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December 2004

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## ABSTRACT

Companies in a wide variety of industries are increasingly turning to technology-based systems to serve customers. The effectiveness of such systems depends on how comfortable users feel with the systems and the quality of technology-based encounters with consumers (Parasuraman and Colby, 2001). Health care is leading the way via using telemedicine for direct patient care. However, holistic (socio-technical) understanding of telemedicine encounter quality is still somewhat limited. To enrich understanding, we use a field study comprising multiple methods (direct observation, interview, survey) and perspectives (researcher and provider) to collect and interpret data. We conduct this study from the position of the health care provider, namely medical professionals who directly use the technology and are accountable for patient care. We enumerate quality attributes in the form of a taxonomy. Furthermore, we enrich understanding and the ability to take action and strategize by discerning the opportunities for controlling each attribute.

**Keywords**

Technology Service Encounters, Telemedicine, Quality, Socio-Technical Systems, Tele-health

## INTRODUCTION

Companies are increasingly turning to technology-based systems to serve customers. A major determining factor on the effectiveness of these systems is the quality of the technology-based interactions (Parasuraman and Colby 2001). The recognition of technology-based service encounters as complex engagements of a socio-technical system is necessary to make significant progress in addressing major outstanding problems regarding encounter success in both research and practice.

In healthcare, service encounters occur regularly between a healthcare provider and a patient. One such encounter, which is mediated by technology, is the use of telemedicine. This paper will focus on the use of one of the most challenging forms of telemedicine, medical video conferencing for direct patient care. In order for such a critical service encounter to be successfully executed, additional knowledge about the attributes that lead to quality service encounters is necessary. To date, there is limited research that focuses on technology-based encounters (Meuter et al., 2000) and particularly on exploring social and technical dimensions of quality in the telemedicine context.

Quality is a multi-dimensional construct that requires contextual analysis to assess the specific attributes necessary for a particular type of system (Delone and McLean 1992). The Delone and McLean model of information system (IS) success and in particular its focus on quality, guides this research. It provides the starting point to assess specific quality attributes that are important for successful telemedicine service encounters. Through the use of observation, interviews, and expert panel data a framework for assessing medical video conferencing quality as it impacts service encounters is formulated. Once this framework is established, additional work is done to better understand when each attribute is best controlled and by whom. Thus, we empirically apply the Delone and McLean model to a specific service encounter context and demonstrate how this framework can be used for context specification. Furthermore, the research results support the need to better understand and assess telemedicine service encounters.

**Telemedicine**

As an integral component of telemedicine, high bandwidth video conferencing is used in medical personnel education, peer consultation, patient education, as well as direct patient care. High bandwidth video conferencing is often chosen for telemedicine treatment requiring invasive procedures, real-time motion-detection (e.g. cardiac monitoring, ultrasonography), and real-time specimen analysis (e.g. scan and pan pathology). Medical video conferencing is arguably the most demanding and complex form of telemedicine, when deployed for direct patient care. Figure 1 provides a view of the environmentof medical video conferencing used in this study. A connection is made with videoconferencing equipment on both sides using ISDN or IP protocols to communicate.

There is widespread interest in utilizing this technology as an economical method to provide expert medical service to patients in remote and awkward locations and to address uneven distribution of health care resources (i.e. facilities and practitioners) (Darkins and Carey, 2000, Maheu et al., 2001). Additionally, there is growing recognition that telemedicine can facilitate the timeliness of medical care by providing service options to a wider range of appropriate medical providers. The implications of timeliness include improved "…care provided during the 'golden window' of treatment opportunity" (Cullen et al., 1999).
Unfortunately, in assessing the telemedicine process and product, "…research on the effectiveness of telemedicine is somewhat limited, although the work that has been done thus far supports the hypothesis that, in general, the technology is medically effective" (Grigsby and Sanders, 1998 p.123). There is currently a need for researchers to provide telemedicine models that facilitate decision making about technical requirements in a particular setting and models that provide insight into the health care service encounter (Taylor, 1998b, Taylor, 1998a).

**Concerns of Providers**

"Successful health care information systems will be those that match the health care environment with respect to the technical, social, and organizational factors; most important the perceptions of key stakeholders" (Heeks et al., 1999 p.100). The failure of an information system (and technology service encounter) can be represented as the embodiment of perceptions (Lyytinen and Hirschheim, 1987). Individual studies address the perceptions of various stakeholder groups with assorted degrees of depth and breath to collectively complete the spectrum of perceptions (e.g. Bitner et al., 1994 for employee/ service provider perspective, , de Ruyter et al., 1999 for consumer perspective). As stated by an American Telemedicine Association official, "It's up to the doctor on the spot to size up the situation and determine when it's appropriate to evaluate a patient via telemedicine and when it's not" (Mcllrath, 1995 p.3). Telemedicine providers (e.g. doctors and nurse practitioners collectively) act as the "front line" and direct users in staging and executing the encounter. Providers have intimate relationships with the organization (as employee, contractor) and patient (doctors through Hippocratic Oath must address the clinical need of the patient). In-depth inquiries from the provider perspective spotlight the central figure of responsibility and encounter activity. Focus on direct users may elucidate multiple dimensions of encounter quality that may not be readily apparent to indirect users of the technology (i.e. patients and the organization).
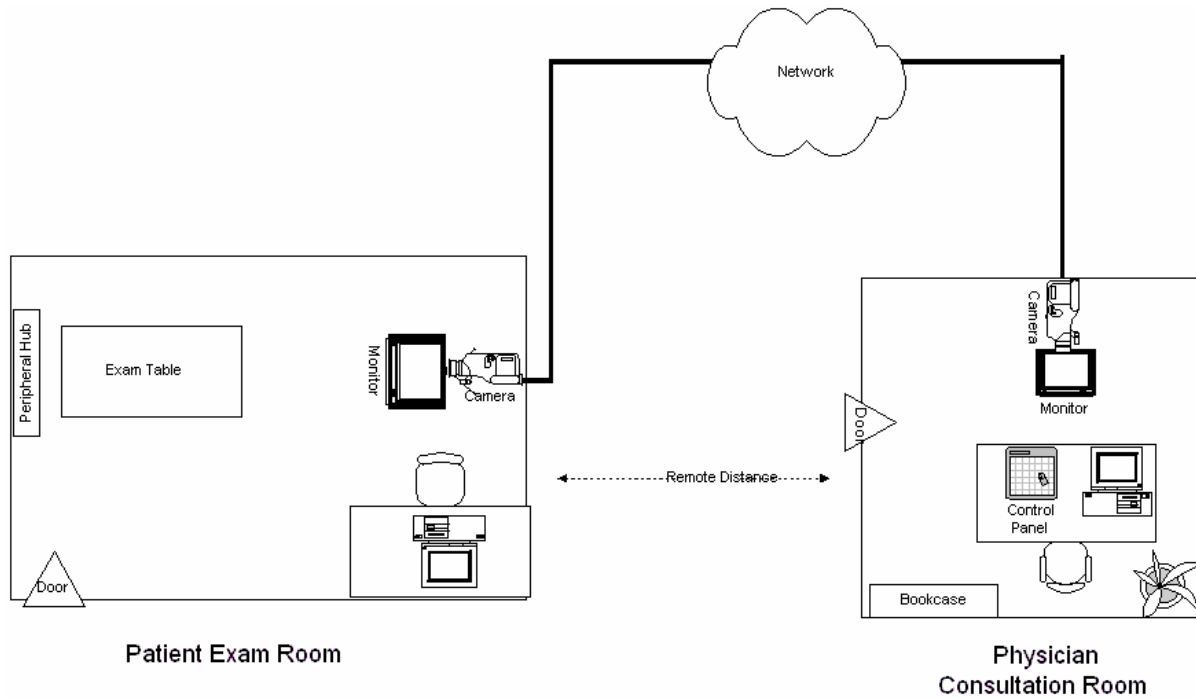
**Figure 1: Medical Video Conferencing (adapted from (LeRouge et al., 2002)**

### Research Focus

The purpose of our research is to propose a taxonomy of telemedicine system quality attributes for direct patient care using high bandwidth video conferencing (hereafter referred to as medical video conferencing). To facilitate the usefulness of this taxonomy, we also address issues of relevance and control for each attribute identified. We adopt a socio-technical perspective recognizing the deployment of such systems as technology service encounters. We choose to provide in-depth focus from the vantage of telemedicine providers, the direct users of the technology (hands-on operation) and those responsible for patient care.

We address the following research questions:

- What quality attributes contribute to telemedicine encounter success from the provider perspective?

- Which telemedicine encounter quality attributes are considered most relevant to encounter success from the perspective of providers?

- At what point in time in relation to the encounter (e.g. before, introduction, core, closure, after) are identified attributes most controllable?

- What entities (e.g. organization, equipment manufacturer, doctor, patient) have most control over each identified attribute?

Decomposition of a multi-dimensional construct, like service encounter quality, into a connecting framework (under the auspice of telemedicine domain characteristics and boundaries) provides an organized representation of a construct, shared terminology, identification of quality variables, and the development of appropriate measures. For practitioners, explicit representation of the quality attributes of technology-based systems and insight on controlling key attributes is essential to implementation, utilization, and common understanding. Without a supporting framework, the ability to create measures to monitor appropriate progress over time remains vague and ambiguous. Additionally, without an understanding of system quality in the telemedicine environment, the potential for successful implementation and utilization of telemedicine systems as well as knowledge building is diminished.

**RESEARCH FRAMEWORK: TELEMEDICINE QUALITY ATTRIBUTES AS ANTECEDENTS TO INFORMATION SYSTEM SUCCESS**

Strauss and Corbin (1990) indicate that one means to extend existing knowledge is to begin with existing frameworks and theories and to uncover how they can be applied to new and varied situations. Of the IS models that acknowledge quality as an antecedent to IS success, the Delone and McLean IS Success Model seems suited to the telemedicine encounter context given its roots in communications theory (DeLone and McLean, 1992). Constructs in this model (service quality, system quality, information quality, use, user satisfaction, individual impact, and organizational impact) reflect the communication system levels. The addition of service quality (Delone and McLean 2002) further reinforces the socio-technical awareness of the model. Figure 3 represents the adapted version of the IS Success Model used for this study (DeLone and McLean, 2002).
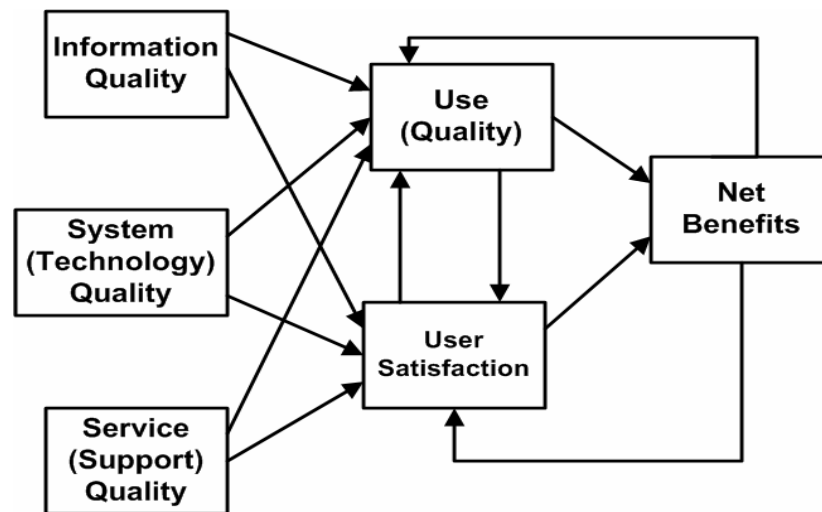


**Figure 3: Reformulated IS Success Model. Adapted from Delone and McLean (2002)**

This framework provides only a precursory understanding of the quality construct.  There is no universal set of quality attributes for any of the suggested dimensions as quality is both multi-faceted and domain-specific. Researchers reiterate the need for domain specification of the Delone and McLean model to facilitate insight, theory building and application (Rai et al., 2002, DeLone and McLean, 2002, Jiang and Klein, 1999). Furthermore, providing services using technology creates a level of complexity that requires the criteria used for evaluating an IS to emerge from investigating first and foremost this context and from understanding the concerns of the stakeholder groups (Stamoulis et al., 2002 p. 249).

We define these dimensions as follows based upon:
- Direct observation (40 hours) of medical video conferencing rooms, functional equipment, and segments of videoconference sessions for representations of quality attributes and issues

- Review of archived video and photographic images of telemedicine encounters and rooms

- Unstructured interviews and other forms of communication with an originator of the model as well as telemedicine researchers inside and outside of the United States

*System Quality* includes those features of medical video conferencing equipment and telecommunication processes utilized for medical video conferencing encounters.

*Information Quality* includes the characteristics of information that allow the participants to take appropriate action concerning patient care and facilitate diagnosis.

*Service Quality* can be defined as the human infrastructure and physical environment provided by the organization that support user comfort and system use. This human infrastructure may include such roles as schedulers and technical support that extend the capabilities of the providers. Additionally, support includes aspects of the patient and consultant setting

provided by the organization that may negatively impact participant comfort resulting in communication distractions or impediments (Tyrrell et al., 2001).

We define *use quality* in this study as informed and effective communication and deployment of technology by direct users (medical staff) during the medical video conferencing encounter that facilitates desired outcomes. By exploring and identifying the attributes of use quality in this context, we hope to provide further insight into refining the concept of use to better understand and specify post-adoption appropriation.

## RESEARCH METHODS

To better understand the phenomena of telemedicine service encounters, we use a hermeneutic, interpretive approach (Klein and Myers, 1999). Iterative data collection and interpretation is used to develop a detailed understanding of the interdependent meaning of each dimension of quality (quality attributes) in a telemedicine service encounter following a adaptation of the process framework introduced by Kanellis et al. (1998, 1999). We use multiple methods (direct observation, interview, survey) and perspectives (researchers and providers with common base knowledge, yet distinct specializations and focus) to achieve a rich understanding of quality in a service encounter. Research procedures reflecting the adapted framework and consideration of interpretive fieldwork principles (Klein and Myers 1999) are presented in Table 1.

**Table 1: Research Design**

| *Research Step from Field Study Model* | *Research Methods and Procedures Associated with Approach* |
|---|---|
| Determination of the concerns and assumptions of the researcher | • Development of research framework through researcher knowledge, literature review, and direct observation. |
| Determination of the concerns and assumptions of the stakeholders | • Direct Observation and Unstructured interviews with telemedicine stakeholders.<br>• Telemedicine Literature Review (practitioner and academic journals). |
| Identification and clarification of possible epistemological and ontological differences | • Telemedicine stakeholders participation in research design.<br>• Review/pre-testing of protocol language and content by telemedicine stakeholders |
| Development of a quality model appropriate to the context | • Expert panel interviews (current telemedicine practitioners, individuals that support practitioners, individuals that research the encounter context, as well as panel members with experience in and/or knowledge of multiple telemedicine roles)<br>• Researcher coding of expert panel interviews to identify quality attributes<br>• Stakeholder coding of expert panel interviews to identify quality attributes<br>• Synthesized analysis of researcher and stakeholder coding of expert panel interviews |
| Communication and feedback between stakeholders and researcher | This occurred at many phases of the project including:<br>• Review/pre-testing of protocol language,<br>• Stakeholder coding of expert panel interviews<br>• Synthesized analysis of researcher and stakeholder coding of expert panel interviews |
| Validation of quality model | • Validating survey of model |
| Analysis and interpretation of results by stakeholders and researchers | • Mapping of quality attributes to research framework<br>  • Relevance assessment of "provider" attributes by interviewees<br>• Researcher and practitioner expert panel assessment of Control Issues |
| Possible action by stakeholders to change the environment | • Participating stakeholders reviewed research result summaries to inspire action in practice.<br>• Report application possibilities to general stakeholder population in the form of formal presentations and publication. |
| Determine need to revisit assumptions, revise, or extend model | • Identify the need for future work based on study. |

### RESULTS

**Development, Analysis, and Interpretation of the Quality Framework**

We present the resulting model in Figure 5 The model embodies the complexity of technology-based service encounters. The range of attributes attests to the need for holistic, socio-technical conceptualization of the telemedicine encounter phenomenon by both research and practice.
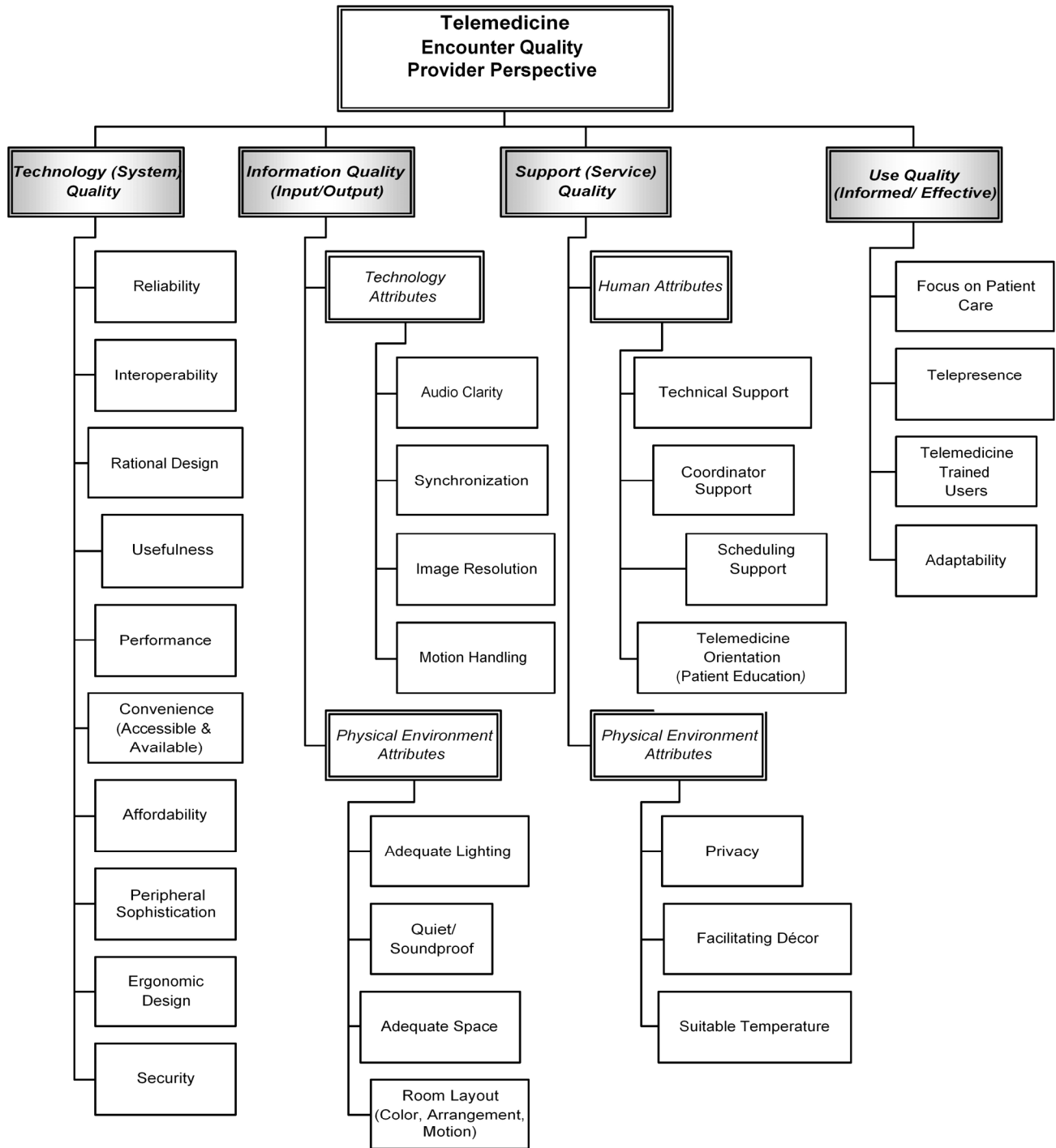
**Analysis and Interpretation of Control Issues in Telemedicine Service Encounters**

The usefulness of a model of telemedicine service encounter quality attributes to both practice and research is greatly enhanced when there is some understanding of when in the encounter certain attributes of quality can be manipulated and who can manipulate them. A team of two providers and three researchers independently addressed the following two questions for each of the identified attributes and then collaborated to reach consensus:

1. *When is the quality attribute most controllable?*
   a. *Before encounter*
   b. *Beginning of encounter*
   c. *Body of encounter*
   d. *Encounter closure*
   e. *After encounter*
   f. *Not controllable*

2. *Who has most control over the quality attribute?*
   a. *Consulting physician*
   b. *TM coordinator*
   c. *Patient*
   d. *Scheduler*
   e. *Technical Support*
   f. *Equipment developer*
   g. *Medical Center Management*
   h. *External Environment*

In the spirit of comprehensive model development, we allowed participants to select multiple attributes in response to each question, as they deemed appropriate. The results are aggregated in Table 3 (When Controlled) and Table 4 (Who Controls).

The control data clearly demonstrates that telemedicine service encounters are complex interactions involving multiple role players with multiple control opportunities before, during, and after the encounter. Though the consulting doctor is "commander in chief" of the encounter, an assessment of control factors in this study reveals many quality attributes are in the hands of other stakeholders and all attributes should be addressed in some way before the encounter begins.  This emphasizes the importance of technology preparation, focusing on the technical and organizational roles, and training of all support personal before the telemedicine session.  During the telemedicine encounter, the focus shifts to the provider (e.g. physician) and consumer (e.g. patient) roles with support roles being available as needed to address quality attribute deficiencies in such areas as lighting, temperature, privacy, technology performance, and information usefulness.

Technology should not get in the way of either the physician or the patient.  The medical care provider should be able to focus on patient care, rather than figuring out technology.   To enable this focus, technical roles, organizational roles, and external factors must support provider efforts.

```
                        ┌──────────────────────────────┐
                        │        Telemedicine           │
                        │     Encounter Quality         │
                        │    Provider Perspective       │
                        └──────────────────────────────┘
```

| Technology (System) Quality | Information Quality (Input/Output) | Support (Service) Quality | Use Quality (Informed/ Effective) |
|---|---|---|---|

**Technology (System) Quality**
- Reliability
- Interoperability
- Rational Design
- Usefulness
- Performance
- Convenience (Accessible & Available)
- Affordability
- Peripheral Sophistication
- Ergonomic Design
- Security

**Information Quality (Input/Output)**

*Technology Attributes*
- Audio Clarity
- Synchronization
- Image Resolution
- Motion Handling

*Physical Environment Attributes*
- Adequate Lighting
- Quiet/ Soundproof
- Adequate Space
- Room Layout (Color, Arrangement, Motion)

**Support (Service) Quality**

*Human Attributes*
- Technical Support
- Coordinator Support
- Scheduling Support
- Telemedicine Orientation (Patient Education)

*Physical Environment Attributes*
- Privacy
- Facilitating Décor
- Suitable Temperature

**Use Quality (Informed/ Effective)**
- Focus on Patient Care
- Telepresence
- Telemedicine Trained Users
- Adaptability

**Figure 5: Telemedicine Service Encounter Quality Model - Provider Perspective**

Technical roles, particularly the equipment manufacturer, are at the forefront of staging the encounter. Equipment manufacturers design the technological tools available for telemedicine encounters. As such, the equipment manufacturer exercises some degree of control over most of the technology quality attributes as well as the information quality attributes. The message from our experts to equipment manufacturers is to keep the equipment working (reliable), coordinated (interoperable), simple (rational design), maneuverable (ergonomic), affordable, and providing function for various medical tasks (peripheral sophistication). This is a very tall order that may best be approached with the understanding that this is a

mission critical operation that requires close communications between equipment manufacturers and telemedicine providers and coordinators.

Organizational roles are also at the forefront of staging a successful encounter. The management of the health care facility can greatly impact quality by providing an appropriate physical environment for telemedicine (e.g. affords privacy, adequate space, adequate lighting). Management can also affect quality via support and synchronization with the telemedicine coordinator. In essence, telemedicine coordinators provide quality by serving as the catalysts in the implementation and diffusion of telemedicine practices. The coordinator manages medical video conferencing experiences and serves an integral role in setting policy and procedural guidelines. In essence, the coordinator acts as the champion between the direct users (e.g. by determining patients and provider needs), health facility management (e.g. through communicating needs), and the equipment manufacturer (e.g. though equipment selection). Additionally, the coordinator may facilitate training or other interventions to enhance acceptance and ease with the equipment and medical video conferencing processes.

A trained staff appears to be a key controllable quality attribute. *"If you are looking towards something which is overall going to change the way healthcare is being delivered there has to be a trained workforce to be able to do it,"* comments one participant. To take action regarding training recommendations, management must know who to train and what material to instruct. Participants referenced training for the spectrum of stakeholders – administrators, clinicians, and technicians for their particular purpose and cross-train, to a lesser degree, for awareness. Participants also provided some guidance regarding the scope and content of training by discussing the importance of:

- Self-education (e.g. time to explore the equipment)
- Job aids (e.g. labeling equipment)
- Patient presentation process
- Supplementing camera views of a patient's body with verbal descriptions of location
- Verbal commands regarding equipment to clinicians
- Patient interaction training.
- 

Additionally, experts mentioned communicating overall purpose and perspective as an important aspect of training, which is within the control of the coordinator and management:
*"Invoking training and core rationale for why we are adopting this technology is important. So not only do they get the technical training, the hands-on training, they get an overall organizational perspective as to why this technology is being adopted, and why is it critical, and what we do on a daily basis."*

Communicating purpose and perspective to patients through patient education and orientation, another important quality attribute, is also necessary. Experts indicate, first and foremost, patients need to be told they are having a telemedicine encounter versus an in-person encounter in advance, perhaps through or reiterated by the scheduling process. Awareness needs to be supplemented by understanding provided through coordinator efforts (e.g. development of a brochure) and explanations from the in-room clinician as indicated by one expert:
*"There needs to be education…you want to have some introductory material there so you can hand (it) out and explain (the telemedicine procedure) in very readable terms… I mean for us that may seem trivial but for a rural population, who oftentimes is very undereducated, that is the only way to do it. Have someone sit there and explain before you just go into the encounter and say, okay, these are the things that will happen, here's the technology, here's how it works."*

Providers also need advance notice and staging to maximize efficiency and effectiveness:
*"The physician should know in advance that he's going to conduct a (medical video conferencing) clinic. There may be several patients from several different sites. So that he can stay in one place and do his evaluations, have available the equipment that he needs, the computerized record system at his fingertips, and be able to sit there while the camera moves from patient to patient."*

**Table 3: When Quality Attribute is Most Controllable for Telemedicine Service Encounters**

| Quality Attributes / Encounter Control Points | Before the Encounter | Encounter Start | Encounter Body | Encounter End | After the Encounter |
|---|---|---|---|---|---|
| | | | | | |
| *System Quality Attributes* | | | | | |
| Reliability | ⊕ | | ⊕ | | |
| Peripheral Sophistication | ⊕ | | | | |
| Ergonomic Design | ⊕ | | | | |
| Interoperability | ⊕ | | ⊕ | | |
| Performance | ⊕ | | ⊕ | | |
| Rational Design | ⊕ | | | | |
| Convenience | ⊕ | | | | |
| Usefulness | ⊕ | | ⊕ | | |
| Security | ⊕ | ⊕ | ⊕ | ⊕ | ⊕ |
| Affordability | ⊕ | | | | |
| | | | | | |
| *Information Quality Attributes* | | | | | |
| Room layout | ⊕ | | ⊕ | | |
| Quiet/Soundproof | ⊕ | | | | |
| Adequate Space | ⊕ | | | | |
| Adequate Lighting | ⊕ | | ⊕ | | |
| Synchronization | ⊕ | | | | |
| Audio Clarity | ⊕ | ⊕ | | | |
| Motion Handling | ⊕ | | ⊕ | | |
| Image Resolution | ⊕ | | ⊕ | | |
| | | | | | |
| *Service Quality Attributes* | | | | | |
| Technical Support | ⊕ | ⊕ | ⊕ | ⊕ | |
| Scheduling Support | ⊕ | | | | ⊕ |
| Coordinator Support | ⊕ | | ⊕ | | ⊕ |
| Patient Education | ⊕ | ⊕ | | | |
| Privacy | ⊕ | ⊕ | ⊕ | ⊕ | |
| Temperature | ⊕ | ⊕ | ⊕ | | |
| Facilitating Décor | ⊕ | | | | |
| | | | | | |
| *Use Quality Attributes* | | | | | |
| Patient Focus | ⊕ | | | | |
| Telepresence | ⊕ | ⊕ | ⊕ | ⊕ | |
| Adaptability | ⊕ | ⊕ | ⊕ | ⊕ | |
| Staff Training | ⊕ | | | | |

**Table 4: Role Most in Control for Medical Video Conferencing Encounter**

| Quality Attributes/ Controller Roles | Provider Roles | | Consumer Role | Technical Roles | | Organizational Roles | | | External |
|---|---|---|---|---|---|---|---|---|---|
| | Physician | In-Room Clinician | Patient | Equipment Manufacturer | Technical Support | Management | Telemedicine Coordinator | Scheduler | Environment |
| ***System Quality Attributes*** | | | | | | | | | |
| Reliability | | | | ⊕ | ⊕ | | | | ⊕ |
| Peripheral Sophistication | | | | ⊕ | | | | | |
| Ergonomic Design | | | | ⊕ | | | | | |
| Interoperability | | | | ⊕ | ⊕ | | ⊕ | | |
| Performance | ⊕ | | | ⊕ | ⊕ | | | | |
| Rational Design | | | | ⊕ | ⊕ | ⊕ | ⊕ | | |
| Convenience | | | | | | ⊕ | ⊕ | ⊕ | |
| Usefulness | ⊕ | ⊕ | | ⊕ | ⊕ | ⊕ | ⊕ | | |
| Security | | ⊕ | | ⊕ | ⊕ | ⊕ | ⊕ | | |
| Affordability | | | | ⊕ | ⊕ | | ⊕ | | ⊕ |
| ***Information Quality Attributes*** | | | | | | | | | |
| Room layout | | | | ⊕ | | ⊕ | ⊕ | | |
| Quiet/Soundproof | | | | | | ⊕ | ⊕ | | ⊕ |
| Adequate Space | | | | | | ⊕ | ⊕ | | |
| Adequate Lighting | ⊕ | ⊕ | | | | ⊕ | ⊕ | | |
| Synchronization | | | | ⊕ | ⊕ | | | | |
| Audio Clarity | ⊕ | ⊕ | | ⊕ | ⊕ | | | | |
| Motion Handling | ⊕ | ⊕ | | ⊕ | ⊕ | | | | |
| Image Resolution | ⊕ | ⊕ | | ⊕ | ⊕ | | | | |
| ***Service Quality Attributes*** | | | | | | | | | |
| Technical Support | ⊕ | ⊕ | | | ⊕ | | ⊕ | | |
| Scheduling Support | ⊕ | ⊕ | ⊕ | | | ⊕ | ⊕ | ⊕ | |
| Coordinator Support | | ⊕ | | | | ⊕ | ⊕ | | |
| Patient Education | ⊕ | ⊕ | ⊕ | | | | ⊕ | ⊕ | |
| Privacy | ⊕ | ⊕ | | | ⊕ | ⊕ | ⊕ | | |
| Temperature | | ⊕ | | | | | ⊕ | | |
| Facilitating Décor | ⊕ | ⊕ | | | | ⊕ | ⊕ | | |
| ***Use Quality Attributes*** | | | | | | | | | |
| Patient Focus | ⊕ | | | ⊕ | ⊕ | | ⊕ | | |
| Consultant Telepresence | ⊕ | ⊕ | | | | | | | |
| Adaptability | ⊕ | ⊕ | | | | | ⊕ | | |
| Staff Training | ⊕ | ⊕ | | | ⊕ | | ⊕ | | |

Though much can be done before the encounter, it is up to the providers to provide patient care during the encounter. This may require physicians to adapt or modify the extent or nature of their service to provide maximum effectiveness, within given capability constraints.

*"You do exams in a little bit different way… you have to learn how to think before the exam how you are going to structure it because you want it to flow and its got to be just a little bit different than with the standard medical exam just because of the fact that you are not in the room with the patient...  The second thing is you know you have to probably do some dry runs of your exam."*

Per the results of this study, providing patient care also requires the consulting provider to strive for ubiquitous presence (i.e. "telepresence"):

*"You have to learn how to interact with the patients in a different way; I think that there is a way to interact over the TV that makes people feel at ease… You have to make the patient feel comfortable, not let him be intimidated.  They are already intimidated by seeing a doctor.  You have to smile at them, acknowledge that the TV is there, and perhaps say something to make the patient feel at ease and then you can go on and do your exam."*

The means to control "telepresence" seem to be a function of both interpersonal skills and camera placement (create the image of virtual "eye contact"and patient focus).

## RESEARCH CONCLUSIONS AND FUTURE DIRECTIONS

Our research promotes the investigation and adoption of domain-relevant quality models to a variety of IS environments and sets the stage for theory building regarding technical service encounters. This research indicates a telemedicine encounter is an orchestrated process, which involves multiple players and multiple points of responsible action to facilitate success.

The principal contribution of this paper is an organized model of quality attributes for a medical video conferencing system and indications of opportunities to control these attributes. Practice may use this model as a means to recognize and assess telemedicine quality standards, contemplate requirements, and enact control directives. The research goal of informing telemedicine practice of this model to improve the design and implementation of real telemedicine systems is being achieved. Practitioners are making use of the developed model by introducing and or revising training programs and telemedicine encounter protocols. As well, participants in this study indicated the model provides a common framework of terminology for communication purposes. Future research could further process design by:

- Focusing on how the control of the quality of telemedicine service encounters is achieved, given the multiple, disparate sources and points of control.
- Investigating the patient perspective and organizational perspective of a telemedicine encounter may build on this initial study to further multi-faceted understanding of this phenomenon.
- Assessing the relative importance of the attributes to most effectively utilize the model and focus attention, particularly in earlier stages of adoption and when balancing quality control efforts under the auspice of contextual constraints (e.g. budget constraints).

Additionally, this research provides the foundation for further construct development and highlights quality attributes (social/human as well as technical) to be considered in studies that test relationships among quality constructs and with telemedicine outcomes. Future research could use this model in developing measurement instruments related to medical teleconferencing quality to assess the impact of these quality attributes on the various dimensions of telemedicine success.

In summary, telemedicine does introduce change to the traditional process of health care delivery. An understanding of the factors of quality and opportunities for control can help the change process as well as the on-going management of telemedicine encounters.

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