A conceptual model to evaluate service quality of Direct to-Consumer telemedicine consultation from patient perspective

Julie Preaux[1], Martí Casadesús[2], Merce Bernardo[3]

[1] University of Barcelona, Department of Business
[2] University of Girona, Department of Organization, Business Management and Product Design
[3] University of Barcelona, Department of Business

ABSTRACT

Objective and Background: *This research aims to develop a theoretical service quality model for Direct-to-Consumer (DTC) telemedicine consultations. Although it can change care delivery for the better, it is crucial to create the appropriate measurement tool to collect and analyze patient's perceptions of service quality to identify any service pitfall and encourage a faster adoption. To the best of the authors' knowledge, this paper is one of the first to investigate and propose a service quality model for DTC telemedicine consultations. This study is therefore motivated by a clear need for such a model as it is currently inexistant.* ***Method:*** *A literature review of health and e-service quality models was conducted to identify a suitable instrument for the research. A total of 60 studies were included.* ***Results:*** *The main findings are threefold: 1) DTC telemedicine service quality is interdisciplinary: it encompasses generic and context-specific dimensions from the health, e-service quality and information system literature; 2) The existing service quality models are not adequate, they do not cover all dimensions of DTC telemedicine services; 3) Although LeRouge et al. (2004)'s Telemedicine service encounter quality model was identified as a reference model, it is inadequate to simply transpose it to the context of the study. Thus, the elaboration of a more suitable instrument and creation of a new updated model by the authors. C****onclusion:*** *The conceptual model captures 3 primary dimensions (system quality, interaction quality and use quality) that represent service quality of DTC telemedicine consultations from a patient perspective.*

Keywords: Direct-to-Consumer (DTC) telemedicine, telemedicine, remote consultation, teleconsultation, service quality, quality dimensions.

INTRODUCTION

Direct-to-consumer telemedicine enables a patient to consult a doctor around-the-clock, in real-time, using a computer or mobile device. It is a rapid growing sector, predominantly led by private companies[33].
DTC telemedicine presents several potential benefits over traditional in-office consultations. On one hand, DTC telemedicine platforms offer the convenience of receiving care anytime and anywhere, the promptness and accessibility of care[77]. On the other hand, however, the absence of prior doctor/patient relationship, lack of medical care coordination and peripherical diagnostic tools, raise concerns about the quality of care and service[77,83]. Most articles on telemedicine service quality either focused on the technological aspects, clinical outcome**,** or patient/provider satisfaction[22]. However few studies focused on the quality attributes of remote consultations[55] and even fewer reviewed service quality with DTC telemedicine consultations. High service quality delivery is a driver of success, can lead to faster adoption and is pivotal to keep a sustainable advantage[68]. Quality has become increasingly predominant for many health sector stakeholders who understand that deficiency in healthcare delivery can lead to patient losses and negative economic impacts[71]. In the context of DTC telemedicine consultation, evaluating service quality is even more important that it is not only influenced by the doctors' skills but also impacted by the other different stakeholders involved, such as the patients, service management teams. To fill the void in previous studies, this research expands beyond the technological and clinical aspects by reviewing the literature on health and e-service quality, with an emphasis on the few articles that investigated service quality with e-health/teleconsultation. Thereby, this study aims to examine and capture the key quality attributes and propose a theoretical service quality model of DTC telemedicine consultations from a patient perspective. This article presents

the steps and results of an exploratory research in which existing e-SQ and health service quality studies are collected and summarized, in-depth analysis performed to develop a conceptual model that will serve as a framework for future empirical testing.

LITERATURE REVIEW

Define Direct-to-consumer telemedicine

Direct-to-customer (DTC) telemedicine is a subset of telemedicine[13]. At the heart of telemedicine is the will to provide medical care at distance using technology to profit patients[78]. The two domains share similarities; however, DTC telemedicine is distinct other forms of telemedicine. Healthcare was traditionally provided via face-to-face contact (e.g., a patient visiting a consultant's office). However, technology gradually modified the way care can be delivered using telecommunication. With the development of ICT, 4 main ICT health domains are currently shaping the scope of possibilities technology can offer to healthcare, namely, telemedicine, telehealth, e-health and m-health[13].
In order to fulfil the purpose of the present research it is important to clearly define the scope of DTC telemedicine that will be examined. A brief overview of each term is proposed here (see figure 1) followed by a more detailed presentation DTC telemedicine and what differentiates it from telemedicine.

- **Telemedicine** enables remote (mainly curative) health care delivery to patients and facilitate information exchange between health professionals[35,78]. **DTC telemedicine** is a subset of telemedicine, it is meant to treat low-acuity conditions and the patient initiate the care[62].
- **Telehealth** enables preventive and curative health care delivery, encompassing telemedicine's clinical services. It has also non-clinical applications: health research, administration and health education for health professionals[35,90].
- **E-health** encompasses telemedicine and telehealth services and enable the share, storage and retrieval of electronic health data. It also incorporates medical informatics, public health informatics and health promotion, information and education for the general public[34,36,66].
- **M-health** enables the self-collection, tracking, storage and transmission of personal health data. It is a subcategory of all previous health ICT domains when e-Health, telehealth and telemedicine services are provided via mobiles devices[34,40,61].

DTC telemedicine, a subset of telemedicine

DTC telemedicine is different from other types of telemedicine in several aspects: the medical conditions for which treatment is sought, where the treatment is taking place, the role of the patient and its relationship with the doctor.
In traditional telemedicine encounters, the healthcare provider will initiate the care after examining the patient. An example would be a patient visiting his general practitioner (GP) for mental health issues and the GP proposing telepsychiatry services as a treatment option. In contrast, in DTC telemedicine the patient initiates the care by contacting a medical provider with whom he has no previous pre-established relationship. The care initiation is driven by the patient. Furthermore, DTC telemedicine encounters will usually take place in the patient's home without any other physical presence. This is in contrast with telemedicine services which may require the patient to visit the hospital and to be assisted by a medical assistant during the encounter. Finally, medical conditions treated via DTC telemedicine are mainly low-acuity conditions, that is to say, acute, simple symptoms that do not require emergency medical treatment[62].
Those peculiar characteristics drive the need for the suggestion of a separate and proper definition of this subset of telemedicine. Thus, the authors propose the following definition of DTC telemedicine: *the delivery of health care services through the use of ICTs, where patients initiate the care and patients and healthcare professionals are separated by distance for the treatment of mainly low-acuity conditions*.

Figure 1
[34,35,89,90]

E-service quality (e-SQ) models

A review of the service quality (SQ) literature shows it is an abstract construct and can be defined as "*fitness for use*": "*An essential requirement of these products is that they meet the needs of those members of society who will actually use them. This concept of fitness for use is universal. It applies to all goods and services, without exception. The popular term for fitness for use is Quality, and our basic definition becomes: quality means fitness for use*"[47]. SERVQUAL is the best known and recognized scale to measure service quality. This instrument developed by Parasuraman et al. in 1988[67] consists of 5 dimensions (namely, tangibles, reliability, responsiveness, assurance, empathy) and was initially developed for offline, traditional, face to face services. Conversely, online or e-services are delivered over the internet. Instead of face-to-face interactions, customers are interacting with an interface and therefore it is highly advisable that companies carefully consider their website's design and functionalities as it will influence the customer evaluation of the overall service quality. The latter statements imply an inherent difference of online and offline service delivery settings, and thus, the necessity to rethink classical service quality theories[41]. As a result, the transposition of SERVQUAL to the online context was questioned[39] and several authors attempted to elaborate a more suitable instrument.

For instance, Loiacono et al. (2000)[57] created WebQualTM and uncovered 12 dimensions to define website quality. These include *informational fit-to-task, interactivity, trust, response time, ease of understanding, intuitive operations, visual appeal, innovativeness, flow/emotional appeal, consistent image, online completeness and better than alternative channels*.

Yoo and Donthu (2001)[93] developed SITEQUAL with four dimensions: *ease of use, aesthetic design, processing speed, and security*. The authors intentionally moved away from the pure assessment of site efficiency (e.g., web traffic, time per page) to measure website quality, thereby clearing the gap they identified in previous studies. Both WebQual and SITEQUAL were criticized for neglecting some important aspects of the online purchase or service experience. For example, it was argued the instruments omitted to investigate customer service, buying process or delivery issues, thus, failing to capture the complete web user online journey[51,69,88].

Another scale that measures the web service quality is Barnes and Vidgen (2002)'s Webqual[12]. The instrument name is similar to the one created by Loiacono et al. however they are two separate scales. Over two years the authors presented four different versions of their instrument[9–12]. The final version (WebQual 4.0)[12] is a five-dimension scale on 3 higher categories: usability (described by the *usability* and *design* dimensions refers the to design and user-friendliness of the website), information quality (encompasses the quality of the *information*: their pertinence, correctness and layout), finally service interaction quality (illustrated by the *trust* and *empathy* dimensions reflect how confident the user should feel when using or shopping on the site and how enjoyable the experience should be).

In 2003, Wolfinbarger and Gilly[88] developed eTailQ. The instrument is composed of 14 items and 4 dimensions, namely: *Fulfillment/Reliability* (products are accurately described and delivered as promised and on time), *Website design* (website features facilitating navigation, information gathering and order processes), *Privacy/Security* (secured payment and confidential sharing of information) and *Customer Service* (the company shows responsiveness, is helpful and provides timely solutions). The work of Wolfinbarger and Gilly was praised by Parasuraman et al. (2005)[69], while they also raised several concerns, for this comprehensiveness and the reliable results obtained for the reliability and security dimensions.

The creators of the notorious SERVQUAL argued simply adapting traditional service quality theories and measurement instruments to the online context may not be sufficient to capture the full essence of e-service quality[69]. For this reason, extensive researches were performed by the authors from 2000 till 2005 when they finally released their Web site's service quality scales, E-S-QUAL and E-RecS-QUAL. . E-S-QUAL is a four-dimensional e-core service quality scale (efficiency, fulfillment, system availability, privacy) composed of 22 times and is applicable to all web users. E-RecS-QUAL is a three-dimensional e-recovery service quality scale (responsiveness,

compensation, contact) with 11 items and is only applied when customers encountered service problems or had inquiries.
In 2006, Bauer et al. created eTransQual[14], an instrument that included the hedonic aspects of the online shopping experience. From their literature review, Bauer et al. noted many academics constructed their SQ measurement scale on functional and technical qualities, neglecting the hedonic/enjoyment aspects of online purchases. For the authors, it is an important omission. eTransQual combined two well-known scales, namely E-S-QUAL and eTailQ and added the hedonic aspects. eTransQual is composed of 25 items and 4 dimensions, namely: *reliability*, *responsiveness*, *process* and *enjoyment.*
In 2007 Cristobal et al.[26] developed PeSQ, a four-dimensional e-service quality scale. The first dimension, *Web design* relates to the layout, user-friendliness and content quality of the website. The second dimension, *Customer Service* encompasses all the personal attention, responsiveness, accuracy expected by the customer. It also refers to the Empathy dimensions in SERVQUAL 1988. The third dimensions, *Assurance* is connected to the web user's perception of the security, privacy and confidentiality the website is offering. The lack of it would be a major pitfall for the company. Finally, *Order Management* refers to the availability of the service/product. It is also similar to the Reliability dimension from SERVQUAL but in the online context.

Health service quality models

Traditional health service quality models

One of the first and widely applied model of Quality of care is the Donabedian's model[29]. In 1966, the authors identified a combination of three key elements to assess quality: the medical outcome, the process of care and the structure. The outcome aspect refers to the effectiveness of the treatment on the patient's health while the process aspect focuses on the technical and interpersonal skills of the healthcare provider. Finally, the structure aspect denotes the settings in which the care is given including the material resources but also the human resources[30,31].
Another widely adopted model to measure service quality in the health care context is the well-know SERVQUAL[67]. However, despite its broad application several authors argued SERVQUAL does not cover all dimensions of health care services. For example, in 1990 Carman[19] tested SERVQUAL in the context of acute hospital care and identified nine different factors, namely, *admission service, tangible accommodation, tangible food, tangible privacy, nursing care, explanation of treatment, access and courtesy afforded to visitors, discharge planning and patient accounting.*
In 1994, Bowers et al.[17] found that two important factors were not captured in SERVQUAL while two of Parasuraman et al.'s dimensions were not significant predictors of health service quality. Their results suggested *empathy, reliability, responsiveness, communication and caring* defined health care quality. To the authors, the patients' inability to assess the provider medical competences (technical quality) leads to the patients focusing on the provider human qualities while delivering health care (functional quality).
Another scale that measures health service quality is Zineldin (2006)[98]'s 5Qs model. The multi-dimensional instrument uncovered 5 dimensions: quality of object (technical quality), quality of process (functional quality), quality of infrastructure (human and technological hospital resources), quality of interaction (effective doctor/patient communication) and quality of atmosphere (pleasant, friendly hospital environment). The 5Qs model is a combination and an extension of Grönroos (1984)[43]'s model and SERVQUAL. The functional and technical quality model[43] is one of the first instrument that conceptualized perceived service quality. It is composed of three dimensions: the technical quality dimension (what service is delivered to the customer), the functional quality dimension (how the service is delivered to the customer) and the corporate image (how the customer sees the firm). To Zineldin, the 5Qs model is more comprehensive than SERVQUAL thanks to the incorporation of the infrastructure, atmosphere and interaction attributes.
Dagger et al. (2007)[27] investigated health service quality and its causality with satisfaction and behavioral intentions. The authors identified 4 primary dimensions, namely, *Interpersonal quality, technical quality, Environment quality and administrative quality*, further defined by 9 sub-dimensions: *interaction, relationship, outcome, expertise, atmosphere, tangibles, timeliness, operations, suppor*t.

Aagja and Garg (2010)[1] created PubHosQual to measure patient's perceived service quality for public hospitals. The instrument with four dimensions (*admission process, medical service, overall service, discharge process and social responsibility*) was tested among Indian patients who received treatment at a public hospital. Results from this study suggested PubHosQual uncovered important dimensions specific to the hospital context and that were not included in SERVQUAL, thus confirming the shortcoming of the model without modification when applied to health services.
More recently Sumaedi et al. (2016)[79] proposed the HSQ model, a hierarchical health service quality instrument, composed of 3 primary dimensions and 8 subdimensions: *Healthcare service outcome* (waiting time, medicine, effectiveness), *Healthcare service environment* (equipment condition, ambient condition) and *Healthcare service Interaction* (soft, hard interaction and expertise). In this model, service quality is viewed as a multi-level construct and encompasses the functional (interaction) and technical (outcome) dimensions identified by Grönroos (1984).

Those previous studies offer some support and can serve as a basis for the identification of dimensions for Direct-to-Consumer telemedicine consultations. However, those first fourteen models also suggest dimensions vary according to the context. Thus, as no study has yet investigated SQ in relation to DTC telemedicine, the next section will focus on models sharing similarities with the context of the research. Six service-specific models that investigated service quality with e-health/teleconsultation/telemedicine are described and discussed.

E-health services quality models

In 2010, Hadwich et al.[44] created an e-health services quality scale with an emphasis on the doctor-patient relationship. Through interviews with patients/physicians in Switzerland and a review of the service, e-service and healthcare quality models, the authors identified 3 primary dimensions, namely, *potential quality, process quality and outcome quality*, further defined by 13 sub-dimensions. It should be noted that the scope of e-health services is very broad and therefore the research goes beyond e-service quality with teleconsultations. The extend of e-healthcare services in the study is vast, from consulting health website to communicating with health and to using mobile/wireless devices to track and collect patients' data.
In 2013, Akter, et al.[4] developed a hierarchical service quality model of mobile health services, composed of 3 primary dimensions and 8 subdimensions (*system quality, interaction quality and information quality*). Due to the fragmented literature on the subject, their dimensions were initially extracted from the Information System (IS), healthcare literature and generic service quality theories. To validate and refine their conceptual model, they carried out a study in Bangladesh among users who had accessed medical care or information via a m-health platform. Mobile health enables the provision of care via mobile/wireless devices. There are similarities between m-health service and DTC telemedicine when the mobile is used to interact with a consultant[40].
In 2014, LeRouge et al.[55] proposed a hierarchical model to measure telemedicine service quality (medical video conferencing) from the patient perspective. The scale is based on an existing model extracted from the Information System literature: the Delone and Mclean Technology quality model[28]. The study was performed in the USA among patients who received telemedicine services in the past 3 months. As opposed to DTC telemedicine, the consultations are provided in hospital with the assistance of a technician who operates the medical instruments while the doctor receives and consults the images and results remotely.
Through interviews with patients and doctors, direct observations of telemedicine consultations and a survey, the model was refined to match the specific taxonomy of telemedicine consultations and focus on service quality.
The final instrument is composed of 26 items and 4 dimensions, namely: system, information, service and use quality attributes.
In terms of measuring service quality of teleconsultations, Xing et al., (2019)[91] developed a scale with 4 dimensions, namely, *reliability, responsiveness, assurance and empathy*. They adopted the SERVQUAL model and all 5 dimensions, but 1 were retained. The empirical study was conducted among patients using The Good Doctor website, the largest health consulting website in China. To the authors, the lack of physical environment in the

online context invalidates the incorporation of the tangibles dimension. This is arguable as the design of a website is a common, recurring e-dimension, present in many e-service quality scales.
Lu et al., (2020)[59] investigated teleconsultation service quality from a doctor's perspective and the research was conducted with Chinese regional doctors using teleconsultation services to seek medical advice from medical experts in a central hospital. Those doctor-to-doctor teleconsultations could be categorized as tele-expertise, a medical professional remotely solicit the opinion of another doctor colleague[15]. They proposed a hierarchical model composed of 4 dimensions, namely, *system quality, structure quality, interaction quality and outcomes quality* and 19 subdimensions. The authors argued teleconsultation share**s** similarities with mobile services and therefore developed their initial dimensions from a mobile and healthcare service quality literature review.
In 2020 and 2021, Verma et al.[85,86] adapted the well-known healthcare service quality 5Qs model developed by Zineldin to explore e-Healthcare service quality. They proposed a hierarchical model by adding subdimensions to Zineldin's 5 initial dimensions: *quality of object* (divided into overall and technical objectivity), *quality of process* (further defined by the functionality, timeliness and responsiveness subdimensions), quality of infrastructure (encompassing the technical, physical, organizational aspects of the infrastructure as well as the manpower skills), quality of interaction (split into the manner and timely interaction) and quality of atmosphere. In the study, the scope of e-healthcare services is not clearly indicated. From the questionnaire items and the characteristics of e-health services, we can deduct it could encompass the use of ICT by:
- the hospital staff to provide faster and better care to the patient by optimizing administrative tasks/communication between departments.
- the patient to self-register and pay online for treatments, access his medical records, communicate with doctors, as well as receiving appointments reminders, etc.

In order the develop the theoretical model, this study began by collecting and analyzing the main e-SQ and health service quality models. Through this process, the authors were unable to find a suitable model for their research due to the lack of consensus with regards to the dimensions, even less so in the field of DTC telemedicine. Therefore, to fulfil the objective of the research further analyses are required.

MATERIALS AND METHODS

The conceptual framework for this study has been developed through a literature review and identification of a reference model. Findings of this review led to the development of the conceptual model via a three-step process:
- Analysis of the proposed dimensions in 35 health and 25 e-service quality models
- Identification of a reference model to adapt, the LeRouge et al. (2014)'s Telemedicine service encounter quality model
- Development of the full conceptual service quality model for DTC telemedicine consultation

The 60 studies were extracted from well-known databases (see tables 1 and 2), Emerald Insight, EBSChost and Google Scholar. The authors also reviewed the bibliography of the articles they retrieved. No year restriction was applied however only articles aiming at developing either a generic or service-specific quality scale were including. The authors used the following searching keywords:
- website, e-service, online service quality, assessment or model or instrument, etc.
- service quality in health/hospital, health, health care, hospital service quality, assessment or model or instrument, etc.

In addition of the studies identified in the Literature review section, the authors limited the number of selected studies to the models that were consistently cited in previous health[37,65,82] and e-service quality[52,64,75] literature reviews.

Analysis

The contribution of the 25 e-service quality instruments review is threefold. First, it confirms there is no consensus on the number and nature of the dimensions. The number of dimensions varied from 3 to 15.
Secondly, it is manifest a number of common, recurring e-dimensions are used by web users when assessing e-services quality. The authors analyzed each study and propose the below dimensions as consistent:

- **Reliability/fulfillment**: Wolfinbarger and Gilly (2003); Santos (2003); Parasuraman et al. (2005); Kim et al. (2006); Sohn and Tadisina (2008).

- ***Responsiveness/Customer support***: Madu and Madu (2002); Parasuraman et al. (2005); Bauer et al. (2006), Cristobal et al. (2007); Blut et al. (2016).

- Usability/ease of use: Yoo and Donthu (2001); Barnes and Vidgen (2002); Yang et al. (2004); Long and McMellon (2004); Collier and Bienstock (2006).

- Web design: Kaynama and Black (2000); Szymanski and Hise (2000); Wolfinbarger and Gilly (2003); Lee and Lin (2005); Cristobal et al. (2007).

- : Loiacono et al. (2002), Barnes and Vidgen (2002); Gounaris et al. (2003, 2010); Collier and Bienstock (2006); Kim et al. (2006).

- Security/Privacy: Yoo and Donthu (2001); Santos (2003); Parasuraman et al. (2005); Connolly et al. (2010); Blut et al. (2016).

Finally, although several models share the same dimensions, it appears some dimensions are generic whereas others are service-specific (e.g., "production portfolio" (Yang and al., 2004) and "product variety", "credibility" (Jun and Cai., 2001) in online banking, "ethical conduct" (Hadwich et al., 2010) in the e-health sector). This mirrors the academics' orientation to add service-specific dimensions to their models to capture the unique characteristics of the studied industry[19,70].
The analysis and the literature review demonstrated it was inadequate to transpose traditional SQ measurement scales to the online context. Traditional SQ scales were developed for offline, face-to-face services, thus, the need to create separate e-service quality scales and distinct e-dimensions[69]. Still, although new e-dimensions were discovered it is evident e-services and traditional services share common dimensions. For example, the Reliability and Responsiveness dimensions are important dimensions both in the online and offline context. It is equality true for the Tangible dimension, although it is interpreted differently in the online context under the denomination Web design.

The systematic review of the 30 health service quality models also reveals there is no consensus on the number and nature of the dimensions.

The authors investigated the most used dimensions and identified that:

- **Tangibles** was cited in 14 models (46.67% of the studies), 12 times as a primary dimension, 2 times as a subdimension.
- **Reliability** was used in 14 models (46.67% of the studies), 10 times as a primary dimension, 4 times as a subdimension.
- **Responsiveness** was mentioned in 13 models (43.33% of the studies), 12 times as a primary dimension, 1 time as a subdimension.
- **Empathy** was utilized in 13 models (43.33% of the studies), 11 times as a primary dimension, 2 times as a subdimension.
- **Assurance** was employed in 9 models (30% of the studies), 8 times as a primary dimension, 1 time as a subdimension.

This indicates an overlap between health service dimensions and generic dimensions from the service quality literature, this can be attributed to the fact that SERVQUAL is the model that is commonly used. In the above counting, only the dimensions identically worded as in SERVQUAL were accounted for. This mirrors the results obtained by Iram et al. (2019)[37] in their systematic review of the dimensions of service quality in healthcare: within the 74 selected studies, 30 of them used the RATER model. While SERVQUAL is the most commonly used scale to measure health service quality, it is important to note only 4 out of the 30 studies have used SERVQUAL without modification (addition and/or removal, reformulation of dimensions). This reflects the criticisms against SERVQUAL to cautiously use the model in the healthcare context. For instance, Abuosi et al. (2013)[2] retained the reliably, tangibles dimensions but merged "responsiveness" and "assurance" into "prompt attention" and added a new dimensions "access". **Access/Accessibility** is also a recurrent contributing factor of service quality in the studies: cited in 7 models (23.33% of the studies). When SERVQUAL is not the reference model, the service quality studies have mainly focused on extensions of the Nordic model (Grönroos) with the presence of all or some of the below dimensions:

- **Environment (structure) quality**: environment used 6 times, structure/infrastructure 5 times and atmosphere 3 times. (46.67% of the studies).
- **Interaction (interpersonal) quality**: interaction cited 7 times, interpersonal 2 times, communication 3 times and relationship 2 times. (46.67% of the studies).
- **Outcome (technical) quality**: outcome applied 7 times and technical 5 times. (40% of the studies).
- **Process (functional) quality**: process used 8 times and functional 2 times. (33.33% of the studies).

It is manifest academics adapt SERVQUAL or create new models to fit the particular medical context of their research. Some health service dimensions are generic while others can be specific to:

- The type of treatment: For example, when assessing hospital service quality (in/day-patient treatment), both Carman (1990) and Aagja and Garg (2010) identified "admission process" and "discharge process" as important factors.
- The treatment delivery type: In terms of e-health service quality instrument, new dimensions extracted from the IS literature appear. Out of the 6 models related to e-health, 3 of them included the system quality dimensions (Akter, et al. (2013), LeRouge et al. (2014); Lu et al., (2020). There is also the appearance of e-service dimensions (e.g., security/privacy).

Findings from this study revealed DTC telemedicine service quality is interdisciplinary: it encompasses generic and context-specific dimensions from the health, e-service quality and information system literature. DTC is a technology-mediated service[38], technology enables a patient and doctor to virtually meet and communicate remotely. This emphasizes the importance of ICT technologies on DTC telemedicine, which will affect the patient's perceived service quality. For this reason, the authors suggest the use of specific dimensions from the IS and e-SQ literature to measure the Human/Technology interaction quality. However, DTC telemedicine cannot be seen as a self-service technology where the human interaction is completely non-existent. Thus, the authors also propose the use of health service quality dimensions to measure the quality of the physician/patient or human/human interpersonal exchange.

Table 1: Selected models on e-service quality
12,14,49,51,54,57,58,60,69,74,76,80,16,88,92,93,95,97,24–26,41,42,44,46

Table 2: Selected models on health service quality
1,2,20,21,23,27,29,30,32,44,45,48,4,50,53,55,56,59,63,72,73,79,81,5,84,86,87,91,94,98,6–8,17–19

LeRouge et al. (2014)'s framework, a reference model

The starting point of the proposed conceptual model was founded on LeRouge et al. (2014)[55]'s Telemedicine service encounter quality model. From the research findings, this model appears as the most suitable in the way that it combines the three relevant fields of research that help define service quality of DTC telemedicine consultation. Firstly, it incorporates key e-service quality dimensions (e.g., *reliability, service support)* to measure the telecommunication process quality. Furthermore, it outlines the importance of ICT technologies with the addition of dimensions (e.g., system quality) extracted from the IS literature. Lastly, it highlights the essential role of the physician in the care delivery via the use quality which echoes the process quality identified in the health service quality literature. The use quality dimension encompasses the operational characteristics, processes and practices to assure a successful system deployment and effective telemedicine encounter.
However, the differences in care delivery between telemedicine and DTC telemedicine, as illustrated in the Literature review section, suggest the need to adapt LeRouge et al. (2014) model.
First, it is apparent the type of medical conditions addressed by telemedicine will impact the conceptual model. In LeRouge et al.'s model, the system and information quality dimensions englobe the reliability of the telecommunication system but also the efficiency, technicity and maneuverability of peripherical devices (retinal camera, electrocardiogram) that enable the diagnosis/treatment of various medical conditions. In the context of the present study, with the lack of connected diagnostic tools, DTC telemedicine is meant to address simple and acute conditions. For this reason, the authors merged LeRouge et al.'s system and information quality dimension into a single dimension: system quality. While we agree system quality impact the perceived SQ, its scope, in the proposed conceptual model, is reduced to the website quality. This led to the inadequacy and dropout of all subdimensions related to the use of medical devices (*e.g., peripheral sophistication, ergonomic design*) and their replacement by subdimensions based on recurring website quality dimensions identified in the e-SQ literature.
Secondly, it is manifest the treatment location will require further adaptation. LeRouge et al. included several subdimensions to measure the environment quality. DTC telemedicine treatment being received exclusively remotely, all physical environment aspects will be disregarded (*facilitating decor, suitable temperature*) and interpreted differently in the online context under the denomination Web design.
Finally, the role of the patient and its relationship with the doctor call for additional adjustments. In LeRouge et al.'s model, the patient interacts with a variety of medical/administrative staff who can assist him before, during and after each treatment. The quality of those interactions is assessed under the service quality (e.g., *technical, scheduling support*) and use quality subdimensions (*e.g., medical team coordination, consultant telepresence*). In the context of the research, the patient will log into the DTC telemedicine platform, create a profile and wait for an available physician with whom he has no previous pre-established relationship[62]. The human-human interactions are solely between the patient and physician. Taking this into account, the authors reworded service quality into interaction quality, a recurring health service quality dimension. Furthermore, the use quality (operational characteristics, processes to assure an effective telemedicine encounter) will also differ from LeRouge et al.'s model to match what is expected from a DTC telemedicine platform (e.g., ease of use, waiting time, accessibility).

In the next section**,** the consultation service quality model in the context of DTC telemedicine will be presented.

Full conceptual service quality model for DTC telemedicine consultation

The proposed conceptual service quality model for DTC telemedicine consultation from a patient's perspective includes 3 primary dimensions and 12 sub-dimensions (see figure 2). The primary dimensions are: *system quality, interaction quality and use quality*. These dimensions consist of the following subdimensions (see table 3):

- *efficiency, reliability, security/privacy and web design*
- *reliably, responsiveness, assurance and empathy*
- *ease of use, waiting time, accessibility, information usefulness*

Figure 2

Table 3

System quality

The first dimension, system quality ~~(see table 3)~~ refers to the patient's perception of the website technology quality/characteristics enabling the telecommunication between the parties[28,55]. To measure system quality, 4 subdimensions, namely *efficiency, reliability, security/privacy and web design* were identified.

~~*Table 3*~~

Efficiency refers to the degree to which the DTC telemedicine platform is easy to access and provides fast loading, processing time to support information sharing (sound quality and image resolution). Previous studies suggested loading, search and navigation speed as important dimensions of e-service quality[69,74,93].

Reliability measures the degree to which the DTC telemedicine platform is dependable over time, functions as designed to perform the promised service accurately and consistently. It describes the stability and steadiness of an error-free system[3].

Security/privacy reflects the degree to which the DTC telemedicine platform is safe and protects the health information provided to and by the patients. Online customers may feel insecure or even afraid when sharing personal information on internet websites (Santos 2003, Wolfinbarger 2003). This applies to credit card information, but also private sensitive information, such as personal health information[3,4]

Website design describes the degree to which the DTC telemedicine platform is easy to use and aesthetic due to its clear layout and visually pleasing design. Web design is a new dimension that appeared in the e-service quality literature and greatly influences customer perceptions of their online experience[14,88].

Interaction quality

The second dimension, interaction quality refers to the patient's perceived quality of interaction with the doctor, divided into 4 subdimensions, *reliably, responsiveness, assurance and empathy*. For the interaction quality, the authors adopted the view of Xing et al. (2019)[91]and incorporated the SERVQUAL model ~~(see table 4).~~

~~*Table 4*~~

Reliability describes the patient's perception of the doctor delivering the promised service in an accurate and dependable manner. R*esponsiveness* refers to the patient's perception of the doctor being willing to assist and help him promptly. For the patient suffering from a medical condition**,** it is vital to receive error-free and consistent medical care. A sick patient also expects prompt support from their doctors to solve their problem and avoid treatment delay[2,81].

Assurance measures the patient's perception of the doctor inspiring confidence by demonstrating courtesy, expertise and ability. The last sub-dimension, *empathy* reflects the patient's perception of the doctor focusing on his best interest and showing personal attention. For patients, the perceived competence of a doctor is reassuring and makes them feel more secure about the quality of care. Additionally, persons seeking care can be distressed about their health condition, which is why demonstrating genuine care and personal attention is considered important[48,81].

Use quality

The last dimension, use quality refers to the patient's perceived efficient and informed usage of communication, service management and technology to achieve the desired outcome. In other words, how well the processes and standards put in place by the DTC telemedicine platform assure a successful utilization of the service[55] ~~(see~~

~~table 5).~~ For a better measurement, use quality is further divided into 4 subdimensions, *ease of use, waiting time, accessibility, information usefulness*.

~~Table 5~~

Ease of use is defined as the patient's perceived convenience while applying for the teleconsultation, being connected to a doctor and navigating the virtual consultation room thanks to the platform being intuitive and easy to understand and operate[57,96].The use of technology must benefit the medical performance as opposed to limit/refrain it[55].

Waiting time reflects the degree to which the DTC platform keeps the waiting time between applying for teleconsultation and being connected to a doctor to a minimum. In the healthcare service quality literature, the timeliness/waiting time to receive treatment is a recurring dimension that eases and enhances the medical care provision process and as a result, impacts the overall perceived service quality [27,59,86,98].

Accessibility describes the patient's perceived technical convenience of being able to reach a doctor whenever needed. It encompasses how the DTC telemedicine provider's service management skills allow the patient to receive treatment anytime and anywhere[96].

Information usefulness measures the patient's perceived quality of information received during the remote consultation. It encompasses how well the doctor provides clear information about the medical condition and adequately explains the needed treatment[5,98]. It describes the doctor's skills to provide guidance and give clear directives to the patient on what to do during and after the consultation[55].

~~Finally, the proposed conceptual service quality model for DTC telemedicine consultation from a patient's perspective includes 3 primary dimensions and 12 sub-dimensions (see figure 2).~~

~~*Figure 2*~~

DISCUSSION

The most important finding of this study was that DTC telemedicine service quality is interdisciplinary: it encompasses generic and context-specific dimensions from the health, e-service quality and information system literature. Since few studies examined service quality of remote consultation and even fewer focused on DTC telemedicine consultations, the starting point of the authors was to investigate the main e-service and health service quality models to find a suitable instrument in the context of their research. This review, as outlined in the Literature review section, did not permit to uncover a suitable model due to the lack of consensus with regards to the dimensions. As a result, two additional literature reviews of recurrent dimensions in both areas were performed. The results showed several dimensions are generic and can be applied across health and e-services. However, the analysis also demonstrated context-specific dimensions must be added to fit the peculiar characteristics of DTC telemedicine. Specifically, the examination of the selected e-health service quality instruments revealed some important dimensions extracted from the Information system literature. Through this process, the authors adopted and adapted Le Rouge et al.[55]'s framework as their reference model in the way that it combines into a single instrument significant elements from the e-SQ, health service quality and IS literature. Drawing on LeRouge et al.[55] model, the multidimensional conceptual model is hierarchical, and the authors propose *system quality, interaction quality and use quality* as the 3 primary most influencing DTC telemedicine consultation's service quality dimensions.

CONCLUSION

This study has several theorical and practical implications. First at the theorical level, the article gives a brief overview of the 4 main ICT health domains and proposes a definition of DTC telemedicine: *the delivery of*

health care services through the use of ICTs, where patients initiate the care and patients and healthcare professionals are separated by distance for the treatment of mainly low-acuity conditions. Then, it extends service quality research by discussing and examining health, e-health and e-service dimensions. Finally, it proposes a multidimensional and multilevel model that lays foundations for future research to investigate, measure and understand patient-perceived consultation service quality in the DTC telemedicine context. From the practice perspective, our model can help DTC telemedicine providers understand how patients evaluate service quality. Identifying quality dimensions enable DTC telemedicine platforms to create appropriate service management strategies, improve customers' experience and may encourage faster adoption of this new way of providing medical care. The present study has also limitations as our proposed model is drawn on a literature review. Thus, future studies are needed to test it empirically and ensure the adequate dimensions are captured.

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