Telemedicine Encounter Quality: Comparing Patient and Provider Perspectives of a Socio-Technical System

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Abstract

The effectiveness of the telemedicine encounter is dependent on the use of state-of-the-art technology and the quality of the technology-based interactions. We take a socio-technical approach to understanding quality during telemedicine encounters. This approach has not been well studied in telemedicine service encounter research. To enrich understanding, we use a multi-method (direct observation, interview, focus group, survey) field study to collect and interpret a rich set of data. We conduct this study from two perspectives. First, we focus on the perceptions of the medical providers (e.g. physicians) who directly use the technology and are accountable for patient care. We then compare provider perspectives to those of patients, who act as indirect users of telemedicine technology and are the ultimate consumers of health care services provided via telemedicine. The result of this field study is a comparative framework of quality attributes for telemedicine service encounters that prioritizes the attributes from the provider and patient perspectives.

1. Introduction

"Quality is a fundamental challenge in our ever changing society, particularly in the use of computers and networks by all of us and within all sectors of social and professional life" [1 p.1]. In health informatics, the quality of a system can have a significant impact on the health and well being of people dependent on it.

Telemedicine is one type of health care system that is used increasingly in many medical applications, including direct patient care exams. "Telemedicine involves the use of modern information technology, especially two-way interactive audio/video communications, computers, and telemetry, to deliver health services to remote patients and to facilitate information exchange between primary care physicians and specialists at some distances from each other" [2 p.2]. Advances in technology and changes in medical care delivery have enhanced the ability of telemedicine to fulfill its purpose and need to develop effective high quality telemedicine systems used in direct patient care exams.

Unfortunately, in assessing 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" [3 p.123]. There is a need to explore which telemedicine factors have constrained or limited telemedicine success.

Telemedicine systems have high criticality in that each encounter of use has the desired outcome of maintenance or improvement of human health. Research indicates it is imperative to understand quality to determine how to best manage service encounters if a service organization is to produce desired outcomes (e.g. satisfaction, loyalty, word of mouth, sales, and profitability) [4]. Service encounters are critical interactions between service providers and recipients that demonstrate an organization's capability to fulfill its mission and shape consumers' impressions of the organization [5, 6].

This research uses one instantiation of telemedicine, high bandwidth medical video conferencing, which is arguably the most demanding and complex form of telemedicine when deployed for direct patient care (see Figure 1). High bandwidth

medical video conferencing is now used frequently to connect patients (and perhaps supporting clinicians) at one medical location to consulting clinicians at other medical locations in the domains of dermatology, cardiology, speech pathology, physical therapy, wound care, neurology, drug screening, diabetic training, and psychiatry.

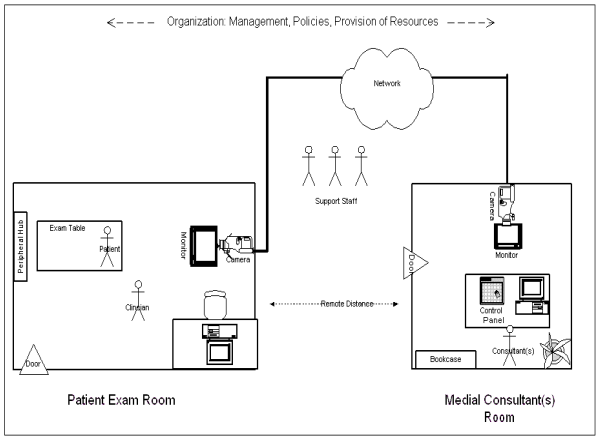


Figure 1. High bandwidth telemedicine service encounter (Adapted from LeRouge et al. [8])

1.1. Telemedicine encounter quality

To manage service encounters, it is necessary to understand both how the quality-generating resources should function (functional or process quality) as well as what result they should achieve for the consumer (outcome quality) [7]. The quality of technology-based service encounters can be thought of as the expected level of service provided by the company, technology, employee, and, to some degree, the customer (e.g. as direct or indirect user of the technology) to support the completion of a successful interaction/transaction. Telemedicine service encounters provide an interesting instance of the nexus of service providers, service recipients, the organization, and technology; as well as the means for providing care to an individual patient by the health organization over the life of the patient/organization association (see Figure 2). Hence, to effectively manage telemedicine as a means of delivering medical service, we must understand both:

- Functional quality, which addresses personnel, technology, physical environment, and customers acting as quality-generating resources in the telemedicine encounter process.
- Desired clinical encounter results including diagnostic accuracy, diagnostic impact, and therapeutic impact as well as other contributing success factors including patient and direct user (medical staff) satisfaction.

Health care standards (e.g. Joint Accreditation of Healthcare Organizations) and telecommunication/ information system standards (e.g. International Multimedia Telecommunications Consortium, Inc.) provide general guidance with respect to outcome quality. However, telemedicine research that provides generalized standards of functional quality that encompass the patient consultation experience are just beginning to emerge [8]. To address this need, this study focuses on functional quality associated with telemedicine encounters.

The functional view of quality takes into consideration the "unity of software including graphical user interface (GUI), the hardware, embedded systems for control and regulation of peripherally technical processes and for communication with other IS, and, last but not least, the associated social action system of persons, who are acting with the technology and other people" [9]. The recognition of technology-based service encounters as complex engagements of a socio-technical system is necessary to make significant progress in addressing challenges regarding encounter success in both research and practice. To date, there is limited research that focuses on technology-based encounters [10] and particularly on exploring social and technical dimensions of quality in this context. This is disappointing since health information systems researchers indicate that successful health care information systems will be those that: 1) match the health care environment with respect to technical, social, and organizational factors and 2) recognize the most important issue is the perception of key stakeholders [11].

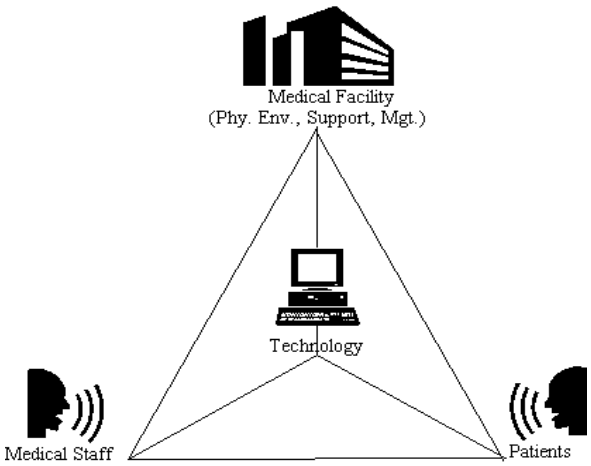


Figure 2. Telemedicine service encounter roles (Adapted from Bitner et al. [4])

1.2. Stakeholder perspectives

Quality within the telemedicine context requires recognition that quality cannot be expressed in a singular vernacular and no perspective alone provides a complete definition. The patient and medical providers serve as key participants throughout the encounter process. The patient and provider may have differing perspectives of the system (and perhaps quality) as they work toward achieving multiple outcomes.

The provider perspective elucidates insight from the central figure of responsibility and encounter activity. Past research has demonstrated health-care professionals have unique characteristics as a user group, which may impact the nature and propriety of commonly proposed antecedents to success in the telemedicine context [12].

The patient perspective is needed from a business perspective. Researchers note that improving quality perceptions can help a healthcare organization attract new customers and increase the number of repeat customers and even small increases can have dramatic effects on profits [13].

Collective exploration of multiple viewpoints is critical to success when high-quality products and services are a goal.

1.3. Research purpose

Quality attributes are not universal, but are context specific and perhaps specific to stakeholder group. The purpose of this research is to decompose the telemedicine system quality construct in the form of a quality model from the perspectives of both providers and patients. Investigating high-end video conferencing systems used for direct patient care should result in a comprehensive model that encompasses the relevant attributes for less critical contexts.

The quality model will provide research with an organized set of characteristics (attributes) and the relationships among them forming a foundation for specifying telemedicine quality requirements and evaluating quality. Furthermore, such a model identifies the variables necessary to methodically study the telemedicine process and develop associated research tools.

For practitioners, explicit representation of the quality attributes of technology-based systems from the perspectives of both patients and providers provides insights essential to implementation, utilization, and common understanding. 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.

Thus, we address the following research questions:

- What quality attributes contribute to telemedicine encounter success from the provider perspective? Patient perspective?
- Are there differences in relative importance among attributes from the perspective of patients? Providers? If so, which attributes are considered most important to encounter success by each group?
- Do the quality perspectives of various users (patients and medical providers) differ? If so, where do these perspectives converge and diverge?

2. Research methodology

We adapt the process framework introduced by Kanellis et al. [14, 15] (see Figure 3) using Klein and Myers' principles for interpretive research as guidelines [16] in the design and execution of this study. The Principle of Interaction between the Researchers and the Subjects for qualitative studies indicates that "the participants, just as much as the researchers, can be seen as interpreters and analysts" [16 p.74]. We highlight the role of telemedicine stakeholders as interpreters and analysts in Figure 3 (gray boxes).

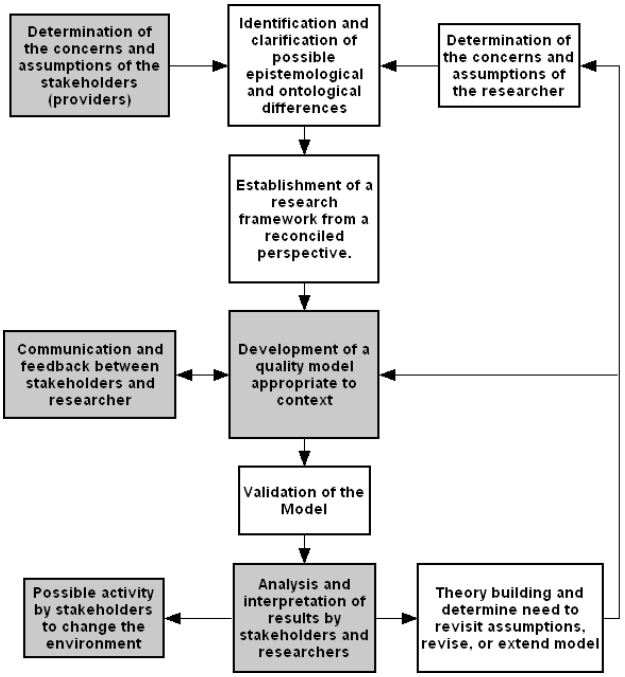


Figure 2. Evaluation of telemedicine encounter quality (Adapted from Kanellis et al. [15])

2.1. Dimensional framework

An adaptation of the respecified DeLone and McLean IS Success Model [17], which supports a socio-technical analysis of systems and acknowledges quality as an antecedent to success, is used in this research to guide theory building. The Telemedicine Service Encounter Relationships model (see Figure 2) implies that medical video conferencing is essentially a communication system used for virtual collaboration to deliver medical care. Constructs in the DeLone and McLean model (service quality, system quality, information quality, use, user satisfaction, individual impact, and organizational impact) reflect the communication system levels. Figure 4 represents the adapted version of the IS Success Model used for this study, with functional quality dimensions that parallel intended dimensions for the telemedicine quality model shaded.

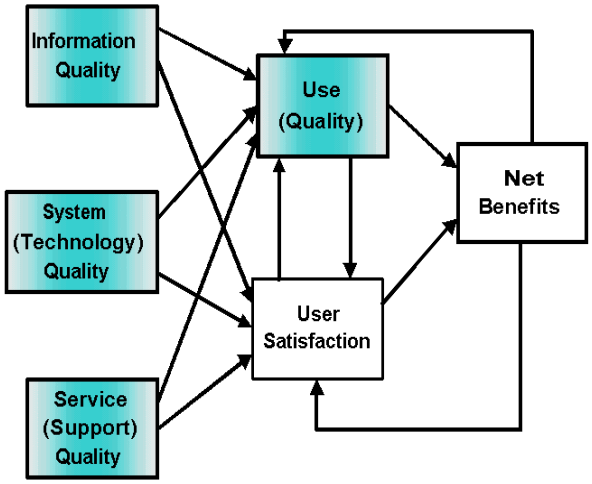


Figure 4: Reformulated IS success model (Adapted from DeLone and McLean [17])

In keeping with the need for contextual specification, the definitions of the quality dimension constructs used for this study have been refined to reflect the concerns and assumptions of stakeholders (providers) based on:

- Direct observation (40 hours) of medical video conferencing rooms, functional equipment, and videoconference sessions for representations of quality attributes and issues
- Review of archived video and photographic images of telemedicine encounters and rooms
- Open-ended survey of 84 telemedicine patients
- Unstructured interviews with an originator of the model as well as telemedicine researchers inside and outside of the United States

Following are definitions of the dimensions of functional quality reflecting both the stakeholder and researcher concerns and assumptions that we use to inspire and organize inquiry into specific telemedicine encounter quality attributes.

System (Technology) Quality - In this study, technology quality attributes are those features of medical video conferencing equipment and telecommunication processes utilized for medical video conferencing encounters.

Information Quality - In a telemedicine encounter, information quality specifically includes the characteristics of information that allow the participants to take appropriate action concerning patient care and facilitate diagnosis. Telemedicine information quality attributes should include attributes that facilitate capturing appropriate input for collaborative communication (e.g. aspects of the physical environment) as well as providing appropriate technology transmission output.

Support (Service) Quality - We address service quality from the perspective of the support provided for use of a telemedicine system during the encounter used in information systems literature, which is most appropriate to the purpose of this study and consistent with the IS domain. In looking at the telemedicine system, service quality can be defined as *the human infrastructure and physical environment provided by the organization that support user comfort and system use*.

Use Quality - Given the nature of this study and current concerns regarding the use construct among the IS community [18], it is our position that use quality, rather than a generalized definition of use has the greatest impact on net benefits in the telemedicine context and that a standard of use must be upheld for a successful encounter. Use quality synergizes technology with process and cognitive ability. 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*.

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 [19, 20]. 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 the context and

from understanding the concerns of the stakeholder groups [21].

2.2. Attribute identification and importance

Iterative data collection and interpretation was used to develop a detailed understanding of the interdependent meaning of each dimension of quality through the specification of quality attributes. Detailed research procedures reflecting the adapted framework are presented in Table 1. Specifically, we used direct observation, expert panel interviews (including telemedicine clinicians, administrators, support personnel, researchers), and validating survey to elucidate the provider perspective. To parallel, we used open-ended survey, focus groups (expertise derived from collective assessment of sporadic encounters), to elucidate patient perspectives. The model validating surveys completed by both groups also served to collect data related to the perceived importance of each attribute identified by each respective stakeholder group.

Table 1. Research design

Research Step from Field Study Model	*Research Methods and Procedures in Multi-method Approach*
Determination of the concerns and perceptions of the researcher	• Evolved through personal insight and awareness of IS, telemedicine, software engineering, quality, health informatics and marketing literatures.
Concerns and assumptions of the stakeholders (providers)	• Direct observation • Open-ended patient survey • Unstructured interviews • Secondary data (e.g. archived telemedicine video) review
Identification and clarification of any possible epistemological differences	• Reconciliation of concerns and assumptions in cooperation with stakeholders.
Establishment of a research framework from a reconciled perspective	• Identification and adaptation of suitable success model congruent with reconciled perspective
Development of a quality model appropriate to context	• Expert-panel interviews • Patient focus groups • Researcher coding and analysis of expert panel interview and focus group transcripts. • Mapping of constructs to research framework.
Communication and feedback between stakeholders and researcher	• Telemedicine stakeholders participation in research design process (e.g. review of questions and protocols) • Stakeholder participation in focus group moderation • Probes during the focus group and interview inquiry process. • Stakeholder interpretive development of quality attribute codes from provider expert panel and patient focus group transcripts
Validation of quality model	• Validating survey to expert-panel members • Validating survey to focus group members • Comparison of stakeholder interpretation of quality attributes to researcher interpretation
Analysis and interpretation of results by stakeholders and researchers	• Interpretive analysis of focus group and expert panel data by stakeholders. • Interpretive analysis of focus group and expert panel data by researchers. • Delphi panel to assess control opportunities. • Stakeholder reviews of research results with researchers to inspire action in practice.
Possible activity by stakeholders to change the environment	• Possible development/modification of telemedicine protocols • Possible development/modification of patient education literature • Possible development/modification of telemedicine training process
Conclusions, theory building and determine of need to revisit assumptions or revise or extend model.	• Expressed through conclusions, limitations, and future work.

3. Discussion of results

The research results of this study are tri-fold: (1) the telemedicine service encounter quality model, (2) identification of the differences between patient and provider in which quality attributes are identified, and (3) understanding what aspects of the telemedicine service encounter are more important to each perspective.

Effects of the research design developed for this study may also be considered results. The goals of integrating practicing stakeholder analysis and interpretation at multiple stages in the research process included expanding the depth of research insight as well as enriching the relevance of this study. It seems both goals have been achieved. Stakeholder efforts to change the telemedicine environment can indicate relevance. Activities by organizations participating in this study to change the telemedicine environment include the development of patient orientation materials, provider training content, and strategic planning guidelines based upon data from this study.

3.1. Telemedicine service encounter quality model

We present the resulting model in Appendix A. A full presentation of the model can be found in [22]. The comparative model embodies the complexity of technology-based service encounters and differences in the attribute list identified by each stakeholder group. The range of attributes identified by both patients and providers attests to the need for socio-technical conceptualization of the telemedicine encounter phenomenon by both research and practice when considering the provider perspective, patient perspective, or both.

We find many commonalities in identified functional quality attributes among all dimensions of quality (technology quality, use quality, information quality, and use quality) between patients and providers. However, differences were noted. We look to role theory to explain the differences indicated by each group. There are two viewpoints of roles in this context – user roles and consumer/professional service provider roles. Telemedicine providers (e.g. medical staff) act as the "front line" and direct users in staging and executing the encounter. Providers, as direct users, singularly identified (or escalated the importance of) some attributes of encounter quality that may not be readily apparent to consumers of medical care who are only indirect users of technology. Likewise, provider identification of some single-group attributes may be attributed to their in-depth understanding of the factors necessary to address the clinical need of the patient.

Conversely, the patient acting as indirect user of the technology is somewhat of an independent observer to the orchestration and actions of direct users (e.g. clinicians in the room with the patient and remote consultants) and seems to note issues not readily observable by those engaged in direct use of the technology and leading the communication process. Furthermore, in their role as consumers of medical services, patients may be more attuned to facility and human factors in forming their perceptions of quality since it is extremely difficult for health care consumers to gauge clinical outcomes given their lack of expertise [13].

3.2. Differences in quality attribute perspectives

To elaborate on the differences between groups, we further discuss single-group attributes (attributes identified by only one group) and differences in the perceived importance of attributes. We find 15 single-group attributes in the model. We address each of the single group attributes in the context of the quality dimension they were mapped to.

System (Technology) Quality - Providers identified all single group attributes related to technology quality. Providers solely identified technology attributes (specifically interoperability, rational design, convenience, and security), which would be most apparent to direct users. In fact, these attributes may be "hidden" from the patient, indirect user. Given that patient personal information is at stake, it is of some surprise that patients did not also identify concerns regarding security. It would seem such factors such as HIPPA regulations prompt the inclusion of security by providers. We speculate patient omission of this attribute may be perhaps attributed to a lack of understanding of potential security infringements or conversely feelings of exposure of self and information for viewing and discussion that may during the course of any medical exam.

Information Quality - Providers, as medical caregivers, identified the attributes of room layout and adequate space which impact their ability to provide service. Patients, as consumers, may not be aware of the importance of these items to the medical care process. Patients singly identified system feedback to patient, which may indicate a desire for participation and assurance in the exam process.

Service (Support) Quality – Coordinator support is the only support quality attribute singly identified. As indirect users, patients may not interact with a

telemedicine coordinator and furthermore may be unaware of the orchestration and management necessary to provide telemedicine.

Use Quality - Patients in their role as consumers singly identified use quality attributes, which emphasized the service they would expect of any medical exam (i.e. clear future directives and professionalism in room). Furthermore, patients identified attributes that would provide more "consumer comfort" (i.e. conveys access/review of patient records and mix with in-person exams). Finally, as independent observers of team interactions, medical team coordination may be more apparent to patients then to those engaging in the coordination process.

In looking at provider and in particular the consulting clinician (often a doctor), as the person in-charge of conducting the exam and having to change work processes, it is logical that providers would be able to identify the need for adaptability. The mention of this attribute seems to provide some indication that the ultimate objective is that patients perceive no change or detriment to the care that would be provided in an in-person exam process.

In order to explore more fully the nature of these differences, we discuss how patients and providers rank the importance of the quality attributes.

3.3. Assessment of attribute importance

An understanding of the importance of individual attributes can facilitate the creation and interpretation of formative measures for each dimension of telemedicine quality as well as provide guidance in balancing situational constraints in quality management efforts. Moreover, assessments of importance further illuminate commonalities and differences between patient and provider perspectives.

As with the range of attributes identified by both patients and providers, the importance assessment of individual attributes attests to the need for socio-technical conceptualization of the telemedicine encounter phenomenon by both research and practice (see Appendix B). It is of note that the "top" attributes (mean above 3.5 on a four point scale) for both groups contain both social (e.g. professionalism – clinician in room for patients and coordinator support for providers) and technical attributes (e.g. peripheral sophistication for patients and interoperability for providers). However, aside from audio clarity and image resolution, which seems to designate the fundamentals needed to engage in this communication process, the mix of "top" attributes is clearly different for patients and providers. Each group included attributes unique to their group in their "top" listing (e.g. team coordination and clear future directives for patients – interoperability and coordinator support for providers). Furthermore, each group's "top" attribute seems to reflect why they are engaging in this technology service encounter. Patients want instructions and guidance regarding their health provided via a means that addresses the challenges of distance. Providers want to provide reliable service via distance.

For the most part, physical environment attributes seem to be on the lower end (under 3 points on a four point scale) for both groups (e.g. facilitating décor and suitable temperature). It seems both groups recognize comfort is desirable but may be willing to sacrifice some comfort to gain telemedicine conveniences.

By comparing the differences in how patients and providers rank the quality attributes in importance, we see that patients' rankings evidence a central concern for how information about their health is communicated to them at a distance, while providers' rankings show a focus on the reliability of the health service they provide via telemedicine. Differences in importance distributions reiterate the result that patients' and providers' view of the telemedicine system is distinct, and based on whether they are indirect or direct users of the system. The differences between patient and provider perspectives in which quality attributes are identified and their relative importance underscores the need to measure the quality perceptions of both groups.

4. Conclusions and future directions

This research indicates a telemedicine encounter is an orchestrated process with a complex list of quality requirements spanning across technology, physical environment and human resources. The principal contribution of this paper is an organized model of quality attributes for a medical video conferencing system that compares and contrasts the perspective of key telemedicine encounter stakeholders to further understand telemedicine encounter success. This study shows that though there is common ground regarding functional quality among the principles participating in the encounter process (e.g. patients and providers), each of these constituencies perceives quality from a unique vantage in fulfilling roles that seems to introduce differences in perception.

Furthermore, this study provides research with a specified articulation of the use quality construct. Additionally, the research process itself may be considered a contribution. Research designs, such as the one operationalized in this study, emphasize that

relevance can be enhanced and meaning enriched by involving practitioners in rigorous research efforts.

This model provides practice with an organized representation of fundamental knowledge required to manage telemedicine services and create measures to monitor appropriate progress over time and ultimately to facilitate telemedicine success as indicated by clinical, profit-orientated, or other outcomes.

This research provides the foundation for further construct and theory development. The model also highlights formative measures (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.

Effort are underway to expand this study by : 1) determining control factors (entity most in control and when attribute is most controllable during the encounter process) related to each of the quality attributes and 2) broadening this U.S. based study to other countries to determine the need to adapt the model in light of cultural and information technology infrastructure differences.

5. References

[1] J. McCall, P. Richards, and G. Walters, "Factors in Software Quality," US Rome Air Development Center Reports NITS AD/A-049 014, 015, 055, 1977.

[2] A. Darkins and M. Carey, Telemedicine and Telehealth. New York, NY: Springer Publishing Company, 2000.

[3] J. Grigsby and J. Sanders, "Telemedicine: Where it is and Where it is Going," Annals of Internal Medicine, vol. 129, pp. 123-127, 1998.

[4] M. J. Bitner, S. W. Brown, and M. L. Meuter, "Technology Infusion in Service Encounters," Journal of the Academy of Marketing Science, vol. 28, pp. 138-149, 2000.

[5] K. F. Winsted, "The Service Experience in Two Cultures: A Behavioral Perspective," Journal of Retailing, vol. 73, pp. 337-360, 1997.

[6] M. J. Bitner, B. H. Booms, and L. A. Mohr, "Critical Service Encounters - the Employees Viewpoint," Journal of Marketing, vol. 58, pp. 95-106, 1994.

[7] C. Gronroos, "The Perceived Service Quality Concept - A Mistake?," Managing Service Quality, vol. 11, pp. 150, 2001.

[8] C. LeRouge, M. Garfield, and A. Hevner, "Quality Attributes in Telemedicine Video Conferencing," presented at Hawaii International Conference on System Sciences, Big Island, HI, 2002.

[9] J. S. Magenheim, "Deconstruction of Socio-technical Information Systems with Virtual Exploration Environments as a Method of Teaching Informatics," presented at 2001 World Conference on Educational Multimedia, Hypermedia, & Telecommunications, Tampere, Finland, 2001.

[10] M. L. Meuter, A. L. Ostrom, R. I. Roundtree, and M. J. Bitner, "Self-Service Technologies: Understanding Customer Satisfaction with Technology-Based Service Encounters," Journal of Marketing, vol. 64, pp. 50-64, 2000.

[11] R. Heeks, D. Mundy, and A. Salazar, "Understanding Success and Failure of Healthcare Information Systems," in Healthcare Information Systems: Challenges of the New Millennium, A. Armoni, Ed. Hershey, PA: Idea Group Publishing, 1999.

[12] P. Hu, P. Chau, O. Sheng, and K. Tam, "Examining the Technology Acceptance Model Using Physician Acceptance of Telemedicine Technology," Journal of Management Information Systems, vol. 16, pp. 91-112, 1999.

[13] S. L. Oswald, D. E. Turner, R. L. Snipes, and D. Butler, "Quality Determinants and Hospital Satisfaction," Marketing Health Services, vol. 18, pp. 19, 1998.

[14] P. Kanellis, M. Lycett, and R. Paul, "An Interpretive Approach to the Measurement of Information Systems Success: From Concept to Practical Application," in Information Systems Success Measurement, E. J. Garrity and G. L. Sanders, Eds. Hershey, PA: Idea Group Publishing, 1998, pp. 133-149.

[15] P. Kanellis, M. Lycett, and R. J. Paul, "Evaluating business information systems fit: from concept to practical application," European Journal of Information Systems, vol. 8, pp. 65-76, 1999.

[16] H. Klein and M. Myers, "A Set of Principles for Conducting and Evaluating Interpretative Field Studies in Information Systems," MIS Quarterly, vol. 23, pp. 67-93, 1999.

[17] W. H. DeLone and E. R. McLean, "Information Success Revisited," presented at Hawaii International Conference on System Sciences, Big Island, 2002.

[18] P. B. Seddon, "A Respecification and Extension of the DeLone and McLean Model of IS Success," Information Systems Research, vol. 8, pp. 240-253, 1997.

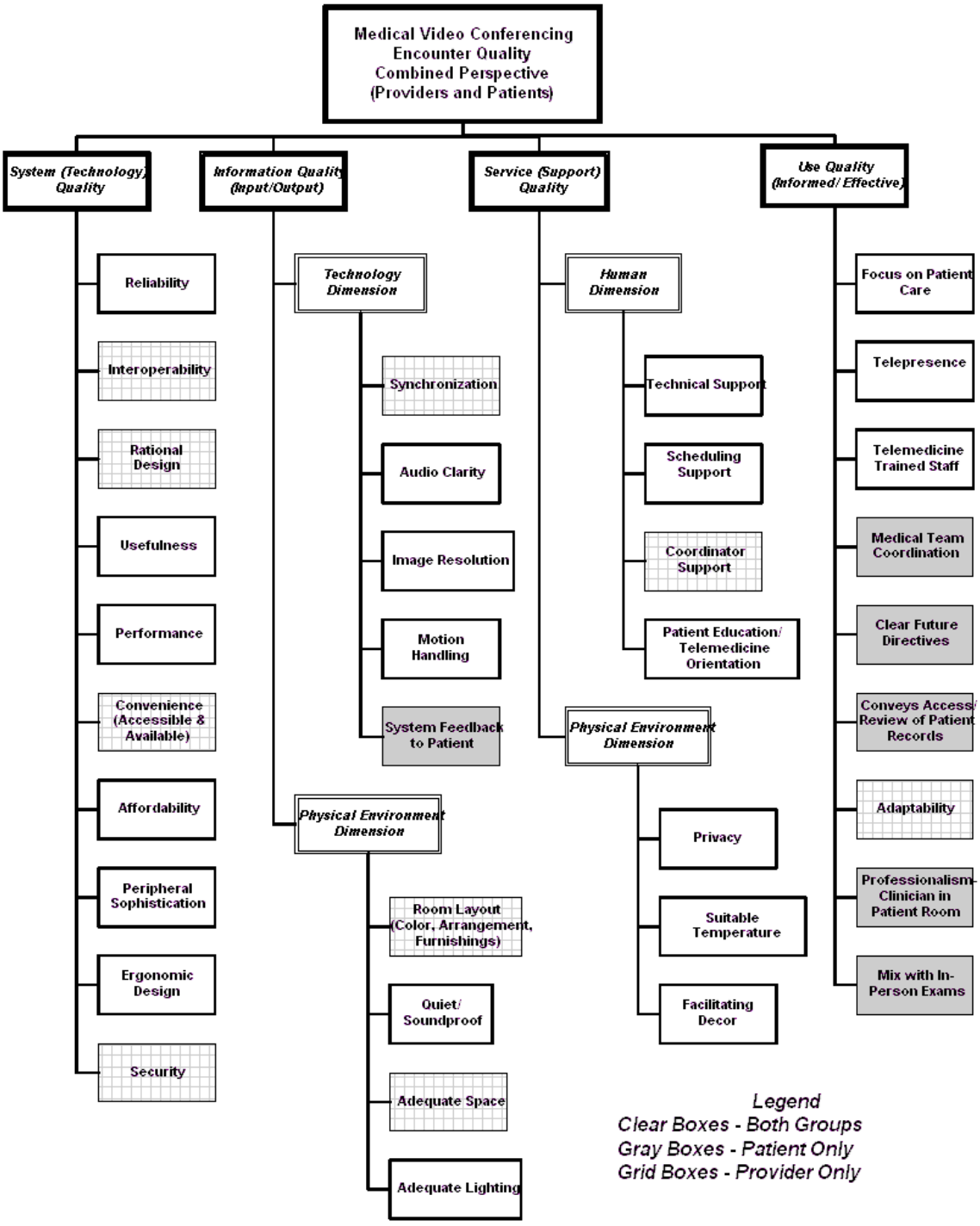
[19] A. Rai, S. S. Lang, and R. B. Welker, "Assessing the Validity of IS Success Models: An Empirical Test and Theoretical Analysis," Information Systems Research, vol. 13, pp. 50-69, 2002.

[20] J. Jiang and G. Klein, "User Evaluation of Information Systems: By System Typology," IEEE Transactions on Engineering Management, vol. 29, pp. 111-116, 1999.

[21] D. Stamoulis, P. Kanellis, and D. Martakos, "An Approach and Model for Assessing the Business Value of E- banking Distribution Channels: Evaluation as Communication," International Journal of Information Management, vol. 22, pp. 247-261, 2002.

[22] C. LeRouge, Assessing the Quality of Telemedicine Systems: High Technology Service Encounters, Doctoral Dissertation, Information Systems, University of South Florida, May 2003.

Appendix A. Telemedicine Service Encounter Quality Model



Appendix B. Results of Validation Process: Ranking of Attributes

Ranked according to highest mean, then lowest standard deviation

Patients			Providers		
Quality Attribute	**Patient Mean**	**Patient SD**	**Quality Attribute**	**Provider Mean**	**Provider SD**
Clear Future Directives	3.762	0.700	Reliability	3.917	0.289
Audio Clarity	3.714	0.463	Audio Clarity	3.750	0.452
Telemedicine Trained Staff	3.619	0.498	Technical Support	3.667	0.492
Peripheral Sophistication	3.619	0.740	Image Resolution	3.583	0.515
Medical Team Coordination	3.571	0.507	Synchronization	3.583	0.515
Image Resolution	3.571	0.598	Interoperability	3.583	0.669
Professionalism Ğ Clinician in Room	3.524	0.512	Coordinator Support	3.583	0.793
Patient Education/Telemedicine Orientation	3.524	0.512	Focus on Patient Care	3.500	0.522
Conveys Access/Review of Medical Records	3.524	0.602	Motion Handling	3.500	0.522
Consultant Telepresence	3.476	0.512	Usefulness	3.417	0.515
Adequate Lighting	3.429	0.676	Scheduling Support	3.417	0.669
Scheduling Support	3.381	0.498	Consultant Telepresence	3.333	0.492
Technical Support	3.381	0.590	Adaptability	3.333	0.492
Reliability	3.381	0.865	Adequate Lighting	3.333	0.651
Focus on Patient Care	3.333	0.483	Telemedicine-Trained Staff	3.333	0.651
Privacy	3.286	0.644	Privacy	3.333	0.651
Usefulness	3.286	0.717	Rational Design	3.333	0.651
Affordability	3.263	0.806	Patient Education/Telemedicine Orientation	3.333	0.778
Quiet/Soundproof	3.190	0.814	Performance	3.167	0.577
Motion Handling	3.095	0.625	Quiet/Soundproof	3.167	0.718
Mix with In-Person Exams	3.050	0.510	Affordability	3.083	0.669
			Convenience	3.083	0.900
Ergonomic Design	3.000	0.707	Room Layout	3.000	0.426
System Feedback to Patient	2.810	1.123	Peripheral Sophistication	3.000	0.739
Suitable Temperature	2.619	0.590	Ergonomic Design	2.917	0.515
Facilitating D□cor	2.476	0.814	Adequate Space	2.833	0.718
Performance	2.381	1.024	Security	2.750	0.754
Convenience	N/A	N/A	Facilitating D□cor	2.667	0.492
Coordinator Support	N/A	N/A	Suitable Temperature	2.583	0.669
Security	N/A	N/A	Clear Future Directives	N/A	N/A
Adequate Space	N/A	N/A	Team Coordination	N/A	N/A
Interoperability	N/A	N/A	Conveys Access/Review of Medical Records	N/A	N/A
Rational Design	N/A	N/A	Professionalism Ğ Clinician in Room	N/A	N/A
Synchronization	N/A	N/A	Mix with In-Person Exams	N/A	N/A
Adaptability	N/A	N/A	Room Layout	N/A	N/A
Room Layout	N/A	N/A	System Feedback to Patient	N/A	N/A