*** p<0.001 **p<0.01 *p<0.05								

Table 35. Presentation and Elicitation: Moderating Effects on Sensory Requirements

	Main Eff		Model 1		Model 2		Model 3	
	St. Beta	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**
IntReq	.171	.004**	.211	.001***	.194	.001***	.203	.002**
PhysReq	-.021	.701	-.035	.517	-.029	.590	-.033	.558
Rep	.268	.002**	.216	.014*	.231	.008**	.216	.024*
Pres	.280	.000***	302	.000***	.290	.000***	.302	.000***
Elic	.301	.000***	.310	.000***	.319	.000***	.318	.000***
PresXElic			-.129	.020*			-.079	.227
PresXPhysReq					.129	.015*	.109	.265
ElicXPhysReq							-.028	.783
PresXElicXPhysReq							-.051	.322
Sig. F Change	N/A		.020* (from Main Eff)		.015* (from Main Eff)		.465 (from Model 2)	
R^2	.684		.698		.700		.706	
Adj. R^2	.670		.683		.684		.683	
Power	0.9		.613		.647		..228	
*** p<0.001 **p<0.01 *p<0.05								

5.5.8. H11: Positive Relationship between e-Consultation Diagnosticity and TMC Use

When assessing e-consultation diagnosticity's impact on telemedicine use, we used two measures of use: a rich measure of use and a lean measure of use. Recall that rich measures of system usage take into account the nature of system use to accomplish relevant tasks, whereas lean measures typically capture the extent of system use without consideration of the tasks the system supports (Burton-Jones and Straub 2006). Furthermore, we incorporated perceived usefulness as a partial mediator between e-consultation diagnosticity and telemedicine use. Results of the PLS analysis (see Figure 15) show that e-consultation diagnosticity is a statistically significant predictor of both lean use (γ=0.32, t=2.371, p<.01) and rich use (γ=0.45, t=6.196, p<.01), as hypothesized. As expected, e-consultation diagnosticity (γ=0.59, t=6.331, p<.01) is also a significant predictor of perceived usefulness, explaining 34.6% of the variance of perceived usefulness. Furthermore, consistent with the technology acceptance literature, the findings reveal that perceived usefulness (γ=0.24, t=3.452, p<.01) and perceived ease of use (γ=0.20, t=2.392, p<.01) are significant predictors of rich use (but not of lean use). Altogether, perceived e-consultation diagnosticity, perceived usefulness, and perceived ease of use explain 7.5% of the variance in lean use and 61.6% of the variance in rich use. Given that perceived e-consultation diagnosticity is a significant predictor of both types of use, H11 is fully supported.

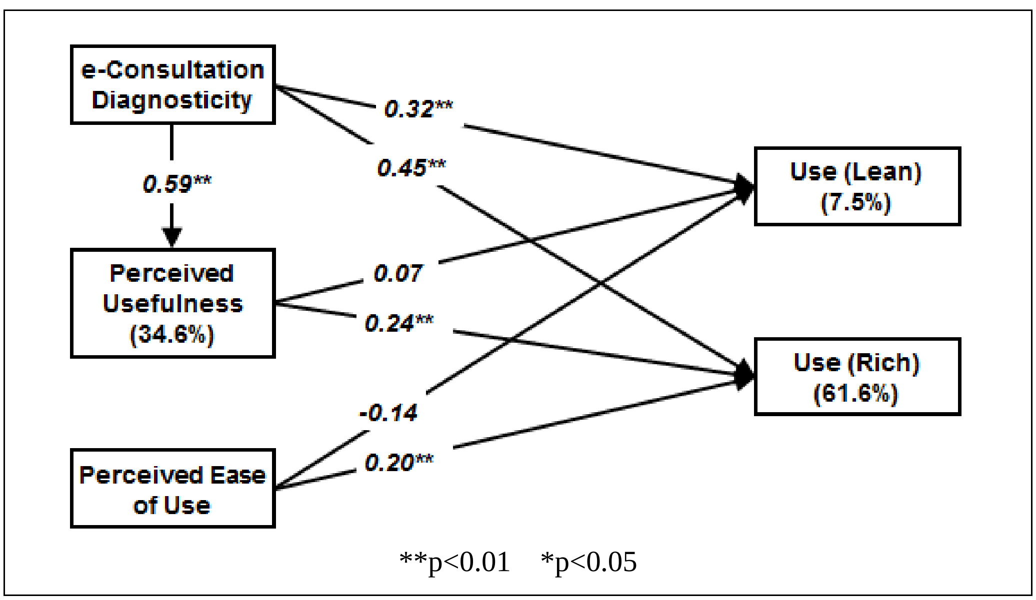


Figure 15. PLS Results for Testing Hypothesis 11

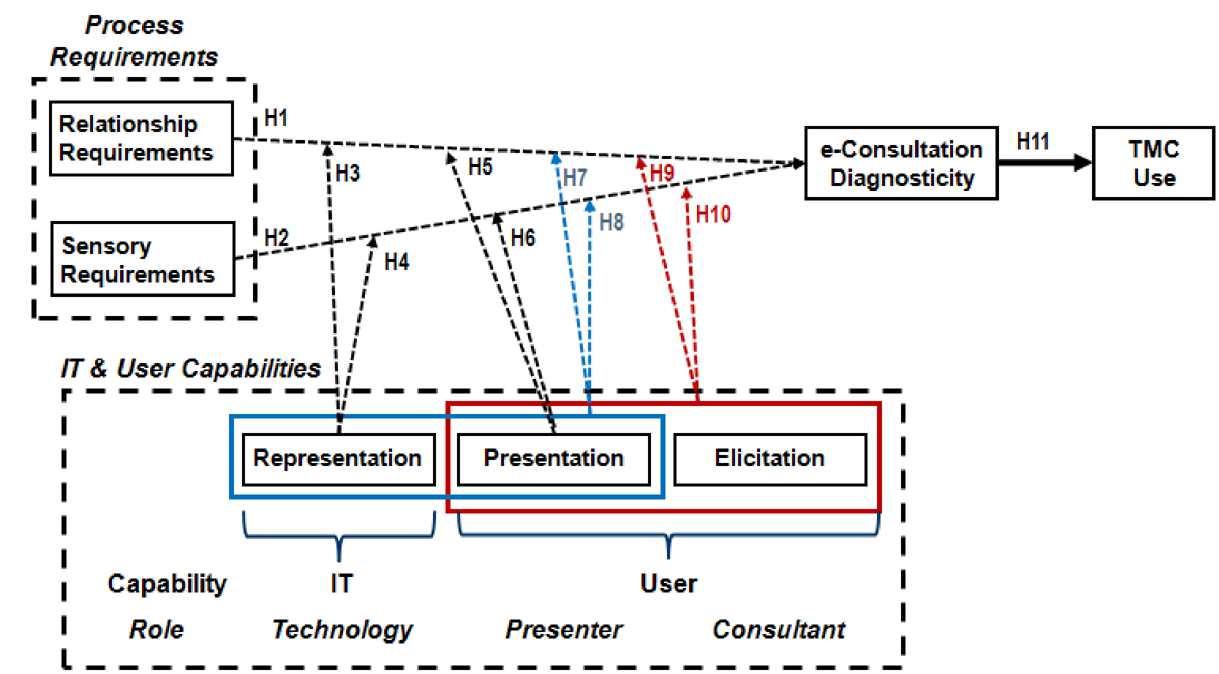
5.6. SUMMARY OF FINDINGS

A summary of the findings for the hypothesis testing is shown in Table 36 and Figure 16. We find that only H11 is supported and all other hypotheses are not supported. These results largely indicate that though the interaction effects between IT capabilities, user capabilities, and process requirements may not be significant, the strong main effects of representation, presentation, and elicitation (stronger than the process effects) imply that user capabilities as well as system capabilities have strong additive effects on e-consultation diagnosticity. To examine the effects of system and user capabilities further, we conducted post-hoc exploratory analysis to delve deeper into understanding the impacts of representation, presentation, and elicitation on perceived e-consultation diagnosticity. These analyses are presented in Appendix K.

Table 36. Hypothesis Testing Results

Hypotheses		**Support**
H1.	Relationship Requirements → e-Consultation Diagnosticity	No
H2.	Sensory Requirements → e-Consultation Diagnosticity	No
H3.	Representation X Relationship Requirements → e-Consultation Diagnosticity	No
H4.	Representation X Sensory Requirements → e-Consultation Diagnosticity	No
H5.	Presentation X Relationship Requirements → e-Consultation Diagnosticity	No
H6.	Presentation X Sensory Requirements → e-Consultation Diagnosticity	No
H7.	Representation X Presentation X Relationship Requirements → e-Consultation Diagnosticity	No
H8.	Representation X Presentation X Sensory Requirements → e-Consultation Diagnosticity	No
H9.	Presentation X Elicitation X Relationship Requirements → e-Consultation Diagnosticity	No
H10.	Presentation X Elicitation X Sensory Requirements → e-Consultation Diagnosticity	No
H11.	e-Consultation Diagnosticity → Use	**Yes**

According to process virtualization theory (Overby 2008), process requirements and technology capabilities enable the virtualization of processes. One of our main propositions is that user capabilities also matter in determining e-consultation diagnosticity (i.e., virtualization of the medical consultation process). Given the mixed support for the moderating effects of user capabilities, we examined their main effects on e-consultation diagnosticity. Results of a stepwise regression analysis indicate that, indeed, user capabilities matter (see Table 37).



*Solid lines indicate significant effects. Dotted lines indicate non-significant effects.

Figure 16. Graphical Representation of Hypothesis Testing Results

Table 37. Change in Explained Variance with Addition of User Capabilities

	Main Eff		**Model 1**		**Model 2**	
	St. Beta	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**
IntReq	.429	.000***	.199	.003**	.171	.004**
PhysReq	-.204	.016*	-.025	.692	-.021	.701
Rep			.671	.000***	.268	.002**
Pres					.280	.000***
Elic					.301	.000***
Sig. F Change	N/A		.000*** (from Main Eff)		.000*** (from Model 1)	
R^2	.196		.574		.684	
Adj. R^2	.182		.564		.670	
*** p<0.001 **p<0.01 *p<0.05						

When running the regression analysis using the process requirements as the main effects, the explained variance in e-consultation diagnosticity is 18.2%. The addition of technology capabilities (i.e., representation) significantly increases the explained variance in e-consultation diagnosticity to 56.4% (sig. F change<.001). This supports the traditional technology-centric conceptualization of technology's impact on task outcomes. When user capabilities are also added to the regression model, the explained variance increases by 10.6%, a statistically significant change (sig. F change<.001). Hence, this finding supports our view that user capabilities, in addition to technology capabilities and task requirements, are in fact significant predictors of e-consultation diagnosticity.

To explore the impact that user capabilities add to the main effects model (in the absence of technology capabilities), we re-ran the stepwise regression analysis first incorporating both user capabilities of presentation and elicitation to the main effects model (one that already contained process capabilities) (see Table 38). The results show that the addition of these predictors to the main effects model increases the explained variance in e-consultation diagnosticity by 46.3% (sig F. change<.001). Thus, even in the absence of technology considerations, user capabilities are significant predictors of e-consultation diagnosticity. When we added technology capabilities (i.e., representation) to the model with process requirements and user capabilities, the explained variance increased by 2.5%, which represents a significant change in explained variance (sig. F change=.002). Thus, both user capabilities and technology capabilities add a significant amount of explained variance to the main effects model, either when added by itself or together to the model.

Finally, we performed a stepwise regression analysis incorporating user and technology capabilities in the main effects model and then adding the process requirements to assess the significance in the change in explained variance. When added as main effects, the user and technology capabilities are statistically significant predictors of e-consultation diagnosticity at a significance level of .01 or higher (see Table 39), explaining 65.1% of the variance in e-consultation diagnosticity. The addition of process requirements to the regression model results in an increase in explained variance of 1.9 percent, which represents a significant change in explained variance (sig. F change=0.015).

Table 38. Change in Explained Variance with Addition of Technology Capabilities

	Main Eff		Model 1		Model 2	
	St. Beta	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**
IntReq	.429	.000***	.199	.001***	.171	.004**
PhysReq	-.204	.016*	-.051	.368	-.021	.701
Pres			.372	.000***	.280	.000***
Elic			.425	.000***	.301	.000***
Rep					.268	.002**
Sig. F Change	N/A		.000*** (from Main Eff)		.002** (from Model 1)	
R^2	.196		.657		.684	
Adj. R^2	.182		.645		.670	
*** p<0.001 **p<0.01 *p<0.05						

Table 39. Change in Explained Variance with Addition of Process Requirements

	Main Eff		Model 1	
	St. Beta	**Sig.**	**St. Beta**	**Sig.**
Rep	.302	.001***	.268	.002**
Pres	.247	.002**	.280	.000***
Elic	.361	.000***	.301	.000***
IntReq			.171	.004**
PhysReq			-.021	.701
Sig. F Change	N/A		.015* (from Main Eff)	
R^2	.660		.684	
Adj. R^2	.651		.670	
*** p<0.001 **p<0.01 *p<0.05				

Figure 17 shows a revised conceptual model that has emerged from our results. We believe that it may be more insightful from an information systems theoretical development standpoint to examine the effects of technology and user capabilities on e-consultation diagnosticity as moderated by process requirements, rather than the other way around.

Irrespective of which is the independent variable and which is the moderator, our findings suggest that a holistic investigation of the user capabilities, technology capabilities, and task requirements of the medical consultation process is an apt conceptualization of e-consultation diagnosticity antecedents. Future research should explore the nature of the relationships between these predictors and e-consultation diagnosticity in greater depth to better understand how they shape perceptions of e-consultation diagnosticity.

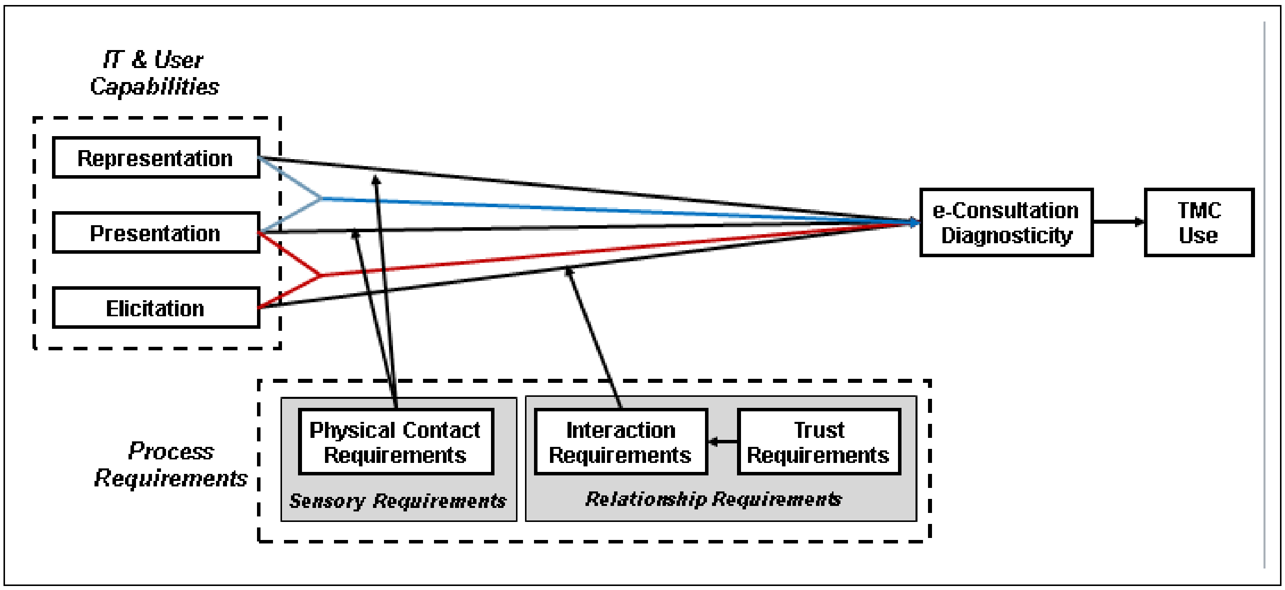


Figure 17. Emergent Conceptual Model

CHAPTER 6: CONCLUSIONS AND FUTURE RESEARCH

6.1. DISCUSSION

The U.S. healthcare system is wrought with challenges in addressing the triple aims of healthcare: reducing costs, increasing access to health services, and improving health quality and outcomes. In light of these challenges, various health information technology applications have been identified as promising solutions to meet these aims (Chaudhry et al. 2006). Telemedicine applications, in particular, have the potential to mitigate all three major challenges currently pervading the healthcare system. However, telemedicine acceptance and use remain low among healthcare providers.

A meta review of provider acceptance of telemedicine revealed that a major concern of healthcare providers is whether telemedicine applications will enable them to sufficiently evaluate patients' health conditions at a distance, a concept we term *perceived e-consultation diagnosticity* (Serrano and Karahanna 2011). This concept is aptly captured in a quote by a consulting provider: "I question…how accurately I can assess someone's mental status through a camera lens" (Peddle 2007, p. 611). The goal of this dissertation study was to theoretically develop this concept and its key antecedents and determine its impact on telemedicine use. Because consulting providers are the main decision-makers when choosing to use telemedicine for clinical evaluations, we focused on consulting providers' perceptions in the current study.

To develop the construct of *perceived e-consultation diagnosticity,* we adapt conceptualizations of perceived diagnosticity from the marketing and e-commerce literatures, and to build the nomological network leading to telemedicine use in which we embed e-consultation diagnosticity, we primarily draw on process virtualization theory (Overby 2008), Burton-Jones and Straub's (2006) conceptualization of information system usage, and insights gained from our qualitative data analysis. Our research makes several contributions to both theory and practice.

6.2. CONTRIBUTIONS TO THEORY

The essential conceptualization underlying the research model in this study is that both technology and user capabilities are essential in meeting the requirements of the medical consultation process and are thus key antecedents to perceptions of e-consultation diagnosticity. This conceptualization fills an important gap in process virtualization theory (Overby 2008) and task-technology fit theory (Goodhue and Thompson 1995) by theorizing not only about the technology's role in virtualizing processes but also specifically theorizing about the user's role in enabling virtual processes. We focus on telemedicine consultations, which are virtual expert consultations, in developing the two user capabilities of *presentation* and *elicitation.* In every virtual expert consultation, there will be an advice seeker who possesses presentation capabilities to effectively describe the problem or symptoms of the problem and an expert consultant who possesses elicitation capabilities to help elicit information relevant to diagnosing the nature of the problem. Both capabilities are important in determining perceptions of e-consultation diagnosticity, as is the *representation* capability of the technology.

Our findings strongly support the conclusion that, not only are technology capabilities important, but user capabilities indeed matter in successfully virtualizing processes as well. Although all of our hypotheses related to the moderating effects of technology and user capabilities were not supported, we found consistent, positive direct effects of technology and user capabilities on e-consultation diagnosticity across all of our regression models. This finding points to an important contribution to theorizing determinants of system success (DeLone and McLean 1992). Extant research in information systems often emphasizes the role of the technological artifact in contributing to successful performance outcomes. Our study reveals that the roles of the users need to be considered in tandem with the role of the technology and incorporated in theorizing about system success, especially when the systems being studied support technology-mediated consultations between users.

Outside of the information systems domain, our research may have important implications in informing theory in the communications domain. When considering any task in which there is an advice giver and an advice seeker, regardless of the communication medium that is in place, the capabilities of presentation and elicitation will be important in facilitating successful communication between the two parties. Thus, even in a face-to-face context, the advice seekers' ability to present their problem effectively to the advice giver will be key, as will be the advice givers' ability to elicit the relevant information from the advice giver in order to help resolve their problem.

6.3. CONTRIBUTIONS TO PRACTICE

Our study contributes to current practices in telemedicine implementations, as well as other system implementations that involve technology-mediated communication (e.g., help desks). While many system implementations involve user training, oftentimes, a focus of the training is to teach users how to use the technology. From our field observations of telemedicine training sessions, this was also the case—users were primarily trained to use specific features of the technology. While this aspect of user training is essential to successful system implementations, it is just as important to train users on technology-mediated communication strategies and best practices because these skills will facilitate performance outcomes as well.

Within the context of telemedicine, consulting providers are typically well trained on how to conduct a medical interview; however, they may find that doing so over telemedicine requires a refinement of their interviewing strategies as well as learning how to provide instruction to presenters at the remote site. Likewise, presenters can receive training on how to give a proper presentation of the patients' medical conditions and complaints; for example, the National School of Applied Telehealth plans to offer a certified telemedicine clinical presenter course. Our study points to particular skills and knowledge that should be conveyed when training presenters and consultants to use telemedicine systems. Thus, results of our study suggest that telemedicine implementations should focus on a system-centric view of training (technology plus users) rather than solely a technology-centric view of training.

6.4. LIMITATIONS

This study is not without limitations. For the qualitative methods, sampling was primarily limited to telemedicine providers within a single telemedicine network in the state of Georgia. Thus, perceptions reflected by respondents may not be representative of consulting providers in other telemedicine networks. For example, in the state of Georgia, telemedicine consultations are reimbursed at the same rate as face-to-face consultations; thus, reimbursement issues were rarely cited as challenges to telemedicine implementations within our interview sample but may have been had we interviewed respondents in states without this type of supporting legislation.

In terms of the field survey, we employed purposive sampling techniques, so the sampling was non-random. Additionally, because we operationalized many of our constructs at the encounter-level, we required a sample of respondents who were currently using, or formally used, telemedicine so that they could report on a specific telemedicine consultation experience. Thus, there may be bias in our sample in that consulting providers who responded to the survey may be more pre-disposed to using telemedicine and more likely to view telemedicine favorably. Likewise, respondents were not prompted to think of a positive or negative telemedicine experience so as not to bias their responses one way or another, but qualitative feedback provided on the surveys reveals that the majority of respondents reported perceptions based on a positive telemedicine consultation experience. Thus, most respondents recorded perceptions of their specific experience based on telemedicine consultations they perceived to represent high levels of e-consultation diagnosticity. Very few respondents recalled an experience in which they perceived low e-consultation diagnosticity. Based on the low mean score for the construct of sensory (i.e., physical contact) requirements, it appears that most respondents recalled a telemedicine experience that was (or have telemedicine experiences in general that are) amenable to a telemedicine consultation, as represented by the following survey quote: *"Keep in mind that I am a psychiatrist who works in outpatient clinic, and I do not need to do physical exams."*

Furthermore, though respondents to the survey represent 27 different states in the U.S., approximately 28 percent of the respondents reside in Georgia and over 20 percent reside in Missouri. This uneven distribution is due to our being able to obtain complete lists of email addresses for consulting providers in telemedicine networks in these two states; thus, we were able to contact and follow up with these providers directly to invite them to participate in our study. For the majority of other states, we had to rely on intermediaries to invite providers to participate in our study, resulting in the lower response rates from these states. Thus, responses from our survey may not generalize to a national sample.

6.5. DIRECTIONS FOR FUTURE RESEARCH

While this study represents an important first step in identifying two important user capabilities, presentation and elicitation, in technology-mediated consultations, future research should explore in more detail the specific dimensions of user capabilities. We identified dimensions of articulation and execution for presentation capabilities and dimensions of interviewing and instruction for elicitation capabilities. It may be that effects of presentation and elicitation vary across these dimensions with some dimensions having moderating and others having direct effects on e-consultation diagnosticity. Furthermore, the relevance of these user dimensions may vary. Future research should explore the effects of both presentation and elicitation in terms of their dimensions to gain more granular insights into the effects of presentation and elicitation on e-consultation diagnosticity.

Furthermore, exploratory emergent concepts in our study point to the importance of shared understanding and trusting relationships between presenters and consultants in virtual expert consultations. These concepts likely determine user capabilities in technology-mediated communications and should be investigated more fully in future studies.

Given the significant direct effects of user and technology capabilities on e-consultation diagnosticity and the unexpected interpretations of some of the interaction effects involving these capabilities, future research should consider the manner in which process requirements may moderate the relationships of user and technology capabilities and process virtualization. This could lead to potentially insightful new contributions to process virtualization theory.

Future studies should also incorporate perspectives that are representative of multiple geographic locations and medical specialties and that span positive and negative perceptions of telemedicine consultations. In particular, exploring perceptions of potential adopters could shed light on additional factors that are relevant to determining perceptions of e-consultation diagnosticity and telemedicine acceptance in the absence of hands-on experiences.

Though our research model was conceptualized within the context of telemedicine consultations, we believe the constructs and hypothesized relationships are relevant to other virtual expert consultation domains. Future studies should investigate the generalizability of the research model in other expert consultation domains to inform the theorizing of the technology and user capabilities that shape e-consultation diagnosticity.

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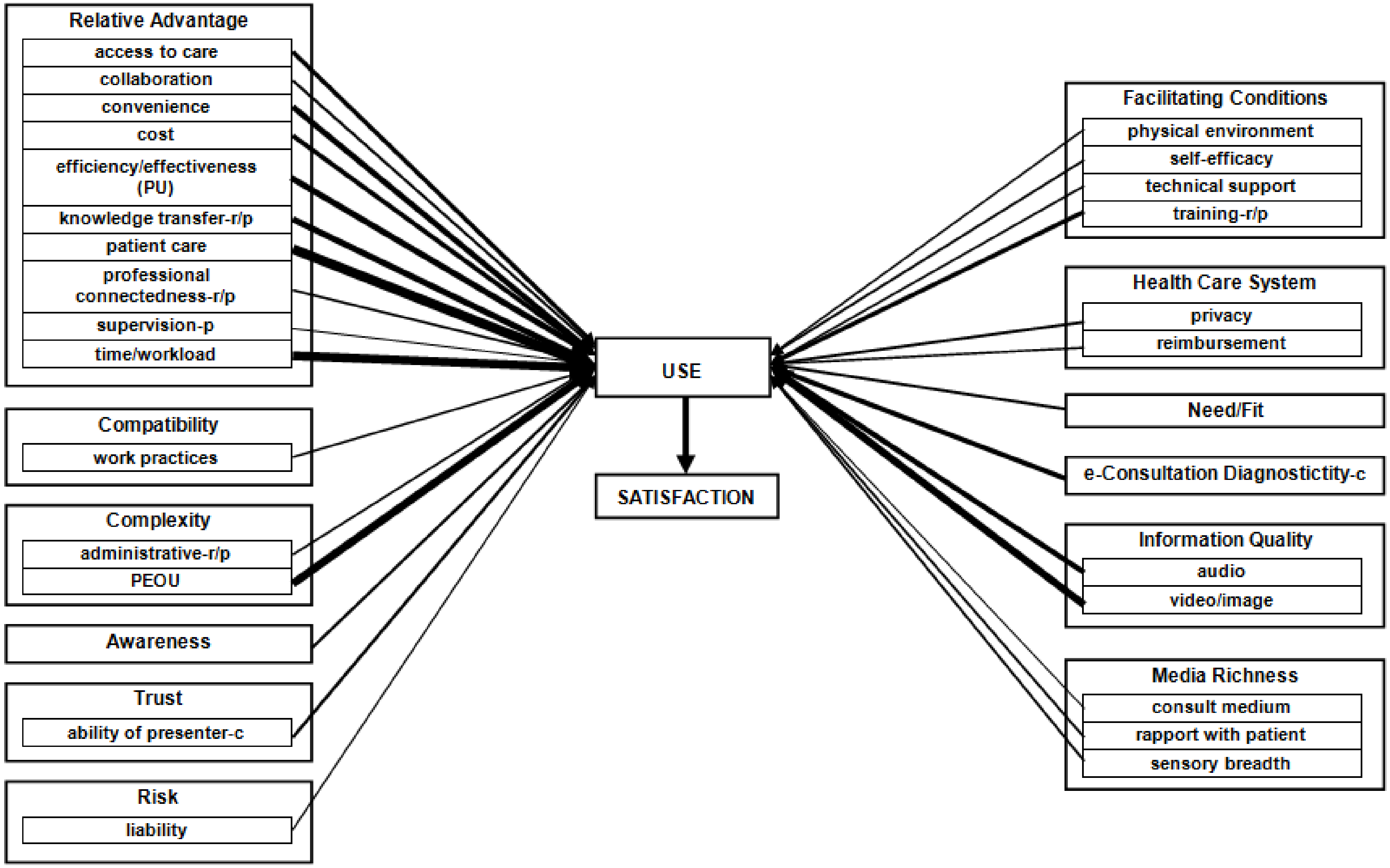
APPENDICES

Appendix A. Conceptual Model of Provider Acceptance of Telemedicine



Appendix B. Interview Informational Letter

Date:
Dear:

I am a graduate PhD student under the direction of Dr. Elena Karahanna. I invite you to participate in a research study entitled "Provider Perceptions of Telemedicine Consultation Services," which is being conducted by Ms. Christina Serrano (MIS Department, the University of Georgia, 706-542-4464) and Dr. Elena Karahanna (MIS Department, the University of Georgia, 706-542-3902). The purpose of this study is to understand how healthcare providers and patients view telemedicine consultation services and, if they use them, how they use them. There are no right or wrong answers. What is important are your perceptions of telemedicine consultation services.

Your voluntary participation will involve participating in an audio-recorded interview that should last approximately 30-45 minutes. Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled.

There are no known risks or discomforts associated with this research. Your participation in this study will be **confidential**. The only people who will know that you are a respondent are members of the research team. No individually identifying information about you or provided by you during this research will be shared with others, except if required by law. The results of the research may be published, but your name/identity will not be used unless you specifically allow us to do so. You can ask to have information related to you returned to you, removed from the research records, or destroyed.

If you grant permission for your interview to be audio-recorded, the audio files of the interviews will be transcribed by a member of the research team, kept by the co-investigator, and only used as part of this research. The audio file will be destroyed upon completion of this research. You can review the audio file as well as the transcription of the interview if you so wish.

For your participation, you will receive a descriptive summary of the results by formally requesting this information from the researchers. If you have any questions about this research project, please feel free to contact Ms. Christina Serrano at cserrano@uga.edu (706-542-4464) Dr. Elena Karahanna at ekarah@terry.uga.edu (706-542-3902). Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 612 Boyd GSRC, Athens, Georgia 30602-7411; telephone (706) 542-3199; email address irb@uga.edu.

Thank you for your consideration. Please keep this letter for your records.

Sincerely,
Christina Serrano

Appendix C. Interview Protocol for Consulting Providers

The main purpose of this interview is to learn about your perspective and experiences with the implementation and use of telemedicine to provide health care services. The following questions are the types of questions that will be asked during the interview.

Make sure respondent has read and understands the informed consent letter.
Request permission to audio-record the interview.

- How are you involved in the Telehealth program? What is your role?
- Why did you decide to adopt telemedicine in the first place? Are you still using it? (If you have discontinued use, why?)
- How many times have you participated in telemedicine consultations in the past? How many times did you refer a patient to a telemedicine consultation? What specialties? Why?
- How do you use (or plan to use) telemedicine in your organization? Why did you decide to use telemedicine in this way?
- What are specific features of the telemedicine system that you use? What do you use these features to accomplish? (Live video consultations, store and forward, etc.)
- What are specific features of the telemedicine system that you do not use? Why do you not use these features?
- What do you see as the major issues from your perspective? Other providers' perspective? Patients' perspective?
- How do you perceive the role of the presenter who is with the patient in the exam room? What skills does this person need to help carry out a successful telemedicine consultation?
- What types of skills do you need during a medical consultation? How do these differ for a telemedicine consultation?
- What are the advantages and disadvantages of telemedicine consultations? Please share any examples or stories you may have.
- What would encourage more use of telemedicine? What would discourage use?
- Under what circumstances would you recommend telemedicine to other providers who have not adopted telemedicine?
- Under what circumstances would you recommend telemedicine services to patients?
- How do your patients view such services? What has been their reaction?
- How can telemedicine ***technology*** be improved to meet the needs of providers and patients?
- How can the telemedicine ***consultation process*** be improved to meet the needs of providers and patients?
- What would be the ideal telemedicine system?
- Please share any other comments or stories regarding the way telemedicine consultations influenced, or will influence, efficiency and effectiveness in your organization.
- Please share any other comments or stories regarding the way telemedicine consultations influenced, or will influence, changes in patient health outcomes.

Appendix D. Exploratory Constructs and Items

Information Completeness	
INFO_ COM1	The telemedicine technology transmitted all of the relevant information I needed for the clinical evaluation.
INFO_ COM2	The telemedicine technology transmitted complete information about the patient's health condition.
INFO_ COM3	The telemedicine technology transmitted a complete picture of the patient's health condition.
Information Accuracy	
INFO_ ACC1	The telemedicine technology transmitted sounds that were very clear.
INFO_ ACC2	The telemedicine technology transmitted video images that gave me an accurate picture of the patient's condition.
Personal Focus	
PER_ FOC1	The telemedicine technology allowed me to observe the patient's emotions.
PER_ FOC2	The telemedicine technology enabled me to personally focus on the patient.
PER_ FOC3	The telemedicine technology allowed me to evaluate the patient's emotional states.
Sensory Cues	
SEN_ CUE1	The telemedicine technology enabled me to visually observe the patient.
SEN_ CUE2	The telemedicine technology allowed me to see everything that I needed to see for the clinical evaluation.
SEN_ CUE3	The telemedicine technology enabled me to hear everything that I needed to hear for the clinical evaluation.
SEN_ CUE4	The telemedicine technology allowed me to hear sounds related to the patient's condition.
System Quality	
SYS_ QL1	The telemedicine technology had technical problems with the network connection.
SYS_ Q2	The telemedicine technology failed due to technical problems with the telemedicine equipment or software.
SYS_ QL3	The telemedicine technology functioned with no delays in the video and audio feed.
Articulation Capability	
ART_ CAP1	The presenter was able to effectively articulate the information I needed to know.
ART_ CAP2	The presenter was able to effectively characterize the patient's chief complaint.
ART_ CAP3	The presenter was able to disregard irrelevant information and communicate to me only what was important.

ART_ CAP4	The presenter was able to articulate the patient's symptoms and concerns to me.
Execution Capability	
EXE_ CAP1	The presenter was able to execute hands-on tasks in order to give me the clinical information I needed.
EXE_ CAP2	The presenter was able to fully conduct the physical tasks associated with the clinical evaluation.
EXE_ CAP3	The presenter was able to effectively use the telemedicine equipment, to include the software and peripherals (i.e., video cameras and scopes), if these were needed.
EXE_ CAP4	The presenter was able to perform the necessary steps to provide the relevant clinical information to me.
Interviewing Capability	
INTER VIEW1	I was able to effectively ask questions to elicit important information about the patient's condition.
INTER VIEW2	I was able to ask questions that were clearly understood by the patient and/or presenting provider.
INTER VIEW3	I was able to conduct an effective interview of the patient's condition.
INTER VIEW4	I was able to encourage the patient and/or presenting provider to discuss the patient's concerns and condition with me.
Instruction Capability	
INSTR UCT1	I was able to clearly specify what the patient and/or presenting provider was/were supposed to do during the clinical evaluation.
INSTR UCT2	I was able to provide clear instructions to the patient and/or presenting provider on observing any patient conditions that needed to be communicated to me
INSTR UCT3	I was able to effectively guide the patient and/or presenting provider through the steps necessary to communicate pertinent clinical information to me.
Presenter Understanding	
UND1	The presenter had full knowledge of the nature of the patient's chief complaints.
UND2	The presenter had a solid understanding of the patient's medical history.
UND3	The presenter fully comprehended the characteristics of the patient's condition.
Shared Understanding	
SHA_ UND1	The presenter had a good sense of the tasks that I needed him/her to complete without my having to provide any instruction.
SHA_ UND2	The presenter understood the questions I asked without my having to provide any explanations.
SHA_ UND3	The presenter understood what needed to be communicated to me during the clinical evaluation without my having to ask.

Appendix E. Candidate Scale Items for Encounter-Level Constructs Included in Research Model

Construct	Item Number	Generic Item Wording	Source	Item Rating	Item Sort	Pre-Test	EFA	CFA-PLS	CFA-SEM
Trust Require-ments	TRU_REQ1	It is necessary that the patient believes he/she can have confidence in my abilities.	New	X	X	X	X	X	X
	TRU_REQ2	It is necessary that the patient feels that he/she can trust me.	New	X	X	X	X	X	X
	TRU_REQ3	It is necessary that there is a trusting relationship with the patient.	New	X	X	X	X	X	DEL[2]
	TRU_REQ4	It is necessary that the patient believes I am acting in his/her best interest.	New	X	X	X	X	X	X
	TRU_REQ5	It is important that the patient feels that he/she can depend on me.	New	X	DEL[3]				
Sensory Require-ments**	SEN_REQ1	It is necessary that I physically observe the patient during the clinical evaluation.	Over. (08)	X	X	X	X	X	X
	SEN_REQ2	It is necessary that I physically examine the patient during the clinical evaluation.	Over. (08)		NEW	X	X	X	X
	SEN_REQ3	It is necessary that I physically evaluate the patient during the clinical evaluation.	Over. (08)	X	DEL[1]				
	SEN_REQ4*	It is necessary that I see/hear/touch the patient during the clinical evaluation.	Over. (08)	X	DEL[3]				
Touching Require-ments***	TOU_REQ1	It is necessary that I employ the sense of touch during the clinical evaluation.	New	X	X	X	X	X	X
	TOU_REQ2	It is necessary that I obtain tactile feedback concerning the patient's condition during the clinical evaluation.	New	X	X	X	X	X	X
	TOU_REQ3	It is necessary that I employ palpation and percussion techniques during the clinical evaluation.	New	X	X	X	X	X	X
	TOU_REQ4	It is necessary that I touch the patient during the clinical evaluation.	New	X	X	X	X	X	X
	TOU_REQ5	It is necessary that I palpate and percuss certain parts of the patient.	New	X	DEL[3]				
Hearing Require-ments***	HEAR_REQ1	It is necessary that I use auscultation techniques to evaluate patient organ systems during the clinical evaluation.	New	X	X	X	X	X	X
	HEAR_REQ2	It is necessary that I listen to the patient (or patient representative) speak during the clinical evaluation.	New	X	X	X	DEL[5]		
	HEAR_REQ3	It is necessary that I hear the patient's heart, lung, and gastrointestinal sounds during the clinical evaluation.	New	X	X	X	X	X	X
	HEAR_REQ 4	It is necessary that I hear the patient during the clinical evaluation.	New	X	X	DEL[3]			

Appendix E (cont.). Candidate Scale Items for Encounter-Level Constructs Included in Research Model

Construct	Item Number	Generic Item Wording	Source	Item Rating	Item Sort	Pre-Test	EFA	CFA-PLS	CFA-SEM
Seeing Require-ments	SEE_REQ1	It is necessary that I visually observe how the patient behaves during the clinical evaluation.	New	X	X	X	X	X	X
	SEE_REQ2	It is necessary that I visually observe the patient's reactions during the clinical evaluation.	New	X	X	X	X	X	X
	SEE_REQ3	It is necessary that I visually inspect certain parts of the patient's body during the clinical evaluation.	New	X	X	X	DEL[5]		
	SEE_REQ4	It is necessary that I see the patient during the clinical evaluation.	New	X	X	DEL[3]			

1. Dropped due to poor item sorting results.
2. Dropped due to poor CFA results.
3. Dropped for brevity or unnecessary redundancy.
4. Dropped due to poor item rating results.
5. Dropped due to poor EFA results.

* Item SEN_REQ4 was not included on the survey as worded; instead, it was divided into three separate items to capture the separate dimensions of seeing, hearing, and touching requirements. For brevity, two of these items were excluded from the final version of the survey.

** Through the measurement validation process, it was determined that the construct of sensory requirements was best captured as two distinct constructs: physical contact requirements and seeing requirements. More explanation is provided in the Measurement Validation section in Chapter 5.

*** Items TOU_REQ1-TOU_REQ4 were combined with HEAR_REQ1 and HEAR_REQ3 to represent a new construct, Physical Contact Requirements. More explanation is provided in the Measurement Validation section in Chapter 5.

Appendix F. Item Rating Results for Constructs

ENCOUNTER-LEVEL CONSTRUCTS			
Construct	**Item**	**Mean Score**	**Comments**
e-Consultation Diagnosticity	DIAG1	2.75	The use of "telemedicine encounter" gives me a little pause in these because it's a little confusing if you mean the telemedicine aspect or just the encounter in general. In other words, is this supposed to conjure up, 'the encounter I happened to have over telemedicine allowed me to...' or, 'even though the encounter in question was on telemedicine I was able to...' While subtle, I think those are two slightly different mindsets when answering. The instructions might need to be clear if they're supposed to be considering it just as any normal medical encounter or thinking about the telemedicine aspects in general. – Judge A "Carefully" has a broad meaning and may mean different things to different people. – Judge B
	DIAG2	2.75	Compared with item number 5, I believe they both say pretty much the same thing, but I like the wording of item 2 better. – Judge B Help in judgment is different from facilitating understanding right? It may have weights on decision making than on diagnosticity… - Judge D
	DIAG3	3.0	
	DIAG4	3.0	I really like this item as it is fairly all-encompassing. – Judge B
	DIAG5	2.75	
	DIAG6	3.0	Good item because it taps at the observation aspect and not just whether one can evaluate. – Judge B
	DIAG7*	2.25	This is more like a 2.5, but I flinch a little at the verb 'understand', because understanding would need to be the culmination of a lot of factors, including medical knowledge, etc. – Judge A This item, along with item #8 ask about the evaluation of the patient's complaint/concerns. Is there a difference between evaluating what the patient is complaining about and what the overall health condition of the patient is? The patient could be complaining about one thing, but the overall evaluation, if thorough, could reveal other health problems worth investigating. – Judge B I wonder if this depends on the patient's intelligence, regardless of encounter medium? – Judge C
	DIAG8*	2.67	Just a comment -- this item seems to get at the telemed encounter facilitating something above and beyond the normal encounter. To me, in this context, "enable" implies something greater than "allow" or "permit." Which of course may be your goal! – Judge C
	DIAG9*	2.25	Ditto comment as above. Same reaction to comprehend as understand. – Judge A Not a big fan of the word "comprehend" in this item. – Judge B Does this depend on the skill of the doctor? I like #2 better. – Judge C

Representation Capability	REP1	2.75	I wonder if realistic is the best word…and if it's as important as useful. – Judge A OVERALL COMMENTS FOR SENSORY REQUIREMENTS - I can see the potential pitfalls of the use of a formative construct here, but I feel like the reflective items are a bit too broad and don't really capture the true meaning of the construct. The caution is whether or not these formative items fully capture the full extent of the construct. In my outsider (and rather ignorant) opinion for this particular construct, they do a good job capturing the full range of meaning. – Judge B Respondents may have a difficult time discerning between this item and those items for e-consultation diagnosticity. I believe the difference between the two is process vs. technology, but it may be difficult for others to make this distinction. Also, this item may simply load directly on the information completeness dimension listed below. – Judge B
	REP4	3.0	Similar to #6 (below), the technology providing the information instead of it being a conduit seems a bit odd. – Judge A
	REP5	3.0	
	REP6	2.75	The idea of the technology providing complete info seems odd. Again, I don't know if there's a method to the active/passive tense, but if you wanted to mix it up…Complete information about the patient's health conditions was provided to me via the telemedicine technology. – Judge A
	REP7	2.75	
	REP8	2.5	I flinch at perfectly. – Judge A Use of the word "perfectly" may be too extreme. Would "adequately" be too soft a word to use here? – Judge B
Presentation Capability	PRE_CAP1	3.0	Do these questions imply without the presenter's aid? – Judge A
	PRE_CAP2	3.0	
	PRE_CAP4	3.0	
Elicitation Capability	ELI_CAP1	3.0	
	ELI_CAP2	3.0	
	ELI_CAP4	3.0	
	ELI_CAP5	2.75	I'm not sure what the model looks like, but it seems these are going to be a very close overlap to e-diagnosticity. – Judge A Seems almost too short of an item to really convey what the construct is trying to measure. – Judge B
Interaction Requirements	INT_REQ1	2.25	Ordering of this was awkward. – Judge A Essentially saying the same thing as item #6 and item 6 is more clearly worded. – Judge B
	INT_REQ2	2.5	
	INT_REQ3	2.5	I rate this more favorably because it uses the word important, which is different from necessary, and because it doesn't specify *in order to diagnose the patient.* – Judge C

			Same as my comment for #6. – Judge D
	INT_REQ4	2.75	I like the term engage, because many people think of physical interaction and a deeper connection when they "engage" with another individual. This should tap at how much of a connection is necessary to perform the consultation. – Judge B I think this is important to the doctor-patient relationship, even if not necessary in the evaluation of a given complaint. – Judge C
	INT_REQ5	2.5	Idea (not related to 5.): What about throwing one in that has the patient as the subject of the sentence in active voice, like…'The patient provided me important information during the interaction.' to change it up? – Judge A I think that a physician's desire for capacity/ability to exchange exists even if it doesn't need to be exercised in a given situation. Just because you didn't need in one case to exchange data, you still need the general ability to be able to exchange data. So I don't think these first seven map to the construct (as I understand the construct). I am assuming the consultant is the physician, btw. – Judge C
	INT_REQ6	2.25*	The amount of information is a little different from the amount of interaction. – Judge D
	INT_REQ7	2.25*	I'm not sure what dialogue will imply if it was necessary to interact in some way that wasn't just talking. – Judge A Awkwardly worded. I don't know of many people that say they "dialogue" with other people. – Judge B I think this is always important in the DPR, even if not necessary, which is why I think it differs from the previous items. Although I'm conflicted about #4. – Judge C
Trust Requirements	TRU_REQ1	3.0	
	TRU_REQ2	3.0	Maybe consider adding a little context…trust my ____. – Judge A
	TRU_REQ3	2.75	I think this is ambiguous in that it's not clear if patient has to trust doctor or doctor has to trust patient. If you want them to answer only on both, maybe add "mutually"? – Judge A "It was necessary to establish a trusting relationship with the patient I evaluated" may be a clearer way to say the same sentence. – Judge B I think all of these are good items for reflecting your construct that differ from the items reflecting perceived need to interact-- these seem to apply in general, instead of as necessary items to evaluate a given case. I think maybe I'm getting stuck on distinguishing between factors necessary for the DPR in general, versus for a single diagnosis. – Judge C
	TRU_REQ4	3.0	
	TRU_REQ5	2.5	Dependence is different than trust. In my eyes, dependence involves a need of one party for the other party whereas trust is a willingness to turn over responsibility. Maybe I'm wrong here though. – Judge B
Sensory	SEN_REQ1	2.5	I'm not sure what physically observe means…does that mean not telemedicine? Eyesight and in person? –

Requirements			Judge A
	SEN_REQ3	2.5	I think this item may be too broadly/generally worded. – Judge B I know that it seems dissonant for me rate these items favorably toward their scales when I disagree so much with the information requirements items. To (try to) explain, I would have to say that I think that if a doctor said, "wow, turns out I didn't need to see/touch/be physical with the patient," he would then acknowledge that he doesn't perceive the absolute need for the ability to have full sensory experience. I don't think that necessarily holds true for the ability to exchange information. In that case, I think a doctor might say, "in this case i didn't need to exercise the ability to exchange high loads of data, but it is still a critical requirement in general for me to do my job." I guess this comes from a perception on my part that the information exchange is more critical than a FULL sensory experience. I hope this explanation helps, and allows you to discount my ratings if necessary. – Judge C
	SEN_REQ4	2.75	Does this mean they have to do all three? What if only one was really important? – Judge A
Touching Requirements	TOU_REQ1	3.0	I like this formative layout much better (or at least the idea of there being sub-dimensions). – Judge A
	TOU_REQ2	3.0	
	TOU_REQ3	3.0	
	TOU_REQ5	2.75	Same as item 3 above, but item 4 seems stronger. – Judge B
	TOU_REQ6**	2.0	"Physically examine" seems too broad to be included as a tactile dimension of this construct. – Judge B Too broad…it covers other aspects. – Judge D
Hearing Requirements	HEAR_REQ1	3.0	
	HEAR_REQ2	3.0	
	HEAR_REQ3	3.0	
	HEAR_REQ4	3.0	
Seeing Requirements	SEE_REQ1	3.0	
	SEE_REQ2	3.0	
	SEE_REQ3	3.0	
	SEE_REQ4	3.0	

* Dropped items

** TOU_REQ6 was removed as an item for Touching Requirements and included as an item for Sensory Requirements (SEN_REQ2) in the next phase of item generation, which was the item sorting exercise.

Appendix G. Item Sorting Results for Constructs

Construct	Diag	IntReq	TruReq	SenReq	Rep	SysQual	PreCap	EliCap	Und	ShaUnd
e-Consultation Diagnosticity										
DIAG1	ABCDEF				G					
DIAG2	ABCDEF			G						
DIAG3	ABCDEFG									
DIAG4	ABCDEF			G						
DIAG5	ABCD			G	EF					
DIAG6	ABCEFG				D					
Interaction Requirements										
INT_REQ1		ABCDEFG								
INT_REQ2		ABCDEFG								
INT_REQ3		ABCDEFG								
INT_REQ4		ABCDEFG								
INT_REQ5		ABCDEFG								
Trust Requirements										
TRU_REQ1			ABCDEFG							
TRU_REQ2			ABCDEFG							
TRU_REQ3			ABCDEFG							
TRU_REQ4			ABCDEFG							
TRU_REQ5			ABCDEFG							
Sensory Requirements										
SEN_REQ1		D		ABCEFG						
SEN_REQ3	G	BF		ACE	D					
SEN_REQ4		D		ABCEFG						

Appendix G (cont.). Item Sorting Results for Constructs

Construct	Diag	IntReq	TruReq	SenReq	Rep	SysQual	PreCap	EliCap	Und	ShaUnd
Representation										
REP1	G				ABCDEF					
REP4	DG				ABEF	C				
REP5					VDPBA	E	C			
REP6	DFG				ABE	C				
REP7					ABCDEF	G				
REP8						ABCDEFG				
System Quality										
SYS_QUAL1						ABCDEFG				
SYS_QUAL2						ABCDEFG				
SYS_QUAL3						ABCDEFG				
SYS_QUAL4						ABCDEFG				
Presentation Capability										
PRE_CAP1		G					ABCDEF			
PRE_CAP2							ABCDEFG			
PRE_CAP3							ABCDEG	F		
PRE_CAP4		C					ABDEG	F		
Elicitation Capability										
ELI_CAP1		G						ABCDEF		
ELI_CAP2								ABCDEFG		
ELI_CAP4								ABCDEFG		
ELI_CAP5					BE			ACDFG		

Appendix G (cont.). Item Sorting Results for Constructs

Construct	Diag	IntReq	TruReq	SenReq	Rep	SysQual	PreCap	EliCap	Und	ShaUnd
Understanding										
UND1							G		ABCDEF	
UND2									ABCDEFG	
UND3									ABCDEFG	
UND4							CG		ABEF	D
UND5									C	EGDFBA
UND6									ACF	EGDB
Shared Understanding										
SHA_UND1							D		B	ACEFG
SHA_UND2										ABCDEFG
SHA_UND3							CE		G	ABDF
SHA_UND4										ABCDEFG
SHA_UND5										ABCDEFG

Appendix G (cont.) Item Sorting Results for Constructs

Construct	SeeReq	HearReq	TouReq	InfoAcc	InfoCom	SenCue	PerFoc	ArtCap	ExeCap	Instruct	Interview
Seeing Requirements											
SEE_REQ1	ABCDEFG										
SEE_REQ2	ABCDEFG										
SEE_REQ3	ABCDEFG										
SEE_REQ4	ABCDEFG										
Hearing Requirements											
HEAR_REQ1	B	ACDEFG									
HEAR_REQ2		ABCDEFG									
HEAR_REQ3		ABCDEFG									
HEAR_REQ4		ABCDEFG									
Touching Requirements											
TOU_REQ1			ABCDEFG								
TOU_REQ2		B	ACDEFG								
TOU_REQ3			ABCDEFG								
TOU_REQ5			ABCDEFG								
TOU_REQ6			ABCDEFG								
Information Accuracy											
INFO_ACC1				ABCEFG		D					
INFO_ACC2				ABCDEF		G					
INFO_ACC3				ABCDEFG							
INFO_ACC4				ABCDEFG							
INFO_ACC5				ABCDEFG							

Appendix G (cont.) Item Sorting Results for Constructs

Construct	SeeReq	HearReq	TouReq	InfoAcc	InfoCom	SenCue	PerFoc	ArtCap	ExeCap	Instruct	Interview
Information Completeness											
INFO_COM1					ABCDEFG						
INFO_COM2					ABCDEFG						
INFO_COM3					ABCDEFG						
INFO_COM4					ABCDEFG						
INFO_COM5					ABCDEFG						
INFO_COM6					ABCDEFG						
INFO_COM7					ABCDEFG						
Sensory Cues											
SEN_CUE1	BE					ACDFG					
SEN_CUE4		E				ABCDFG					
SEN_CUE5					E	ABCD			FG		
SEN_CUE6	C		D			ABEFG					
Personal Focus											
PER_FOC1							ABCDEFG				
PER_FOC2							ABCDEFG				
PER_FOC3							ABCDEFG				
PER_FOC4							ABCDEFG				
Articulation Capability											
ART_CAP1								ABCDEFG			
ART_CAP2								ABCDEFG			
ART_CAP3								ABCDEFG			
ART_CAP4								ABCDEFG			
ART_CAP5								ABCDEFG			
ART_CAP6								ABCDEFG	B		

Appendix G (cont.) Item Sorting Results for Constructs

Construct	SeeReq	HearReq	TouReq	InfoAcc	InfoCom	SenCue	PerFoc	ArtCap	ExeCap	Instruct	Interview
Execution Capability											
EXE_CAP1									ABDEFG	C	
EXE_CAP2									ABCDEFG		
EXE_CAP3									ABCDEFG		
EXE_CAP4								B	ACDEFG		
EXE_CAP5									BDFG	ACE	
Instruction											
INSTRUCT1										ABCDEFG	
INSTRUCT2										ABCDEFG	
INSTRUCT3										ABCDEFG	
INSTRUCT4										ABCDEFG	
Interviewing											
INTERVIEW1											ABCDEFG
INTERVIEW2								CG		BF	ADE
INTERVIEW3											ABCDEFG
INTERVIEW4							F			D	ABCEG

Appendix H. Complete Online Survey

The University of Georgia

Participant Informational Letter
Provider Perceptions of Telemedicine Consultation Services

Survey Closing Date: May 15, 2011 at Midnight

I am a graduate PhD candidate under the direction of Dr. Elena Karahanna. I invite you to participate in a research study entitled "Provider Perceptions of Telemedicine Consultation Services," which is being conducted by Ms. Christina Serrano (MIS Department, the University of Georgia, 706-296-6102) and Dr. Elena Karahanna (MIS Department, the University of Georgia, 706-542-3902). The purpose of this study is to understand how consulting healthcare providers view telemedicine consultation services to evaluate patients' health conditions and, if they use them, how they use them. There are no right or wrong answers. What are important are your perceptions of telemedicine consultation services.

To participate in this study, you should be a current or former user of real-time video/audio conferencing telemedicine in order to evaluate patients' medical conditions, in which you assumed the role of the consulting provider who provided the medical expertise needed for the consultation.

Your voluntary participation will involve answering questions on a survey about your perceptions of telemedicine consultations. Completing the survey should last approximately 15 minutes. **Even though some questions appear similar, please answer every question and do not skip any.** Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled.

There are no known risks or discomforts associated with this research. Your participation in this study will be **anonymous**. No individually identifying information about you will be collected as part of this study, unless you voluntarily provide this information. However, you should understand that as with most communications over the Internet, there is a limit to the confidentiality that can be guaranteed due to the Internet technology itself; hence, there is some risk that your responses may not be completely secured. Once your completed survey is received and downloaded to the researchers' computer, the researchers will follow standard confidentiality procedures. We will present data from the study in aggregate form and, therefore, none of your individual responses will be presented and you will not be identified in the discussion of results.

For your participation, you may receive a descriptive summary of the results by formally requesting this information from the researchers. As an incentive to participate in the research study, we are offering individuals the chance to win an iPad 2 through a lottery drawing. Participation in the research study is not required to enter the drawing. You may enter the drawing by sending an email that contains your first name and last name to Ms. Christina Serrano at cserrano@uga.edu or you may provide this information at the end of the online survey. Please note that, in order to comply with tax laws, the individual who is selected to receive the iPad 2 will need to provide the researchers his/her name, mailing address, and social security number on a separate payment form. The completed form will be sent to the Business Office at the Terry College of Business and then to the UGA Business Office. The researchers have been informed that these offices will keep this information private, but may have to release the iPad 2 recipient's name and the monetary value of the iPad 2 to the IRS, if ever asked. The researchers in this study will keep the iPad 2 recipient's private information confidential by storing it in a secured location. However, the researchers are not responsible once the reward recipient's name, social security number, and mailing address leave their office for processing payment.

If you have any questions about this research project, please feel free to contact Ms. Christina Serrano at cserrano@uga.edu (706-296-6102) or Dr. Elena Karahanna at ekarah@terry.uga.edu (706-542-3902). Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 612 Boyd GSRC, Athens, Georgia 30602-7411; telephone (706) 542-3199; email address irb@uga.edu.

Thank you for your consideration. Please save/print this letter for your records.

Sincerely,

Christina Serrano

By selecting "I consent," you formally consent to participating in this research study.

- ◯ I consent.

Are you a current or former user of REAL-TIME video/audio conferencing telemedicine in order to evaluate patients' medical conditions, in which your role is/was that of the CONSULTING PROVIDER? If you answer "Yes," then you qualify to complete this survey and may select "Next" to proceed.

- ◯ Yes
- ◯ No

HOW TO SAVE: To save your work and come back at a later time, Bookmark this Page and click the "Save & Continue" button at the end of any fully completed page.

Throughout the survey, some questions will appear similar, but please answer every question and do not skip any.

In this section we ask you a few questions about yourself and your use of telemedicine.

Age

18-24	25-34	35-44	45-54	55-64	65+
○	○	○	○	○	○

Sex

○ Male

○ Female

What U.S. state or territory do you currently reside in?

Medical Specialty/ies: (please list)

Number of years using telemedicine

Less than 1	1-3	4-6	7-9	10+
○	○	○	○	○

Please type your responses in the text boxes provided.

	Average
On average, how many hours per week do you spend using the telemedicine system?	
On average, how many patients do you see per week via telemedicine?	
On average, what percentage of your patients do you see via telemedicine versus face-to-face (traditional) only?	

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In this section please think about **ONE OF YOUR MOST RECENT EXPERIENCES USING TELEMEDICINE TO CLINICALLY EVALUATE A PATIENT'S MEDICAL CONDITION**. Answer the following questions based on your perceptions of this **SPECIFIC TELEMEDICINE CONSULTATION**. Please note the difference in how we define *telemedicine technology* and *telemedicine consultation*. TELEMEDICINE **TECHNOLOGY** refers to the telemedicine equipment, software, and network only (e.g., video and audio transmitted). TELEMEDICINE **CONSULTATION** refers to both the technology and the interactions with people via the technology.

Briefly describe the patient's medical condition for this particular telemedicine consultation.

During **this particular telemedicine consultation**, the ***telemedicine consultation*** allowed me to:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Carefully evaluate the health condition of the patient							
Thoroughly assess the health condition of the patient							
Accurately evaluate the patient's health condition							
Perform all of the assessment tasks necessary to evaluate the patient's condition							

During **this particular telemedicine consultation**, the ***telemedicine technology***:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Provided a realistic representation of a traditional face-to-face medical consultation.							
Allowed me to observe the patient's emotions.							
Had technical problems with the network connection.							
Transmitted audio and video feedback that was adequate for the clinical evaluation.							
Enabled me to visually observe the patient.							
Transmitted all of the relevant information I needed for the clinical evaluation.							
Failed due to technical problems with the telemedicine equipment or software.							
Transmitted complete information about the patient's health condition.							
Functioned with no delays in the video and audio feed.							
Transmitted a complete picture of the patient's health condition.							
Enabled me to personally focus on the patient.							
Enabled me to hear everything that I needed to hear for the clinical evaluation.							
Allowed me to evaluate the patient's emotional states.							
Transmitted sounds that were very clear.							
Allowed me to see everything that I needed to see for the clinical evaluation.							
Transmitted video images that gave me an accurate picture of the patient's condition.							
Allowed me to hear sounds related to the patient's condition.							

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In this section please continue thinking about the SPECIFIC TELEMEDICINE CONSULTATION you identified and respond to questions based on your perceptions of this particular experience.

During **this particular telemedicine consultation**, ***I*** was able to:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Elicit from the patient and/or presenting provider all essential information about the patient's condition.							
Effectively ask questions to elicit important information about the patient's condition.							
Clearly specify what the patient and/or presenting provider was/were supposed to do during the clinical evaluation.							
Ask questions that were clearly understood by the patient and/or presenting provider.							
Provide clear instructions to the patient and/or presenting provider on observing any patient conditions that needed to be communicated to me during the clinical evaluation.							
Elicit from the patient and/or presenting provider the entire range of clinical information that could be provided to me.							
Effectively guide the patient and/or presenting provider through the steps necessary to communicate pertinent clinical information to me.							
Conduct an effective interview of the patient's condition.							
Elicit from the patient and/or presenting provider every important detail that I needed to know concerning the patient's health status.							
Encourage the patient and/or presenting provider to discuss the patient's concerns and condition with me.							
Elicit from the patient and/or presenting provider the relevant information I needed in terms of the patient's medical history and current symptoms.							

During **this particular telemedicine consultation**, the ***patient*** was able to:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Execute hands-on tasks in order to give me the clinical information I needed.							
Effectively articulate the information I needed to know.							
Communicate the patient's pertinent clinical information to me.							
Perform the necessary steps to relay the important clinical information to me.							
Effectively characterize his/her chief complaint.							
Fully conduct the physical tasks associated with the clinical evaluation.							
Disregard irrelevant information and communicate to me only what was important.							
Complete the tasks necessary to present me with the information I needed.							
Effectively use the telemedicine equipment, to include the software and peripherals (i.e., video cameras and scopes), if these were needed.							
Articulate his/her symptoms and concerns to me.							
Perform the necessary steps to provide the relevant clinical information to me.							

How often had you worked with this patient prior to this particular telemedicine consultation?

First-time Patient	Rarely	Occasionally	Frequently	Very Frequently

Was a presenting provider present with the patient during this particular telemedicine consultation?

- Yes
- No

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In this section please provide responses with respect to <u>HOW YOU TYPICALLY PERFORM CLINICAL EVALUATIONS OF THE PARTICULAR MEDICAL CONDITION</u> you described but within a TRADITIONAL, FACE-TO-FACE CONTEXT.

In general, when conducting clinical evaluations ***<u>for medical conditions such as this one</u>***, it is necessary that:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
The patient believes he/she can have confidence in my abilities.							
I physically observe the patient during the clinical evaluation.							
I visually observe how the patient behaves during the clinical evaluation.							
The patient and I exchange a lot of information.							
The patient feels that he/she can trust me.							
I employ the sense of touch during the clinical evaluation.							
I use auscultation techniques to evaluate patient organ systems during the clinical evaluation.							
There is a high level of interaction between me and the patient.							
I listen to the patient (or patient representative) speak during the clinical evaluation.							
I obtain a large amount of medical information from the patient.							
I obtain tactile feedback concerning the patient's condition during the clinical evaluation.							
There is a trusting relationship with the patient.							
I visually observe the patient's reactions during the clinical evaluation.							
I employ palpation and percussion techniques during the clinical evaluation.							
The patient believes I am acting in his/her best interest.							
I physically examine the patient during the clinical evaluation.							
I hear the patient's heart, lung, and gastrointestinal sounds during the clinical evaluation.							
I visually inspect certain parts of the patient's body during the clinical evaluation.							
I touch the patient during the clinical evaluation.							

In general, when conducting clinical evaluations ***<u>for medical conditions such as this one</u>***:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
I would continue to use the telemedicine system to provide the clinical evaluations.							
I intend to continue using the telemedicine system to provide the clinical evaluations.							
I will try to use the telemedicine system every possible chance that I can.							

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In this section we ask you to answer questions regarding your **PERCEPTIONS AND USAGE OF TELEMEDICINE IN GENERAL**.

In general:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Telemedicine consultations enable me to carefully evaluate the health conditions of patients.	○	○	○	○	○	○	○
Using the telemedicine system for telemedicine consultations allows me to achieve quality patient health outcomes.	○	○	○	○	○	○	○
Using the telemedicine system is a cost-effective way to clinically evaluate patients.	○	○	○	○	○	○	○
I receive the necessary technical support services when problems arise with the telemedicine system.	○	○	○	○	○	○	○
I use the telemedicine system to diagnose patients' health conditions.	○	○	○	○	○	○	○
I intend to continue use of the telemedicine system to complete a variety of clinical tasks.	○	○	○	○	○	○	○
Using the telemedicine system allows me to consult with patients I wouldn't otherwise have the opportunity to meet with face-to-face.	○	○	○	○	○	○	○
I use the telemedicine system to monitor patients' health conditions.	○	○	○	○	○	○	○
Telemedicine consultations allow me to perform all of the assessment tasks necessary to evaluate patients' health conditions.	○	○	○	○	○	○	○
I plan to use the telemedicine system to provide medical services in the future.	○	○	○	○	○	○	○
I find it easy to get the telemedicine system to do what I want it to do.	○	○	○	○	○	○	○
Telemedicine consultations enable me to thoroughly assess patients' health conditions.	○	○	○	○	○	○	○
I find that the telemedicine system is useful in my job as a consulting provider.	○	○	○	○	○	○	○
The necessary resources are available to help me with scheduling telemedicine consultation appointments.	○	○	○	○	○	○	○
I use the telemedicine system to accomplish a variety of tasks (e.g., diagnosing and monitoring patient conditions, physician assistant oversight, distance education, etc.).	○	○	○	○	○	○	○
The telemedicine system is easy to use.	○	○	○	○	○	○	○
I will try to use the telemedicine system to participate in telemedicine initiatives every possible chance that I can.	○	○	○	○	○	○	○
Using the telemedicine system makes it easier to conduct clinical evaluations of patients.	○	○	○	○	○	○	○
I use the telemedicine system across a number of telemedicine initiatives.	○	○	○	○	○	○	○

Other uses of telemedicine: (please list)

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In this section we ask you to identify the recent telemedicine consultation experience you identified in this survey.

Please think about **the recent telemedicine experience using telemedicine <u>TO CLINICALLY EVALUATE A PATIENT'S MEDICAL CONDITION</u>** that you identified in this survey and describe this experience, to include your interactions with the technology, the patient, and the presenting provider (if applicable).

Please type your email address if you would like to be entered in the drawing to win the iPad 2. Alternatively, you may email your first and last name to Ms. Christina Serrano at cserrano@uga.edu.

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Back Submit Survey

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We thank you for your time spent taking this survey.
Your response has been recorded.

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Appendix I. Perceived Diagnosticity Definitions and Scales from the Literature

Construct	Definition	Scales	Source
Perceived Diagnosticity (of the trial)	The degree to which the consumer believes the trial is useful in evaluating the brand's attributes... a trial will be perceived as most diagnostic when the product's salient attributes are mostly experiential (i.e., attributes that can be directly evaluated during trial) and when there are no doubts about expertise or trial validity. p.328	*Product-level Diagnosticity* 1. Overall, how helpful would you rate the trial experience you just had in judging the quality and performance of the software? (1-7 scale: Not helpful at all/Extremely helpful) *Attribute-level Diagnosticity* 2. To what extent did your trial experience with the software enable you to directly judge whether the package (possessed attribute X)? (1-7 scale: Trial did not enable me to judge this attribute/ Trial somewhat enabled me to judge this attribute/ Trial fully enabled me to judge this attribute)	Kempf & Smith, 1998
Trial Diagnosticity	The perceived usefulness of the trial in forming brand evaluations (Kempf & Smith, 1998) p.38	*Product-level Diagnosticity* 1. Overall, how helpful would you rate the trial experience you just had in judging the quality and performance of the software? (1-7 scale: Not helpful at all/Extremely helpful)	Kempf 1999
Perceived Trial Diagnosticity	The perceived usefulness of the for evaluating the brand (Kempf & Smith, 1998) p.28	*Product-level Diagnosticity* 1. Overall, how helpful did you feel this taste test was in allowing you to carefully evaluate the new soft drink? (1-9 scale: Not helpful at all/Somewhat helpful/Extremely helpful)	Kempf & Laczniak, 2001
Perceived Trial Diagnosticity	The perceived usefulness of the product trial in evaluating the brand (Kempf & Smith, 1998) p.7	*Product-level Diagnosticity* 1. Overall, how helpful would you rate the trial experience you just had in judging the quality and performance of the software? (1-7 scale: Not helpful at all/Extremely helpful) *Attribute-level Diagnosticity* 2. To what extent did your trial experience with the software enable you to directly judge whether the package	Kempf, Laczniak, & Smith, 2006

		(possessed attribute X)? (1-7 scale: Did not enable/fully enabled) Trial did not enable me to judge this attribute/ Trial somewhat enabled me to judge this attribute/ Trial fully enabled me to judge this attribute)	
Perceived Diagnosticity	The extent to which consumers believe that particular shopping experiences are helpful to evaluate products (Kempf & Smith, 1998) p.117 *In the context of e-commerce:* The perceived ability of a Web interface to convey to customers relevant product information that helps them in understanding and evaluating the quality and performance of products sold online. p.117	*Product-level Diagnosticity* 1. Overall, how helpful was the shopping experience to familiarize yourself with the watch? 2. How helpful would you rate the shopping experience you just had in influencing your overall evaluation of the watch? (1-7 scale: Not helpful at all/Extremely helpful) *Attribute-level Diagnosticity* 3. To what extent did this shopping experience enable you to judge attribute X? (1-7 scale: Did not enable me/Fully enabled me)	Jiang & Benbasat, 2004
Product Diagnosticity	The extent to which a consumer believes that a website is helpful in terms of fully evaluating a product (Kempf & Smith, 1998) p.125	1. I expect this website to help me get a *real feel* for this product. (Strongly disagree/agree) 2. Being able to get a *real feel* for a product would make it (much more difficult/ easier) for me to purchase this product from this Web vendor. 3. I expect this website to help me *carefully evaluate* this product: (Strongly disagree/agree) 4. Being able to *carefully evaluate* a product would make it (much more difficult/easier) for me to purchase this product from this Web vendor.	Pavlou & Fygenson, 2006
Product Diagnosticity	The extent to which a buyer believes that a website is helpful in terms of evaluating a product (Kempf & Smith, 1998) p.117-118	1. I expect prescription filling websites/Biggerbooks to help me get a real feel for prescription drugs/books. 2. I expect prescription filling websites/Biggerbooks to help me carefully evaluate prescription drugs/books	Pavlou, Liang, & Xue, 2007

Appendix J. Representative Interview Quotes in Support of Hypotheses

H11: Perceptions of e-consultation diagnosticity will be positively related to use of TMCs.	
Supporting Quote(s):	"In order for telemedicine applications to gain widespread acceptance, clinicians will need to be convinced…that diagnoses can be made accurately" ***(Craig et al. 1999, p. 180).*** "And on occasions I will find that it is an inadequate technology [for clinical evaluations], and I will not use it." ***– Consulting Physician (Interview)***
H1: Relationship requirements of the medical consultation, in terms of interaction and trust, will be negatively related to e-consultation diagnosticity.	
Supporting Quote(s):	"It's going to be hard to build a relationship through telemedicine like that because you're not face-to-face. I mean, you are face-to-face but not physically face-to-face. [Building a relationship is important] in getting them to open up…and discuss the issues that they have." ***– Consulting Physician (Interview)*** "I think that patients might be more likely to open up more fully to a doctor that they know and trust. And a lot of times when I would come in with a patient at first, that I didn't know, they were kind of standoffish, a little wary of me. But once we had talked for a few minutes, then they seemed to kind of say okay, this looks like a person that I can trust, that really cares about why I'm here. And then they might go ahead and tell me stuff that they otherwise might not have…The telemedicine…I don't think it would ever be exactly as close or as warm or as perhaps as trusting as you would get in person." ***- Consulting Physician (Interview)***
H2: Sensory requirements of the medical consultation will be negatively related to e-consultation diagnosticity.	
Supporting Quote(s):	"There are times when there's no substitute for laying your hands on somebody and just seeing the temperature of their skin and things that just cannot be transmitted." ***– Consulting Physician (Interview)*** "It is impossible to do a trustworthy physical exam over a video screen. I could not possibly rule out appendicitis over the screen and therefore had to transfer this patient to the ER." ***– Consulting Physician (Survey)***
H3: The IT representation capability will moderate the relation between relationship requirements and e-consultation diagnosticity, such that the relationship requirements will have a weaker effect on e-consultation diagnosticity for consultations with higher representation capability than for those with lower representation capability.	
Supporting Quote(s):	***Interviewer:*** How important is the video component? Is it something you could just do over the phone? ***Consulting Provider:*** No. You can't do it over the phone. You still need to be—visualize the person and have—because a part of a psychiatric evaluation is developing some rapport with the patient. The patient needs to feel comfortable with you, and you working with them, so that there's honesty and disclosure of what is going on, that kind of thing. So that's a little hard to do fully, I think, without being face-to-face with somebody. "Basically, the interview and evaluation was conducted almost exactly as I would have performed face-to-face. Audio and visuals were real life…and the patient communicated freely." ***– Consulting Physician (Survey)***
H4: The IT representation capability will moderate the relationship between sensory requirements and e-consultation diagnosticity, such that the sensory requirements will have a weaker effect on e-consultation diagnosticity for consultations with higher representation capability than for those with lower representation capability.	
Supporting Quote(s):	"If I could listen to that patient on telemedicine, or if I could listen to their…They can't tell me…They'll say, 'Well, his pulse is a little irregular.' Well, if I could look at him on telemedicine and listen, I can tell you if it's A-Fib [atrial fibrillation] or PAC's [premature

<table>
<tr><td></td><td>atrial contractions]…I can’t tell that over the phone.” – Consulting Physician (Interview)
“We do sometimes need to watch a patient walk, zoom into the patient close or up close to their hands to make sure that they’re not having—to their face or their hands or their feet or whatever to make sure that there aren’t any kind of side effects from medications, that kind of thing. But we can usually do that very well from the camera.” – Consulting Provider (Interview)
“Well, you know, anatomic defects that you were trying to feel, where it would be necessary to feel in order to evaluate would be difficult with telemedicine…but in that situation we could use an ultrasound. Usually, we could tell the same information in an ultrasound and would not need to feel.” – Consulting Physician (Interview)</td></tr>
<tr><td colspan="2">H5: The presentation capability will moderate the relation between relationship requirements and e-consultation diagnosticity, such that the relationship requirements will have a weaker effect on e-consultation diagnosticity for consultations with higher presentation capability than for those with lower presentation capability.</td></tr>
<tr><td>Supporting Quote(s):</td><td>“An example that I had the other day is that…the history was very unclear and, you know, the family says he’s [the patient] doing well, there’s no problem. But then you talk to the occupational therapist and the occupational therapist is like, ‘This child’s [patient’s] social skills are terrible…I’m fairly convinced that the child is autistic and the family doesn’t think that there’s anything wrong except that he can’t talk.’ So it’s very helpful in many cases for me to get information from the presenting provider.” – Consulting Physician (Interview)
“You always welcome the higher—the more educated, because they contribute so much more. A nurse, a RN at the other end that can do a nursing assessment and give more input, or has seen that patient before is going to be a wealth of information to you…It works really well when we have a nurse that can—is just more knowledgeable and can provide more information.” – Consulting Provider (Interview)
“If the patient couldn’t give you answers and the presenter had to give you all the information…then I would rather have a doctor give me the information, or a very experienced nurse.” – Consulting Physician (Interview)
“The nurse present with him can assess any immediate physical concerns he might bring up and report directly. These have become efficient and effective interactions, at times with more therapeutic exploration of specific issues.” – Consulting Physician (Survey)</td></tr>
<tr><td colspan="2">H6: The presentation capability will moderate the relationship between sensory requirements and e-consultation diagnosticity, such that sensory requirements will have a weaker effect on e-consultation diagnosticity for consultations with higher presentation capability than for those with lower presentation capability.</td></tr>
<tr><td>Supporting Quote(s):</td><td>“A nurse, an RN, at the other end that can do a nursing assessment…is going to be a wealth of information to you.” – Consulting Provider (Interview)
“Typically every site has somebody who at least brings the patient in and takes their vital signs for me.” – Consulting Physician (Interview)
“There is a nurse with the patient that reports the assessment findings.” – Consulting Provider (Survey)</td></tr>
<tr><td colspan="2">H7: There is a three-way interaction between IT representation, presentation capability, and relationship requirements such that the negative effect of relationship requirements on e-consultation diagnosticity is weaker in the presence of high IT representation and high presentation capability, stronger in the presence of low IT-representation and low presentation capability, and in-between when one is low and one is high.</td></tr>
<tr><td>Justification:</td><td>Presenting providers with high presentation capability will have a solid understanding of the patients’ conditions and medical histories, how to work with the patients they present, and how to articulate the patients’ conditions. Using this knowledge and these skills,</td></tr>
</table>

	presenting providers are able to compensate for limitations in the telemedicine technology in a manner that facilitates information exchange and trust in a telemedicine consultation.
Supporting Quote(s):	"[The presenting provider]…helps in the rapport building by being who she is and doing what she does…[she] makes the experience more comfortable, makes them [patients] feel less awkward talking to a television screen. And I would like to think that they would be more honest and forthright because they feel comfortable. I mean, if they're more awkward, if they feel more anxious about the situation, I feel like they might not be as forthcoming and not as trusting with me." – ***Consulting Physician (Interview)*** "Also one of the sites has a physician present, and I think that her presence during the appointments is nice for a couple of reasons. One, she interacts with the family and with the child, so sometimes she can give me observations that I can't always get a good sense of. Or let's say…we ask the child [patient] to step outside, the site coordinator or the [presenting] physician will give me insight as to what the child's behavior was like outside of the examining room. Because those would all be things that in an in-person appointment, when I go out to the waiting room, many times I can observe the patient out there…With telemedicine, I don't get that piece so it's nice to have the physician or site coordinator, so they can give me that feedback." – ***Consulting Physician (Interview)*** "Sometimes I have them [presenting providers] ask the questions directly or restate it. I'll tell them, 'Ask him, you know, why does he want to kill his roommate?' That kind of thing. Having the real person ask the question is sometimes necessary." – ***Consulting Physician (Interview)***
H8: There is a three-way interaction between IT representation, presentation capability, and sensory requirements such that the negative effect of sensory requirements on e-consultation diagnosticity is weaker in the presence of high IT representation and high presentation capability, strongest in the presence of low IT representation and low presentation capability, and in-between when one is low and one is high.	
Justification:	Presenters are also able to compensate for the lack of sensory cues available in the virtual environment. For example, the presenter can "touch and feel" for the consultant and articulate the findings and allow the consultant to observe patient reactions. Furthermore, if medical scopes (e.g. stethoscope, otoscope) are required to examine the patient, the presenter is able to physically operate these devices to obtain the needed information and then convey this information to the consultant.
Supporting Quote(s):	"All of the essential parts of the physical examination were able to be completed via telemedicine, and the components which could not be directly observed (such as odor, palpation, ausculation, etc.) were readily communicated by the presenting site's medical provider." – ***Consulting Physician (Survey)*** "I'm not saying it's not important to see and touch the patient…but in this particular situation, if you have a good presentation by the nurse—and there's a few of them that give great presentations—you receive sufficient information that way." – ***Consulting Physician (Interview)*** "In order for it (telemedicine) to work—a condition that is absolutely necessary is to have a qualified person that will link the patient and the physician. And that person has to be a registered nurse practitioner or a physician's assistant. Because you're practicing medicine and seeing the patient and then treating the patient and (you are) responsible for what happens to the patient, then that person (on the remote end) needs to do a good physical examination with an abdominal exam, heart sounds and everything. They need to relate to you what is happening to the patient…They (physicians' assistants and nurse practitioners) are fully capable. They have done thousands of physical examinations; they know what's normal, so whatever is abnormal they report. It just takes some training —

<table>
<tr><td></td><td>the hardest thing to do is a neurological exam and an abdominal (exam) probably. Neurological exam takes some training, special training in trying to do it right and interpret it right, and then the abdominal exam—you really have to put your hands in there and try to feel the liver and the spleen—and that takes awhile to develop that expertise. And if you miss it, it’s serious.” – Consulting Physician (Interview)</td></tr>
<tr><td colspan="2">H9: There is a three-way interaction between presentation capability, elicitation capability and relationship requirements such that the negative effect of relationship requirements on e-consultation diagnosticity is weaker in the presence of high presentation capability and high elicitation capability, strongest in the presence of low presentation capability and low elicitation capability, and in-between when one is high and the other is low.</td></tr>
<tr><td>Justification:</td><td>In a telemedicine consultation, a consulting provider with high elicitation capability will also be able to compensate for limitations in presentation capability through the use of effective interviewing techniques. The interaction of elicitation capability and presentation capability facilitates information exchange among consultants and presenters.</td></tr>
<tr><td>Supporting Quote(s):</td><td>“I think just knowing some basic physical exam and things is helpful. And it could be done—it would be laborious—but it could be done with someone who was completely ignorant of the process, too. I know there’s one—not to be personal—but one nurse at the nursing home that will just kind of go on and on about things, and I’m just like, ‘Just let me ask you a few questions, and then we’ll be able to get this accomplished more efficiently.’” – Consulting Physician (Interview)
“The patients are very rarely able to give you the information you need. So you need to be able to ask the relevant questions.” – Consulting Physician (Interview)
“And I think sometimes the rural areas, they’re less sophisticated…that would be a good word that I would use to describe them…and thus making, I think, the interview a lot harder…I end up having to ask a whole lot more questions, and a lot more directed questions and very specific questions.” – Consulting Physician (Interview)</td></tr>
<tr><td colspan="2">H10: There is a three-way interaction between presentation capability, elicitation capability and sensory requirements such that the negative effect of sensory requirements on e-consultation diagnosticity is weaker in the presence of high presentation capability and high elicitation capability; strongest in the presence of low presentation capability and low elicitation capability; and in-between when one is high and the other is low.</td></tr>
<tr><td>Justification:</td><td>The elicitation capability of consultants also enables the conveyance of sensory information required during the telemedicine consultation. In the interviewing process, the consulting provider can gather sensory information by asking the presenter to describe how a patient condition looks in appearance or how it feels to the touch. Through instructing capabilities, the consulting provider can request specific sensory information, such as looking in a patient’s ear, be collected and shared.</td></tr>
<tr><td>Supporting Quote(s):</td><td>“Mine was a patient that had a swollen leg. And all I had to do was look at the leg and I asked the nurse to measure its circumference compared to the other leg and found that, I think it was the right leg, was two inches farther around than the left.” – Consulting Provider (Interview)
“The normal thing you’d feel would be, in almost all cases, the abdomen. Or you might be palpating for injury, if the patient fell. So what I would want to do is to tell the person there, ‘Please push on their belly. I want to look at their face while you’re pushing on their belly.’ So if the nurse pushes on the belly and the patient [makes a face of someone grimacing] like that, then I can guess, that probably hurt.” – Consulting Provider (Int)
“[During the telemedicine consultation] I would just be saying [to the presenting provider], ‘Okay, hold the stethoscope,” or “Shine the light in their eyes.’” – Consulting Provider (Interview)</td></tr>
</table>

Appendix K. Post-hoc Exploratory Analysis

In our post-hoc exploratory analysis, we focused on the IT and user capabilities (i.e., representation, presentation and elicitation) and how they may potentially impact perceived e-consultation diagnosticity independent of the process requirements of a medical consultation. Again we employed stepwise regression analyses to investigate the influences of two-way interaction effects between these capabilities as well as a full model with all two-way interactions and the two-way interaction between representation, presentation, and elicitation. Due to multicollinearity concerns, we employed the partial Gram-Schmidt procedure to orthogonalize all interaction terms (Burrill 1997), which alleviated issues with multicollinearity.

In our hypotheses, we posited that both (1) representation and presentation and (2) presentation and elicitation could substitute for one another in meeting process requirements and subsequently enable perceived e-consultation diagnosticity. The exploratory regression analyses (see Table A for a summary of results) revealed that the two-way interaction effect between representation and presentation is indeed negative (indicating a substitution effect) and statistically significant (γ=-0.155, p=.005; γ=-0.243, p=.060; γ=-0.248, p=.055) across the three regression models in which it is included.

To interpret this interaction effect, we plotted the interactions, specifying presentation as a moderator in one plot (Figure A) and representation as a moderator in the second plot (Figure B). Our findings suggest interactions between representation and presentation that are difficult to interpret and non-conclusive. In Figure A, the interaction plot indicates that representation has a stronger positive impact on perceptions of e-consultation diagnosticity when presentation capability is high (t=5.441, p<0.001) and no significant relationship when presentation capability is low. According to our theorizing, representation capability should be a significant factor in determining e-consultation diagnosticity—particularly when presentation capability is low.

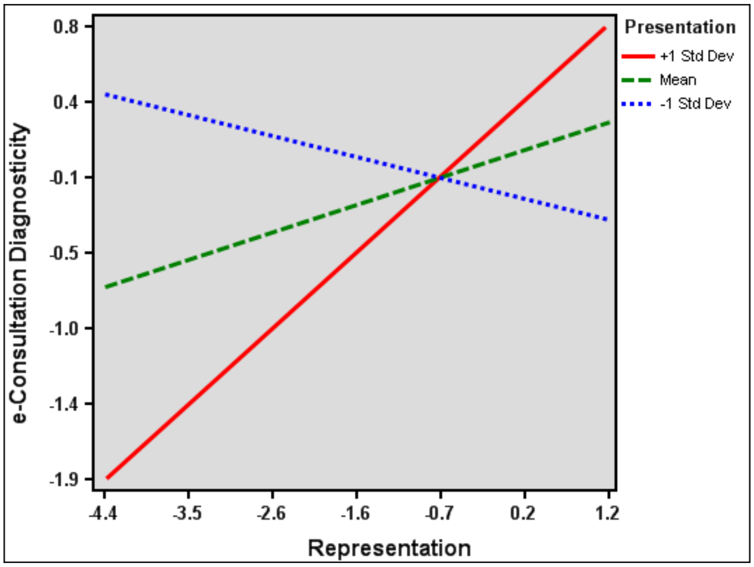

Figure A. Moderating Effect of Presentation on Representation and e-Consultation Diagnosticity (Exploratory)

To glean additional insights concerning the interaction between representation and presentation, we plotted representation as a moderator of presentation and e-consultation diagnosticity (Figure B). Results of this analysis are also difficult to interpret. The interaction plot suggests that presentation capability has a strong positive influence on e-consultation diagnosticity when representation is high ($t=5.553$, $p<0.001$) but no significant relationship with e-consultation diagnosticity when representation is low. Based on our theorizing, we would expect presentation capability to be especially important when representation is low. Thus, while our post-hoc analysis reveals that the interaction of presentation and representation has a significant effect on e-consultation diagnosticity, it is not clear how to make sense of this relationship. This may suggest possible complementarities between presentation and representation (rather than substitution effects), though our qualitative data suggests otherwise. We will explore this interesting finding in follow up studies.

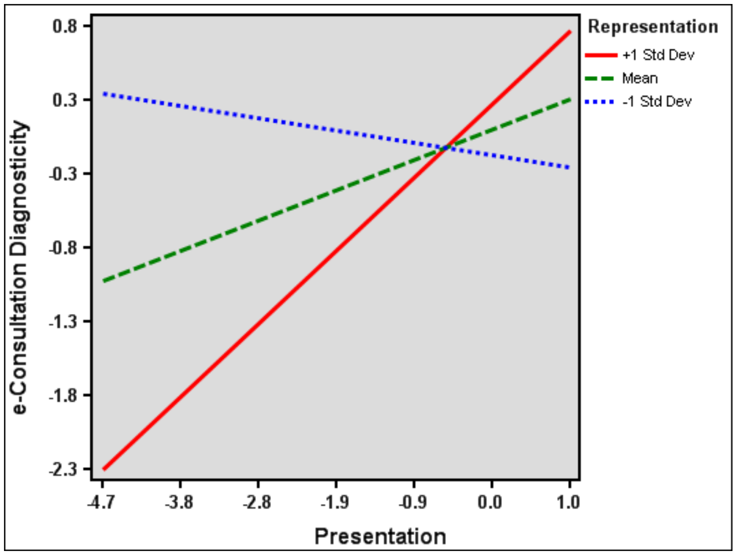

Figure B. Moderating Effect of Representation on Presentation and e-Consultation Diagnosticity (Exploratory)

The exploratory post-hoc analysis also revealed a significant interaction effect between presentation and elicitation (γ=-0.127, p=.023). This becomes non-significant in the presence of the two-way interactions between representation and presentation and between representation and elicitation and in the presence of the three-way interaction between representation, presentation, and elicitation, likely due to power issues and multicollinearity. To probe into the meaning of the significant interaction effect of presentation and elicitation, we plot the interactions using elicitation as the moderator in one plot (Figure C) and presentation as the moderator in the second plot (Figure D).

According to the interaction plot in Figure C, presentation capability has a strong positive influence on perceptions of e-consultation diagnosticity in the presence of high elicitation ability (t=4.207, p<0.001) but no significant relationship with e-consultation diagnosticity when elicitation capability is low. Again, this effect is counter-intuitive, in that when elicitation capabilities are low, presentation capabilities should be more material to e-consultation diagnosticity.

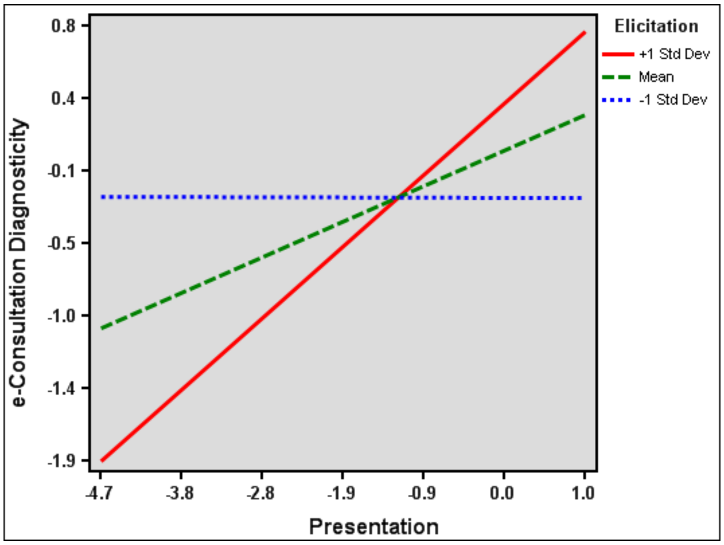

Figure C. Moderating Effect of Elicitation on Presentation and e-Consultation Diagnosticity (Exploratory)

According to the interaction plot in Figure D, elicitation capability has a strong positive influence on perceptions of e-consultation diagnosticity in the presence of high presentation capability (t=5.111, p<0.001) but no significant relationship with e-consultation diagnosticity when presentation capability is low. This is also counter-intuitive in that when presentation capabilities are low, one would expect elicitation capabilities to be important for conducting clinical evaluations through the telemedicine technology.

We do not specifically hypothesize an interaction effect between representation and elicitation, nor do we hypothesize a three-way interaction between representation, presentation, and elicitation, but we explore these relationships in our post-hoc analysis for the sake of completeness. Our findings reveal that these interaction effects are non-significant.

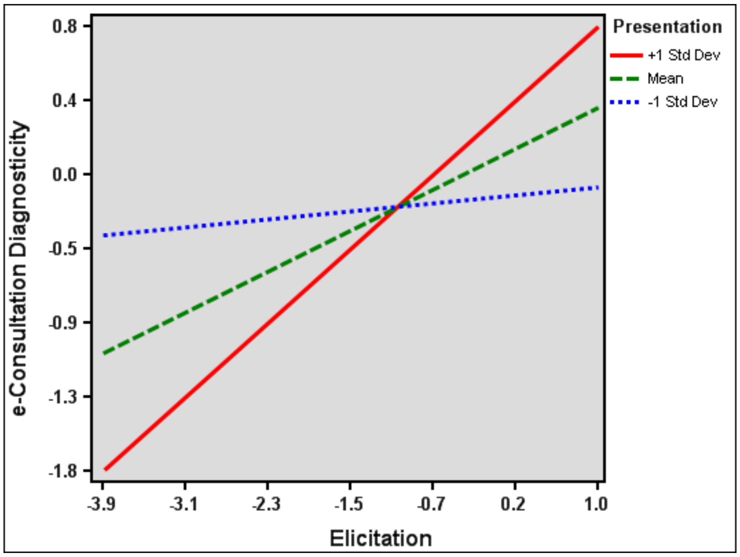

Figure D. Moderating Effect of Presentation on Elicitation and e-Consultation Diagnosticity (Exploratory)

Altogether, the post-hoc analysis revealed that, in addition to having significant main effects on perceived e-consultation diagnosticity, the two-way interaction effects of (1) representation and presentation and (2) elicitation and presentation influence perceptions of e-consultation diagnosticity. These effects will be explored more fully in follow up studies.

A summary of all data analysis, including the post-hoc analysis, findings from the field survey is presented in a graphical representation displayed in Figure E.

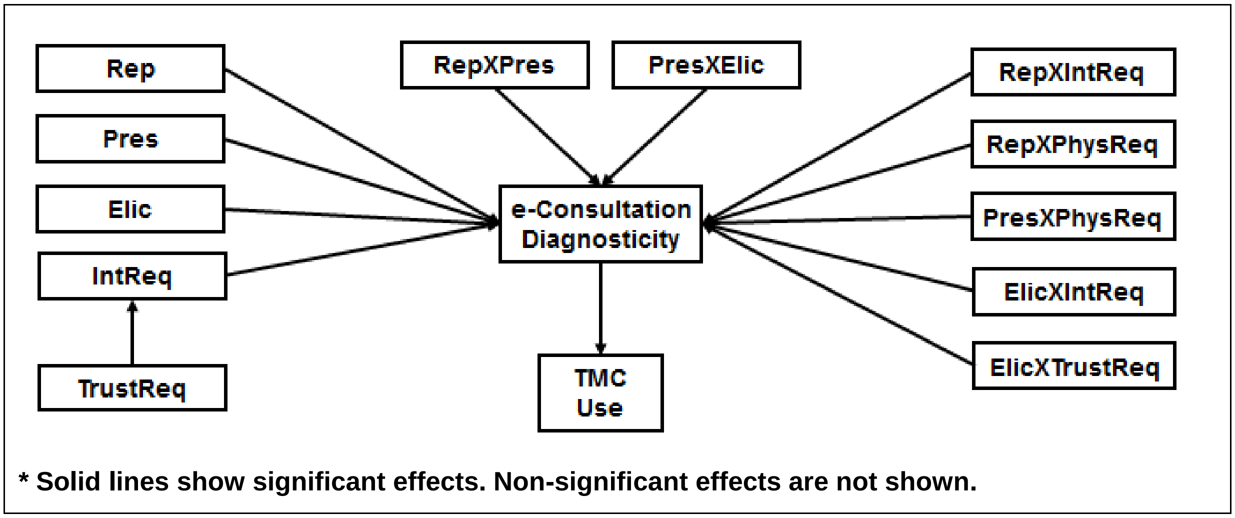

Figure E. Pictorial Representation of All Significant Findings

Table A. Post-Hoc Regression Analysis Results

	Main Eff		Model 1		Model 2		Model 3		Model 4		Model 5	
Predictors:	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**	**St. Beta**	**Sig.**
IntReq	.199	.005**	.247	.001***	.233	.001***	.226	.002**	.242	.001***	.236	.001***
TrustReq	-.050	.466	-.041	.532	-.040	.549	-.034	.617	-.050	.457	-.054	.427
PhysReq	-.028	.619	-.036	.513	-.041	.464	-.034	.546	-.030	.583	-.010	.870
Rep	.259	.003**	.240	.005**	.209	.019*	.256	.004**	.256	.007**	.263	.006**
Pres	.287	.000***	.291	.000***	.308	.000***	.289	.000***	.282	.000***	.280	.000***
Elic	.312	.000***	.310	.000***	.318	.000***	.297	.001***	.314	.000***	.317	.000***
RepXPres			-.155	.005**					-.243	.060	-.248	.055
PresXElic					-.127	.023*			.063	.634	.068	.603
RepXElic							-.082	.155	.048	.551	.051	.528
RepXPresXElic											.058	.291
Sig. F Change	N/A		.005** (from Main Eff)		.023* (from Main Eff)		.155 (from Main Eff)		.033* (from Main Eff)		.291 (from Model 4)	
R^2	.685		.707		.699		.691		.709		.712	
Adj. R^2	.669		.689		.681		.672		.685		.686	
*** p<0.001 **p<0.01 *p<0.05												