Evaluating digital health attributes for users’ satisfaction: an application of the Kano model

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Abstract
Purpose – The purpose of this paper is to investigate user satisfaction with digital health solutions by identifying and prioritizing different service attributes on the basis of their impact on improving user satisfaction.
Design/methodology/approach – Through a literature review and interviews with health professionals and patients, 20 attributes of digital health services provided in Italy have been identified. User satisfaction with these attributes has been evaluated by adopting the Kano model’s continuous and discrete analyses.
Findings – The findings reveal the essential attributes of digital health services that meet users’ expectations, identify the attributes that users appreciate or dislike having and highlight unexpected attributes that lead to a significant boost in satisfaction when provided.
Research limitations/implications – This study demonstrates the efficacy of the Kano model in assessing the nonlinear correlation between user satisfaction and the quality of digital health services, thus contributing to fill a gap in the literature in this area. The main limitation of this work is the use of a non-probabilistic sampling method.
Practical implications – This research suggests healthcare institutions and organizations consider user preferences when designing digital health solutions to increase their satisfaction. The results indicate different effects on user satisfaction and dissatisfaction for different categories of attributes in the Italian context.
Originality/value – Previous works studied customer satisfaction with digital health, assuming a linear relationship with service quality, or investigated consumer adoption intentions focusing on the technological factors. This work advances available knowledge by analyzing the nonlinear relationship between digital health attributes and users’ satisfaction and dissatisfaction.

Keywords Digital health, User satisfaction, Healthcare quality, Service attributes, Kano model

1. Introduction
In recent years, the healthcare sector has undergone a significant transformation with the integration of information technologies (IT), leading to improvements in various aspects of healthcare provision (Daim and Griffy-Brown, 2015). These improvements include online data collection, internet-assisted surgery, medical data management and more (Rajak and Shaw, 2019). The adoption of digital health technologies has seen exponential growth, encompassing telemonitoring, wearable health devices, mobile apps and artificial intelligence (AI) (Marbouh et al., 2020). Amid the COVID-19 pandemic, digital health technologies played a crucial role in delivering basic healthcare services, demonstrating their cost-effectiveness and accessibility (Abbady et al., 2019). This period underscored the potential of digital health...
services in healthcare (Kumar and Pumera, 2021; Dmoura et al., 2020), with widespread Internet access driving increased adoption (Vieira et al., 2023).

Even as the realm of digital health technologies rapidly expands, the challenge of determining which applications are suitable for users persists. Designing effective digital health solutions is a multifaceted process that goes beyond mere technological expertise. The success of such endeavors hinges on the creation of technologies and services that exhibit flexibility and a profound understanding of diverse user preferences. Failure to comprehend the intricacies of user needs and the complex dynamics inherent within healthcare systems can result in the failure of these innovations (Burrows et al., 2015).

In Italy in 2021, digital health spending reached EUR 1.69 billion, marking a 12.5% increase compared to 2020, equivalent to 1.3% of public health expenditure. Although this signifies significant growth, it is still insufficient to fully realize and complete the digital transformation in healthcare. The projection is for this amount to reach 4 billion by 2024, with 2 billion allocated to Information and Communication Technologies (ICT), 1.8 billion to medical devices and the remaining funds to business process outsourcing. The National Recovery and Resilience Plan (PNRR) designates investments of EUR 15.63 billion to the healthcare industry, including EUR 7 billion for facility development and telemedicine and EUR 8.63 billion for innovation, research and the digitization of the National Health Service, particularly to enhance the Electronic Health Record (EHR) (Digital Health Italia, 2022). However, investing in digital technologies alone is insufficient. Drawing from past experiences, data reveals that less than half of the investments made have successfully achieved their objectives. Typically, the causes are attributed to the inefficiencies of public administration and healthcare organizations, often without thorough consideration of the patient’s role, a significant stakeholder in this process. For instance, crucial digital tools like the EHR, despite considerable effort, are now accessible nationwide, yet their adoption rates remain low (Cavacece, 2023).

The healthcare sector has consistently endeavored to enhance the quality of care and patient safety by refining the processes involved in service delivery. In this domain, evaluating user satisfaction with digital solutions is a key objective, as it has the potential to yield various positive outcomes, including user loyalty, positive word-of-mouth, repeated usage and health- and well-being-oriented behaviors (Rotar and Kozar, 2017). The conventional healthcare quality method assumes a linear correlation between customer satisfaction and service quality (Sohn et al., 2017). Traditional quality evaluation models, such as SERVQUAL (Parasuraman et al., 1988), posit that improvements in service quality will directly result in increased customer satisfaction and vice versa (Priyono and Yulita, 2017). In this study, we adopt a distinct approach in the form of the Kano model (Kano et al., 1984). This method is grounded in a two-dimensional quality model, known as the dualistic approach, proposing that enhancements in service quality may not always lead to equivalent increases in customer satisfaction. This highlights a nonlinear correlation between service quality and customer satisfaction (Kano et al., 1984; Matzler et al., 2004; Chen and Chuang, 2008; Basfirinci and Mitra, 2015; Wu et al., 2018).

Some studies indicate a correlation between the level of patient satisfaction and the utilization of digital health services (Ninditya and Pujiyanto, 2022); however, more evidence is necessary regarding the factors influencing satisfaction and the effects caused by technological challenges (Azad et al., 2022), necessitating further investigation on the subject (Nudurupati et al., 2015; Kraus et al., 2021). Various scholars have identified different attributes of digital health services that can impact patient satisfaction (Rajak and Shaw, 2019; Azad et al., 2022; von Huben et al., 2023), but the swift evolution of digital technologies requires a more profound understanding of user preferences and needs to develop effective solutions (Marbouh et al., 2023).
The Kano model has gained recognition as a valuable tool for categorizing attributes that hold significance from the customer’s perspective, a concept that extends to the realm of healthcare (de Vasconcelos et al., 2023). This model has been utilized not only for identifying patient needs but also for uncovering opportunities for improvement and effectively prioritizing them (Materla and Cudney, 2020).

Previous research suggests that the Kano model has the potential to pinpoint priorities for service development and improvement, fostering a profound understanding of customer needs (Pflügner et al., 2021; Gimpel et al., 2021; Fu et al., 2023). However, while it has been extensively applied to enhance patient satisfaction in various healthcare contexts, its potential within the digital health sector remains largely untapped, as only a limited number of studies have delved into this area (Pflügner et al., 2021; Gimpel et al., 2021; Fu et al., 2023).

The application of the Kano model in this field could assist healthcare institutions in providing services that align more closely with patient needs and preferences. With this aim, this study investigates user satisfaction with digital healthcare services in the Italian system by addressing the following research questions:

- **RQ1.** Are users satisfied with the digital health services offered in the Italian healthcare system?
- **RQ2.** Which attributes of digital health services possess the potential to enhance users’ satisfaction?
- **RQ3.** Which attributes of digital health services neither influence user satisfaction nor lead to dissatisfaction?

The remainder of the paper is organized as follows: initially, we review the literature on digital transformation in healthcare and its impact on patient satisfaction, providing insights into the application of the Kano model in the healthcare area. Next, we detail the research methodology employed. Subsequently, we present the findings of the empirical research involving 252 Italian users. We conclude by discussing the results and considering their implications for both research and practical applications. Finally, we outline the main limitations of the study and offer suggestions for future research.

### 2. Literature review

#### 2.1 Digital transformation in healthcare and patient satisfaction

The phenomenon of digital transformation, involving substantial changes in an entity’s attributes through information, computing, communication and connectivity technologies (Vial, 2019), has also impacted the healthcare industry. In this context, it refers to the adoption of new technologies for secure, high-quality care (Haggerty, 2017). This encompasses various areas such as self-tracking, big data, predictive analytics and shared decision-making (Kostkova, 2015; Belliger and Krieger, 2018). Digital transformation in healthcare is evident in seven technology-focused research areas, including integrated information management, medical images, electronic medical records, portable devices, e-health access, telemedicine and medical data privacy (Marques and Ferreira, 2020). Mathews et al. (2019) expanded the concept to include genomics, AI and wearables. Digital health encompasses the concept of e-health (Cunningham et al., 2014), defined as “the health services and information delivered or enhanced through the Internet and related technologies” (Eysenbach, 2001, p. 1). E-health domains include health monitoring, communication and data management (Shaw et al., 2017).

The adoption of digital technologies offers several opportunities to enhance healthcare quality and patient satisfaction (Marbouh et al., 2023). Digital healthcare enables innovative and cost-effective interventions and treatments (Zanaboni et al., 2018; Irizarry et al., 2015; Pramanik et al., 2017) and facilitates patient-centered care (Tortorella et al., 2020, 2022) by providing...
scalability, personalization, effectiveness, accessibility and streamlined patient pathways (Murray et al., 2016), thereby increasing patient empowerment (Jamkhaneh et al., 2022; Kostkova, 2015). Ciasullo et al. (2022) demonstrate that Health 4.0 not only enables more effective and timely delivery of health services and increases accessibility to emergency care but also promotes value co-creation by stimulating the digital empowerment of patients and caregivers. However, despite the potential, the adoption of digital health faces challenges related to meeting consumer needs, understanding user motivations, addressing digital literacy gaps and managing healthcare costs (O’Connor et al., 2016; Gjestsen et al., 2017; Gjellebæk et al., 2020). For these reasons, the impact of digital technologies on healthcare quality and patient satisfaction requires further investigation (Nudurupati et al., 2015; Kraus et al., 2021).

Some studies indicate a high level of patient satisfaction with digital health services during the pandemic, primarily attributed to benefits such as time and cost savings (Ninditya and Pujiyanto, 2022). However, a lack of knowledge about the factors influencing satisfaction with digital health services and challenges related to technological difficulties and the absence of physical examinations undermine the sustainability of future digitization projects (Azad et al., 2022). A rushed implementation of technology can lead to inadequate solutions, and understanding user needs is crucial in the evolving digital health landscape (Hasselblad et al., 2019). In conclusion, effective implementation, continuous evaluation of users’ needs and patient-centered assessments are essential to maximize the benefits of digital health services and enhance patient satisfaction (Marbouh et al., 2023; Ninditya and Pujiyanto, 2022; Azad et al., 2022).

2.1.1 Digital health technologies features for patient satisfaction. Understanding user preferences stands as a crucial factor for the success of digital health technologies. In an era witnessing a rapid surge in digital health solutions, there exists a notable gap in comprehending consumer adoption intentions. The predominant adoption model, the technology acceptance model (TAM), tends to concentrate on technological factors determining user intentions, sideling significant aspects such as user attention to health information accuracy, perceived usefulness and privacy protection (Cheung et al., 2019).

Health information accuracy signifies consumers’ trust in the authenticity of health information provided by digital technologies (Kim and Shin, 2015). Perceived usefulness is closely linked to the ability of digital solutions to encourage users’ behaviors to enhance their health (Zhang et al., 2017). Privacy protection pertains to users’ confidence that their personal data will not be exploited or shared without consent (Kim and Shin, 2015).

A study by von Huben et al. (2023) employed a combination of literature review and interviews with patients, healthcare professionals and community members to outline user preferences concerning attributes of digital health services. The results underscore that the most vital attributes for user satisfaction encompass technology reliability and stability, provision of accurate and clear information, privacy protection and data security, cost-effectiveness, clearly defined legal responsibilities, training and technical support, easy accessibility and usability, regular updates, additional benefits, no limitations in treatment options, equivalent effectiveness as traditional face-to-face services, opportunities for health self-management, ability to download personal health data in a useable format, unrestricted use in terms of time and place and patient involvement in the design and development process.

Azad et al. (2022) demonstrate that user satisfaction with digital health services hinges on attributes such as reliability, convenience, responsiveness and flexibility. Reliability pertains to the capability of a digital service to meet user needs, convey information accurately and safeguard personal data (Semeijn et al., 2005). Convenience implies time savings, process continuity and accessibility at the user’s convenience (Wang et al., 2005). Responsiveness denotes the promptness of assistance and the effectiveness of communication (Azad et al., 2022). Flexibility encompasses the service provider’s ability to adapt to different situations and individual needs (Wolfinbarger and Gilly, 2003).
Büyüközkan and Çifçi (2012) identified attributes such as tangibility, responsiveness, reliability, information quality and empathy. Zaidan et al. (2015) pinpointed usability, functionality, security, user support, customization and ease of use as critical attributes for customer satisfaction with open-source electronic health records. Ciasullo et al. (2017) demonstrate how certain attributes of innovative services, such as resource openness, sharing and recombination, enhance patients' satisfaction by fostering their inclination to co-create value, thereby enhancing the well-being of the entire healthcare service ecosystem. Rajak and Shaw (2019), concentrating on mobile health applications, identified attributes influencing user satisfaction, including usefulness, efficiency, flexibility, customization and reliability. Marbouh et al. (2023) conducted a review, unveiling that patient satisfaction with digital services hinges on various attributes. These encompass privacy and data security, often surpassing concerns about costs; clarity in regulations governing digital technology usage; reduction of home or hospital visits and unnecessary travel; improved connectivity among patients; enhanced patient experience; time and cost savings; facilitation of routine follow-up; more efficient communication; reduced stigma and simplified management of medical history and billing.

In summary, the surge of digital health technologies necessitates a comprehensive understanding of user preferences and needs. Identifying the attributes influencing satisfaction can offer valuable guidance for the development and evaluation of effective digital health solutions.

2.2 Overview of the Kano model

The Kano model finds its roots in Herzberg's two-factor theory (1966), which includes motivators (factors triggering employee satisfaction) and hygiene factors (elements preventing dissatisfaction) (Hartono and Chuan, 2011; Oh et al., 2012). It categorizes service quality features into five groups using a Cartesian plane, where the x-axis represents the "fulfillment of quality attributes," and the y-axis represents the "customer satisfaction derived from the fulfillment of quality attributes" (Figure 1). Distinct attributes can exert varied effects on customer satisfaction, depending on their respective categories (Kano et al., 1984). Each category outlines how the presence or absence of a service attribute influences customer satisfaction (Basfirinci and Mitra, 2015; Chen and Chuang, 2008).

Source(s): Authors’ elaboration based on Shahin et al. (2013) and Madzik (2018)
The first category relates to “must-be” (M) attributes, signifying essential qualities necessary for achieving customer satisfaction. Customers anticipate these attributes, and while their presence does not significantly elevate satisfaction beyond a neutral level, their absence unquestionably leads to dissatisfaction (Yu and Ko, 2012; Asian et al., 2018).

The second category encompasses “attractive” (A) attributes associated with features that result in heightened customer satisfaction when present, yet their absence does not lead to customer dissatisfaction. These attributes are unexpected by the customer and their provision elicits positive sentiments, while their absence goes unnoticed by the customer (Shen et al., 2000; Yu and Ko, 2012; Asian et al., 2018).

The third category involves one-dimensional (O) attributes, which have a linear impact on customer satisfaction. Improving their quality leads to increased satisfaction and vice versa (Busacca and Padula, 2005; Asian et al., 2018).

The Kano model introduces two additional categories: the “indifferent” (I) category encompasses attributes that do not impact customer satisfaction, irrespective of their presence or absence (Kano et al., 1984; Bayraktaroglu and Özgen, 2008); the “reverse” (R) category includes attributes that result in customer dissatisfaction when present and satisfaction when absent. Moreover, responses that are ambiguous or incorrect are classified as “questionable” (Q) (Chen, 2012; Oh et al., 2012; Basfirinci and Mitra, 2015).

Attributes are categorized based on response frequency (Chen, 2012). While this approach is valuable for estimating attribute quality, it doesn’t fully capture customer needs (Oh et al., 2012). To refine the outcomes of the Kano model, Timko (1993) introduced coefficients for customer satisfaction and dissatisfaction, gauging the shifts in satisfaction when attributes are present or absent (Chen, 2012; Oh et al., 2012; Shahin et al., 2013). These coefficients not only facilitate the exploration of methods to enhance satisfaction but also strategies to mitigate dissatisfaction (Go and Kim, 2018).

The Kano model finds various applications beyond customer satisfaction assessment, including creating new products, enhancing existing services, aiding decision-making, setting development priorities, capturing opinions and boosting customer loyalty (Nilsson-Witell and Fundin, 2005; Yu and Ko, 2012; Lin et al., 2015; Asian et al., 2018). It helps identify critical service attributes, supports competitive strategies (Cheng and Chen, 2018) and reveals mechanisms for creating satisfaction (Madzik and Pelantova, 2018). Moreover, Shahin and Mohammadi Shahiverdi (2015) linked the Kano satisfaction coefficient to customer lifetime value estimation.

The Kano model has been widely applied in service marketing (Pawitra and Tan, 2003; Kim et al., 2009; Chen et al., 2011; Chang and Sung, 2012; Chen, 2014; Basfirinci and Mitra, 2015; Lin et al., 2015; Chen and Chen, 2015; Gustavsson et al., 2016; Cheng and Chen, 2018; Pai et al., 2018; Formisano et al., 2019, 2021; Cheng et al., 2019).

2.2.1 The Kano model implementation in the healthcare sector. The application of the Kano model in the healthcare sector is relatively recent and addresses the challenge of ambiguity surrounding customers’ needs for healthcare services (Materla et al., 2019).

Materla et al. (2019) conducted a systematic literature review on the topic, spanning from 2002 to 2016 and encompassing 17 papers. The review revealed a notable scarcity of research that comprehensively integrates all healthcare system service entities to provide insights into patient satisfaction. Instead, existing studies predominantly presented isolated findings from specific service units. Examples include the use of the Kano model by Al-Sayyari et al. (2009) to compare differences in hemodialysis treatment expectations among Arab and Austrian patients, by Cordero-Ampuero et al. (2012) to assess patient and physician anticipations concerning the treatment of osteoarthritis and by Matias-Guiu et al. (2012) to evaluate patient expectations concerning symptomatic migraine treatment.

A range of research works combines the Kano model with other methodologies to enhance healthcare services. Notably, authors have integrated the Kano model with the...
Quality Function Deployment (QFD) approach to identify and prioritize patients’ needs, facilitating decision-making and strategy formulation for healthcare providers (Chiou and Cheng, 2008; Nordin and Razak, 2014; Shamshirsaz and Dong, 2014). Additionally, the Kano model has been combined with the SERVQUAL model to investigate public healthcare service quality (Christoglou et al., 2006), examine the impact of new facilities on patient quality perceptions (Vassiliadis et al., 2014), explore the quality of hospital services within the medical tourism sector in Thailand (Wongrukmit and Thawesaengskulthai, 2014), enhance hospital competitiveness through prioritized service quality elements (Yeboah et al., 2014) and analyze the connection between attributes of service quality and customer behavior (Sulisworo, 2015). Furthermore, alternative quality approaches like the service blueprint (Chang and Yang, 2010), multi-criteria satisfaction analysis (Krassadaki and Grigoroudis, 2010), analytic hierarchy process (AHP) model (Lee et al., 2011), Herzberg two-factor theory (Basu and Chhillar, 2013) and customer satisfaction matrix (El-Hashmi and Gnieber, 2013) have been integrated with the Kano model to explore various facets of healthcare service quality.

The results of Materla et al. (2019) underscore the immediate necessity for studies utilizing the Kano model to gain comprehensive insights into intricate patient requirements, enhance current service attributes and introduce innovative attributes capable of elevating patient satisfaction while abating healthcare costs.

In more recent developments, the Kano model has found application in assessing customer satisfaction determinants within public pediatric inpatient services, suggesting strategies for enhancing customer experiences (Ferreira et al., 2021). It has also been utilized to classify healthcare quality aspects with potential impacts on patient satisfaction (Dinulescu and Dobrin, 2022), evaluate services provided by Basic Health Units in Brazil's Unified Health System (Lacerda et al., 2022), identify the primary factors influencing service quality for patients undergoing wound care (Cudney et al., 2023) and investigate the requirements linked to walk-in clinics in the United States (Materla and Cudney, 2020).

Despite these advancements, a notable gap exists in applying the Kano model to the expanding field of digital health services. This gap is particularly evident as few works have ventured into this area. Pflügner et al. (2021) conducted a study to identify application features crucial for the satisfaction of elderly individuals using teleconsulting applications. They found that features like information on data protection and efficient menu navigation were categorized as must-be attributes, signifying their criticality. Conversely, features such as the call button for emergency service or outpatient care and medication reminder messages were categorized as one-dimensional attributes, directly affecting user satisfaction according to their fulfillment. The study of Gimpel et al. (2021) delved into the needs and preferences of different user groups across various countries in relation to mobile health apps. The authors identified must-be features such as protected personal access and data encryption, alongside eleven attractive features encompassing emergency access, integration of health-related records, trackers, manual upload, data sharing with doctors, appointment booking, reminders, medication support, care plans and general education. Similarly, Fu et al. (2023) integrated the Kano model with the decision-making trial and evaluation laboratory (DEMATEL) method to explore the role of user satisfaction in mediating continued use intentions of mobile health apps. According to their results, the most important attributes are: physical sign data collection and ease of use, classified as must-be; health risk assessment, health tracking, periodic assessment, health monitoring and management, community discussions and sharing health experiences through social platforms, considered attractive attributes. On the other hand, privacy and security, health management plan, a straightforward and intuitive interface, a well-organized functional layout, consistent usage, comparative feedback on health management effectiveness and easily understandable icons or menus are categorized as one-dimensional attributes.
3. Method
This paper employs the Kano model (Kano et al., 1984) to examine the influence of attributes in digital health services on user satisfaction. The original version of the model was utilized, marking the initial endeavor to apply it in investigating the impact of digital health service attributes on user satisfaction. Nevertheless, to address certain limitations of the model and enhance results, the discrete data analysis was combined with the continuous analysis proposed by DuMouchel (1993) and the satisfaction and dissatisfaction coefficients introduced by Timko (1993).

The World Health Organization (WHO) defines health services as “any service (not limited to medical or clinical services) aimed at contributing to improved health or to the diagnosis, treatment and rehabilitation of sick people” (WHO, 1998, p. 9). Digital health services denote health services that have undergone partial or complete digitization.

From the literature review mentioned earlier, 32 attributes of digital health services were identified. Following consultations with three health professionals and fifteen digital health users, the service attributes most relevant for user satisfaction in the Italian healthcare system were selected, resulting in 20 attributes as detailed in Table 1.

A Kano questionnaire was developed using a dualistic approach, encompassing both functional and dysfunctional questions (Chen, 2012; Oh et al., 2012). For each evaluated service, a pair of questions was included: (1) a functional question assessing how customers feel when the service possesses the attribute and (2) a dysfunctional question gauging customer sentiment when the service lacks the attribute. Each question follows the format “how do you feel if the service has/does not have this attribute.” Respondents could choose from the options: I like it; I expect it; I am neutral; I can tolerate it; I dislike it.

Additionally, a self-stated importance questionnaire was introduced to assess the relative importance of each attribute for customers. Participants were asked to rate the importance of each attribute on a Likert scale (Mkpojiogu and Hashim, 2016). The Likert scale used ranged from 1 to 9, where 1 denotes “Not at all important,” and 9 signifies “Extremely important,” allowing for greater discrimination in values as recommended by Blauth et al. (1993).

The questionnaire was distributed through a Google Form link using the convenience sampling method. Although it is a non-probabilistic sampling technique, it is the most suitable and widely used method in clinical research and healthcare area (Elfil and Negida, 2017; Lloyd, 2004). This is because it allows the selection of the sample based on convenient accessibility and proximity (Gravetter and Forzano, 2012). A total of 252 valid responses were collected. The sample comprises 53% males and 47% females. Among the respondents, 40% are aged between 31 and 50, followed by the age groups 18–30 (34%), 51–70 (24%) and over 70 (2%). In terms of education, 49% of the respondents have a university degree, 26% have a Ph.D. or postgraduate master’s degree and 23% have a high school diploma. Regarding employment, civil servants make up the majority (31%), followed by university students.

| A1 ease to use |  | A11 saving time |
| A2 Ease to access |  | A12 Manual upload of personal documents |
| A3 Reliability of content |  | A13 Record and download of personal data |
| A4 Low extra costs |  | A14 Enough usage information |
| A5 Data sharing with peers |  | A15 Data sharing with professionals |
| A6 Community forum |  | A16 Clear legal responsibility |
| A7 Rewards for its use |  | A17 Privacy protection |
| A8 Health monitoring and management |  | A18 Security of personal data |
| A9 Technical support |  | A19 Health check/health diary |
| A10 Reducing travel |  | A20 Reminders and booking appointments |

Table 1.
Digital health services attributes

Source(s): Authors’ elaboration
(29%), private employees (15%), self-employed (14%), unemployed (5%) and pensioners (4%). Ninety-two percent of the sample stated that they have used a digital health service at least once, among those listed, namely EHR, digital prescription, digital referral, online booking and mobile health apps.

4. Findings
Based on the evaluation table (Table 2), responses were categorized into one of Kano’s six classifications described above.

Initially, service attributes were categorized through discrete analysis, wherein each attribute is assigned the most frequently occurring category in the responses, represented by the mode (Table 3).

Next, the continuous analysis, as suggested by DuMouchel (1993), was implemented to address certain weaknesses of the discrete method. These limitations include the potential loss of pertinent information arising from consolidating all interviewee responses into a single category for each attribute, the disregard for data variance and the uniform weighting

| A1 | 57.94 | 15.87 | 19.05 | 0.79 | 0.00 | 6.35 | 100 | M |
| A2 | 60.32 | 17.46 | 19.84 | 1.59 | 0.00 | 0.79 | 100 | M |
| A3 | 24.60 | 30.95 | 17.46 | 12.70 | 3.17 | 11.11 | 100 | O |
| A4 | 27.78 | 35.71 | 11.90 | 15.87 | 1.59 | 7.14 | 100 | O |
| A5 | 7.14 | 11.90 | 19.05 | 41.27 | 7.14 | 13.49 | 100 | I |
| A6 | 7.94 | 12.70 | 15.87 | 36.51 | 12.70 | 14.29 | 100 | I |
| A7 | 4.76 | 7.48 | 58.50 | 23.13 | 4.08 | 2.04 | 100 | A |
| A8 | 3.97 | 3.17 | 65.08 | 20.63 | 4.76 | 2.38 | 100 | A |
| A9 | 10.32 | 30.16 | 16.67 | 24.60 | 4.76 | 13.49 | 100 | O |
| A10 | 15.20 | 39.20 | 10.40 | 20.80 | 4.00 | 10.40 | 100 | O |
| A11 | 21.43 | 51.43 | 5.71 | 11.43 | 0.00 | 10.00 | 100 | O |
| A12 | 22.58 | 45.97 | 8.06 | 13.71 | 3.23 | 6.45 | 100 | O |
| A13 | 23.66 | 44.27 | 2.29 | 16.03 | 3.05 | 10.69 | 100 | O |
| A14 | 28.80 | 45.60 | 4.00 | 12.00 | 0.00 | 9.60 | 100 | O |
| A15 | 6.35 | 49.21 | 8.73 | 23.81 | 1.59 | 10.32 | 100 | O |
| A16 | 54.76 | 11.11 | 8.73 | 18.25 | 2.38 | 4.76 | 100 | M |
| A17 | 57.14 | 11.90 | 16.67 | 8.73 | 0.00 | 5.56 | 100 | M |
| A18 | 55.56 | 9.52 | 12.70 | 16.67 | 1.59 | 3.97 | 100 | M |
| A19 | 5.26 | 13.53 | 55.64 | 21.05 | 2.26 | 2.26 | 100 | A |
| A20 | 3.17 | 3.17 | 67.46 | 20.63 | 4.76 | 0.79 | 100 | A |

Source(s): Authors’ elaboration based on Matzler and Hinterhuber (1998)

E-health attributes for users’ satisfaction
of all responses. In contrast, the continuous method involves translating each response option into a numerical value on an asymmetrical scale. This scale considers answers on the negative end (Reverse and Questionable) as weaker compared to those on the positive end (Must-be and One-dimensional):

1. Functional: \(-2\) (Dislike), \(-1\) (Live with), \(0\) (Neutral), \(2\) (Must-be), \(4\) (Like);
2. Dysfunctional: \(-2\) (Like), \(-1\) (Must be), \(0\) (Neutral), \(2\) (Live with), \(4\) (Dislike);
3. Importance: \(1\) (Not at all Important), \ldots, \(9\) (Extremely Important.)

The mean scores for all functional and dysfunctional answers, along with the importance scores, were computed. These average values have been depicted on a two-dimensional plane for classification (Table 4).

Lastly, the “Better” and “Worse” scores, also known as satisfaction and dissatisfaction coefficients, introduced by Timko (1993), were computed. These scores, which assess changes in customer satisfaction or dissatisfaction when each attribute is provided or not provided, integrate Kano’s outcomes with a comprehensive evaluation of customer needs (Chen, 2012; Oh et al., 2012). The Better coefficient indicates the increase in satisfaction when the attribute is present, while the Worse coefficient signifies the decrease in satisfaction when the attribute is absent (Oh et al., 2012; Shahin et al., 2013). These scores were estimated using the following formulas, taking into account the sum of responses in each category for a single attribute (Table 5):

\[
\text{Better} = \frac{A + O}{A + O + M + I} \\
\text{Worse} = -\frac{O + M}{A + O + M + I}
\]

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Dysfunctional (X)</th>
<th>Functional (Y)</th>
<th>Importance (Z)</th>
<th>Category</th>
</tr>
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<td>A1</td>
<td>3.36</td>
<td>2.75</td>
<td>7.24</td>
<td>O</td>
</tr>
<tr>
<td>A2</td>
<td>3.36</td>
<td>2.75</td>
<td>7.10</td>
<td>O</td>
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<tr>
<td>A3</td>
<td>2.93</td>
<td>2.81</td>
<td>7.40</td>
<td>O</td>
</tr>
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<td>A4</td>
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<td>2.82</td>
<td>7.95</td>
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<tr>
<td>A5</td>
<td>1.14</td>
<td>1.58</td>
<td>5.69</td>
<td>I</td>
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<td>1.25</td>
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<td>A</td>
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<td>2.15</td>
<td>2.41</td>
<td>6.53</td>
<td>O</td>
</tr>
<tr>
<td>A10</td>
<td>2.64</td>
<td>2.63</td>
<td>7.32</td>
<td>O</td>
</tr>
<tr>
<td>A11</td>
<td>3.46</td>
<td>3.03</td>
<td>7.68</td>
<td>O</td>
</tr>
<tr>
<td>A12</td>
<td>3.08</td>
<td>2.79</td>
<td>7.86</td>
<td>O</td>
</tr>
<tr>
<td>A13</td>
<td>3.09</td>
<td>2.61</td>
<td>7.61</td>
<td>O</td>
</tr>
<tr>
<td>A14</td>
<td>3.41</td>
<td>2.80</td>
<td>7.95</td>
<td>O</td>
</tr>
<tr>
<td>A15</td>
<td>2.60</td>
<td>2.68</td>
<td>6.96</td>
<td>O</td>
</tr>
<tr>
<td>A16</td>
<td>2.89</td>
<td>1.95</td>
<td>7.47</td>
<td>M</td>
</tr>
<tr>
<td>A17</td>
<td>3.16</td>
<td>2.45</td>
<td>7.26</td>
<td>O</td>
</tr>
<tr>
<td>A18</td>
<td>2.93</td>
<td>2.07</td>
<td>7.48</td>
<td>O</td>
</tr>
<tr>
<td>A19</td>
<td>1.73</td>
<td>2.99</td>
<td>6.28</td>
<td>A</td>
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<td>A20</td>
<td>1.26</td>
<td>2.96</td>
<td>5.69</td>
<td>A</td>
</tr>
</tbody>
</table>

Table 4. Continuous analysis

Source(s): Authors’ elaboration
As a demonstration, considering attribute A1, there are 44 responses categorized as Attractive (A), 146 as Must-be (M), 40 as One-dimensional (O) and 2 as Indifferent (I). Consequently, the scores are:

\[
\text{Better A1} = \frac{44 + 40}{44 + 40 + 146 + 2} = 0.36
\]

\[
\text{Worse A1} = -\frac{40 + 146}{44 + 40 + 146 + 2} = -0.80
\]

This implies that when attribute A1 is provided, customer satisfaction experiences a 36% increase, and in its absence, satisfaction decreases by 80%.

The mean functional, dysfunctional and importance values across all responses are plotted on a categorization plane for convenient comparison of attributes with similar placements (Figure 2). Since averages might obscure data variations, standard deviations are incorporated into the graphic as error bars to provide an indication of the accuracy of categorizations. The Importance scores are visually represented by transforming the scatter plot dots into bubbles, with sizes corresponding to their respective importance levels.

5. Discussion
The findings of this study, based on input from 252 Italian citizens, underscore five crucial attributes that digital solutions must possess to meet user expectations. These are ease of use (A1), ease of access (A2), clear legal responsibility (A16), privacy protection (A17) and security of personal data (A18), classified as must-be attributes. This signifies that a user-friendly technology with affordable accessibility for everyone, irrespective of technological skills, coupled with high-level security guaranteed by a trusted institution, is considered a fundamental aspect of digital health services for citizens’ consideration and use. Although the presence of these attributes may not directly boost customer satisfaction, their absence

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Better coefficient (%)</th>
<th>Worse coefficient (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>0.36</td>
<td>-0.80</td>
</tr>
<tr>
<td>A2</td>
<td>0.38</td>
<td>-0.78</td>
</tr>
<tr>
<td>A3</td>
<td>0.56</td>
<td>-0.65</td>
</tr>
<tr>
<td>A4</td>
<td>0.52</td>
<td>-0.69</td>
</tr>
<tr>
<td>A5</td>
<td>0.38</td>
<td>-0.26</td>
</tr>
<tr>
<td>A6</td>
<td>0.39</td>
<td>-0.28</td>
</tr>
<tr>
<td>A7</td>
<td>0.70</td>
<td>-0.10</td>
</tr>
<tr>
<td>A8</td>
<td>0.73</td>
<td>-0.07</td>
</tr>
<tr>
<td>A9</td>
<td>0.57</td>
<td>-0.50</td>
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<td>A10</td>
<td>0.58</td>
<td>-0.63</td>
</tr>
<tr>
<td>A11</td>
<td>0.63</td>
<td>-0.81</td>
</tr>
<tr>
<td>A12</td>
<td>0.60</td>
<td>-0.75</td>
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<tr>
<td>A13</td>
<td>0.54</td>
<td>-0.78</td>
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<tr>
<td>A14</td>
<td>0.55</td>
<td>-0.82</td>
</tr>
<tr>
<td>A15</td>
<td>0.66</td>
<td>-0.63</td>
</tr>
<tr>
<td>A16</td>
<td>0.21</td>
<td>-0.71</td>
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<tr>
<td>A17</td>
<td>0.30</td>
<td>-0.73</td>
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<tr>
<td>A18</td>
<td>0.24</td>
<td>-0.69</td>
</tr>
<tr>
<td>A19</td>
<td>0.72</td>
<td>-0.20</td>
</tr>
<tr>
<td>A20</td>
<td>0.75</td>
<td>-0.07</td>
</tr>
</tbody>
</table>

Source(s): Authors’ elaboration
undoubtedly leads to dissatisfaction, as users perceive the digital solution as lacking. However, attributes A1, A2, A16 and A17 fall into the one-dimensional category in the continuous analysis, indicating a linear correlation with user satisfaction. To better comprehend the impact of these attributes on user satisfaction, considering the disparate results between the two types of analysis, it is helpful to consider Timko’s (1993) satisfaction and dissatisfaction coefficients. These coefficients demonstrate that the provision of these attributes enhances customer satisfaction by approximately 21–38%, while their omission can result in approximately 70–80% customer dissatisfaction.

These findings align with existing literature. Pflügner et al.’s (2021) study on essential features for satisfaction with teleconsulting applications similarly categorizes data protection and practical menu navigation as must-be attributes. Regarding satisfaction with mobile health applications, attributes such as protected personal access and data encryption have been classified as must-be attributes in the works of Gimpel et al. (2021) and Fu et al. (2023). Moreover, privacy protection and data security are indicated as key attributes for customer satisfaction with digital health technologies by Zaidan et al. (2015), Cheung et al. (2019), von Huben et al. (2023) and Marbouh et al. (2023). Similarly, the importance of clarity in regulations and responsibility, as well as easy accessibility and usability, has been emphasized by von Huben et al. (2023) and Zaidan et al. (2015).

Nine attributes fall into the Kano category of one-dimensional: reliability of content (A3), low extra costs (A4), technical support (A9), reducing travel (A10), saving time (A11), manual upload of personal documents (A12), record and download of personal data (A12), enough usage information (A14) and sharing data with professionals (A15). This implies that users prefer having these attributes and dislike their absence. Users exhibit a “more is better” response to these attributes, meaning that the greater the digital service offers them, the more customer satisfaction rises. These attributes demonstrate a proportional connection between functionality and satisfaction, with each enhancement in functionality correlating with
heightened satisfaction. The “Better” and “Worse” coefficients indicate that, for these attributes, the rise in satisfaction when provided is comparable to the increase in dissatisfaction when not provided, with a marginally higher percentage of dissatisfaction than satisfaction. The substantial influence on satisfaction stemming from these attributes, particularly A10, A11 and A12, reveals that users look to digital health solutions for immediate advantages such as saving time and reducing travel to health facilities, in addition to managing their personal documents. Looking at previous works, it should be noted that the manual upload of documents and data sharing with doctors are classified as attractive attributes of mobile health apps in the work of Gimpel et al. (2021). Reliability is the attribute most considered in studies on consumer satisfaction with digital health technologies (von Huben et al., 2023; Azad et al., 2022; Rajak and Shaw, 2019; Büyüközkân and Çifçi, 2012). Training and technical support and the ability to download personal data are considered user preferences regarding attributes of digital health services by von Huben et al. (2023). In the review of Marbouh et al. (2023), instead, the reduction of home or hospital visits and unnecessary travel and time and cost savings emerge as attributes influencing customer satisfaction with digital health services.

The possibility of receiving a reward for using the digital service (A7) and the ability of the technology to assist with health supervision and management (A8), creating a health check or health diary (A19) and providing reminders and managing appointments (A20) are categorized as attractive attributes. This indicates that these are unanticipated features that, upon introduction, elicit a positive response. Indeed, their provision results in approximately 70% satisfaction, while their absence leads to dissatisfaction ranging from 0.7% to 20%. The findings suggest that these services, while not essential for users, can differentiate the offerings of digital health solutions and attract more users. This is confirmed by other studies that categorize attributes like booking, reminders, care plans, health monitoring and management as attractive features in assessing customer satisfaction with mobile health apps (Gimpel et al., 2021; Fu et al., 2023). Additional studies highlight the potential of extra benefits (such as rewards), opportunities for health self-management and the facilitation of routine follow-up as features capable of enhancing customer satisfaction with digital health solutions (von Huben et al., 2023; Marbouh et al., 2023).

Finally, the attributes data sharing with peers (A5) and community forum (A8) are indifferent attributes that do not impact user satisfaction. In fact, the better coefficients for these attributes are around 0.3% and the worse coefficient is below 0.3%. This indicates a lack of interest by citizens in sharing their health experiences with others. These results contrast with those of Fu et al. (2023), who classify attributes like community discussions and social sharing of health management experiences as attractive, as well as with those of Marbouh et al. (2023), who mention improved connectivity between patients as a feature capable of increasing customer satisfaction with health mobile apps.

6. Conclusions and implications
This paper examines the influence of 20 attributes of digital health solutions provided in Italy, identified with the assistance of health professionals and patients, on user satisfaction and dissatisfaction using the Kano model.

The results indicate that for a digital health solution to achieve user satisfaction, it must be accessible and easy to use, ensuring data security, privacy protection and clear legal responsibility for its management.

To elevate satisfaction beyond a basic level, digital solutions should be designed to reward users for their use and provide assistance in managing their health condition, such as offering reminders, booking appointments and the option to create health checks and diaries.
Some attributes exhibit a linear relationship between quality and satisfaction level. Attributes like the opportunity to save time, reduce travel, share data with professionals and record, upload and download personal data, as well as the provision of reliable content, usage information and technical support with low extra costs, create the same level of satisfaction when present and dissatisfaction when absent.

However, the opportunity to share data with peers and participate in community forums does not impact user satisfaction or dissatisfaction.

This categorization of attributes provides healthcare institutions and organizations with insights into the characteristics digital health solutions should possess to increase user acceptance and involvement, thereby avoiding past failures.

From a practical standpoint, this study suggests three levels of attributes for practitioners and policymakers to consider when planning digital health services, based on the desired level of satisfaction and response from users. Basic attributes, including ease of use and access, privacy and data security, and a clear definition of legal responsibility, must be ensured to increase adoption and reduce abandonment rates. To enhance user satisfaction, digital health services should be designed with low costs, reliable content, technical support, personal document management and the option to share data with doctors. For increased user satisfaction beyond a basic level and improved engagement, a third level of attributes, such as functions supporting autonomous health status supervision and management and rewards, like fiscal incentives, should be incorporated. In the context of limited financial resources for healthcare and the urgency to accelerate health digital transformation post-pandemic, this study highlights the importance of prior user preference studies for designing successful solutions.

From a research perspective, this work demonstrates the effectiveness of a model based on a nonlinear relationship between health service quality and patient satisfaction in assessing user preferences for digital solutions. This model can replace or complement traditional models, such as SERVQUAL for investigating the quality of digital health services or TAM for studying user acceptance. The proposed model not only identifies the attributes of digital health services that generate user satisfaction but also classifies them based on their actual impact on users, influencing their attitudes towards the service. Therefore, it offers a valuable approach for studies on healthcare digitization addressing challenges related to understanding and analyzing the acceptance, adoption and usage rates of digital solutions in various healthcare systems.

7. Limitations and future research
This paper outlines certain limitations, primarily related to the use of a non-probabilistic sampling method and the confined geographical context of the investigation, which is limited to central Italy.

To enhance the generalizability of the findings, future research will concentrate on enlarging the sample size and extending the geographical scope. Additionally, to enhance the precision of attribute identification and address specific limitations, it is recommended that future investigations replicate the study using updated versions of the Kano model proposed by other scholars. The refinement process could involve integrating the conventional model used in this study with techniques such as the AHP and the QFD matrix, as suggested by PakizehKara et al. (2016). Furthermore, introducing fuzzy logic into the model, as proposed by Shahin et al. (2017a) and incorporating models that categorize one-dimensional and indifferent attributes into multiple categories, as advocated by Vaez ShahrEstani et al. (2020) and Shahin et al. (2017b), could contribute to more reliable findings.

Another recommendation for future studies is to employ the model to investigate customer satisfaction with individual digital services, such as EHRs, and to restrict the survey to patients of a specific type of organization. This is crucial as certain organizational
characteristics, such as whether it is a public or private entity, can impact professionals’ awareness of quality improvement initiatives (Ciasullo et al., 2023).

References


TQM


**Further reading**


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