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Evaluation of the Usage Requirements of Hospital Signage Systems Based on the Kano Model

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Abstract: This study aimed to determine the quality type and importance ranking of hospital signage systems' usage requirements using the Kano model. This study collected data from 300 users in three hospitals in Guangzhou and evaluated 32 metrics of hospital signage systems. The Kano model questionnaire was used to analyze the quality type of each demand indicator, and the better–worse coefficient was used to calculate the sensitivity and importance ranking of the demand. Of the 32 attributes evaluated by participants, 4 are must-be quality (M), 4 are one-dimensional quality (O), 12 are attractive quality (A), and 12 are indifferent quality (I). The results of this study suggest that the presence of most of the evaluated attributes is associated with maintaining a level of user satisfaction, and the lack of these attributes causes user dissatisfaction. There is a strong demand for basic usage functions and an easy-to-use hospital signage system. In addition, users often wish to add and improve signage functions and have greater expectations for the inclusion of features such as digital intelligence and regional culture in this study. The results of this study show that the Kano model can better derive the user requirements for hospital signage systems and can promote the improvement of hospital signage systems in a more targeted manner, according to the quality type and importance of requirements, providing a research basis for the sustainable development of healthcare services.

Keywords: hospital signage system; signage function; Kano model; usage requirements; hospital service management

Citation: Deng, L.; Romainoor, N.H.; Zhang, B. Evaluation of the Usage Requirements of Hospital Signage Systems Based on the Kano Model. *Sustainability* **2023**, *15*, 4972. https://doi.org/10.3390/su15064972

Academic Editors: Yang Yu, Hao Wu and Lingbo Liu

Received: 16 January 2023
Revised: 7 March 2023
Accepted: 7 March 2023
Published: 10 March 2023

1. Introduction

Enhancing the quality of life and well-being of urban citizens via design support is a global issue in the modern world. With the expansion of the urban population, and thus the increased use of large and complex building spaces, wayfinding is very important for the citizens' everyday lives and travel [1–4]. Hospitals are large, complex, and multifunctional public places that are often comparable to mini cities [5–8]. The multifunctional nature of hospitals can increase the difficulty of wayfinding to some extent, which is a particular concern in large hospitals [6,8–10]. One study found that 74.2% of hospital users had difficulty finding their way around hospital environments [11], and an additional 12% of patients mentioned the lack of appropriate guidance signage [12]. Wayfinding involves more factors than signage, such as building structure and individual elements [13,14]. However, hospital signage systems play an important role in the wayfinding process [15,16]. An effective hospital signage system can not only bring great convenience to patients and visitors by assisting wayfinding, reducing stress, and preventing users from getting lost, but can also improve the quality of hospital services and city image shaping [17–20].

China's hospital signage system design was developed along with urban construction and had a slow start compared to more developed countries. Additionally, with the expansion and refurbishment of hospitals, the design and management of signage systems in many cities are limited, especially in small- and medium-sized cities, with problems such as poor standardization, weak guidance, insufficient signage systems, and inconvenience

of use [11,12,21]. Due to this, the current design of signage and information in Chinese hospital environments cannot meet users' wayfinding needs. As part of a public service, hospital signage systems should meet the needs of users. How to optimize and improve the design of the signage system based on a full understanding of users' needs, enhance the function of the signage system, and realize the fine management and service quality of the hospital is particularly significant.

According to the American Institute of Graphic Arts (AIGA) [22], the definition of a signage system design is a visual design that consists of identification, guidance, explanation, warning, and other functions via a combination of text, graphic, and color. In the field of wayfinding, signage design is critical. Effective signage can assist people of many different backgrounds with easy access to information, break down language barriers, and provide comprehensive information to help people in their daily lives [23]. Based on the related studies, existing signage systems can be grouped into three categories: orientation signage, direction signage, and identification signage [15,18,24–26].

High-quality physical environments can promote health and well-being [27,28]. From the perspective of environmental psychology, the hospital environment has an impact on the daily practice of healthcare professionals, the effectiveness of care and the recovery of patients, and it is an important component of safe and high-quality healthcare services [29,30]. The physical environment has a critical role in aiding navigation in healthcare facilities [31]. Many spatial features of a hospital environment are complex and difficult to distinguish, which often causes wayfinding difficulties and is indicative of the quality of "wayfinding design" in outpatient areas [26]. Passini defines the architectural structure, spatial layout form and signage design of hospitals as important environmental factors that influence wayfinding behavior [15]. Several studies report that signage in the hospital environment is critical to visitor wayfinding [15,18,32]. The hospital signage system design helps users to guide attendees to their destinations in order to receive medical services. Therefore, the design quality of the hospital signage system is an essential environmental factor in generating wayfinding behavior [18,31,32].

Preliminary recommendations for the design of hospital signage systems have been made based on previous research that examined color, graphics and text, and installation location. Color is the most eye-catching feature of signage, and designs for wayfinding should be based on contrast and readability [33–35]. Color can help to distinguish departments and allow users to find their way by emphasizing information [18,32,36]. To make it simpler to identify a sign, there must be adequate contrast between the text and the graphic. According to the Americans with Disabilities Act (ADA), the contrast between text and its background should be 70% [23]. In addition, the use of graphics in signage systems is a key point, and pictograms are recommended since they are more prominent and easier to understand than abstract graphics and text [37,38]. Aside from colors and graphics, text is also an important factor in signage design. The layout, type of font, font size, spacing, and grouping of fonts in signage affect the way users understand signs [22,39]. The legibility of fonts can be improved by modifying the font case, adding bold fonts, and using sans serif fonts such as Helvetica [36]. Moreover, signage planning in the right location is the basis for assessing its legibility [26] and increasing the maximum distance at which the sign can be effectively understood can be achieved by increasing the contrast of arrows, widening the size of the sign, and modifying the aspect ratio of the signage [40].

However, a successful hospital signage system includes more than just the above signage design elements. It is a comprehensive and integrated system, beginning with a public survey and culminating in the final development of the system, with the sustainability of future developments also being considered [27]. The effect of a signage system on wayfinding needs to be evaluated on a case-by-case basis, especially considering the diversity of different environmental factors and users' needs [41].

Methods for evaluating user satisfaction with healthcare services have become an important topic of research in the field of healthcare management in recent decades [42–46]. As mentioned earlier, the healthcare environment is considered a quality factor in healthcare.

Marie Elf et al. tested 23 instruments to assess the quality of the healthcare environment, but none met the robustness criteria. Most studies lack a solid, up-to-date theoretical foundation. In addition, many of the methods lacked a theoretical framework centered on human needs. Therefore, this author argues that perceived hospital quality indicators should be fully developed with a user-centered theoretical framework [28]. In addition, the sustainability of healthcare services is an emerging research topic, and hospitals are increasingly adopting business management sustainability strategies and operational processes to further enhance hospital service satisfaction [47–49]. Many hospitals have begun to view sustainable healthcare as an important management approach that addresses healthcare sustainability from social, economic, environmental, and health perspectives [50–52]. Andrea Brambilla describes the validation of an evidence-based framework for hospital facility quality assessment from social, environmental, and organizational perspectives, and the findings highlight user–patient centeredness, wayfinding strategies, and spatial functionality as the most important concepts in the improvement of existing healthcare facilities [53] (Brambilla et al. 2021). Anna Anåker argues that sustainability has become one of the main goals of healthcare and that design quality is outlined as a core concept for developing new healthcare environments, including environmental sustainability, social and cultural interaction, and resilient architecture. To implement the concept, it must be able to meet the complex needs of stakeholders in the healthcare environment [27]. A hospital signage system with both service and product attributes in the healthcare environment is worth evaluating from the perspective of user demand and user satisfaction [41,54].

Based on these factors, the Kano model can provide a practical pathway for assessing the quality of healthcare services. The Kano model emphasizes the analysis of user perceptions, which enables healthcare providers to understand the complex behaviors of users and their service quality needs; therefore, the model can be used to improve user satisfaction [55,56]. As mentioned earlier, hospital management and services are not only reflected in healthcare services but also in the signage system. Existing research shows that effective space organization and signage systems can positively influence patients' perception of overall hospital services [16,20,57]. The efficacy of health services can enhance and indicate the involvement of users, and their impressions of services and related goods are taken into account [42]. Overall, the use of the Kano model in the field of healthcare is effective. It not only helps us to understand patients' expectations of quality but also the differences in these expectations [58,59]. In addition, the effectiveness of health services can only be improved by fully understanding user needs and perceptions of services and related products via the Kano model, and provide a more sustainable competitive advantage for hospital management [48,60].

Although the Kano model has been widely used to elicit users' service quality requirements and improve user satisfaction, its implementation in healthcare is still in its infancy, and user needs for healthcare services are ambiguous [56]. There are no studies based on previous research findings that have applied the Kano model to assess demand and satisfaction with the use of hospital signage systems. Therefore, this study aims to fill this research gap by using the Kano model to comprehensively assess users' usage needs and perceptions of hospital signage systems to further improve the quality of healthcare services. This study is complementary to previous studies [12,61] that evaluated the quality of health services and their characteristics from a user perspective via the Kano model, based on the HEALTHQUAL [62] multidimensional scale. Three general hospitals in different administrative districts of Guangzhou were randomly selected for this study. The objectives of this study are (1) to explore the relationship between hospital signage system quality attributes and user satisfaction; (2) to identify and classify the quality attributes of the hospital signage system through the Kano model (i.e., must-be (M), attractive (A), one-dimensional (O), reverse (R), and indifferent (I)); and (3) to provide a research basis for promoting the design of hospital signage systems and the sustainable development of healthcare service quality.

The remainder of the paper is organized as follows. Section 2 presents the theoretical Kano model; Section 3 describes the materials and methods used in this study in accordance with the research objectives; Section 4 presents the results of a questionnaire survey from three hospitals in Guangzhou; Section 5 discusses the results considering the previously identified objectives; and Section 6 presents the study's main conclusions.

2. Theoretical Model

The concept of customer satisfaction has been recognized and adopted by business managers since the 1950s. Customer satisfaction is closely related to business management and service quality [63]. Oliver and Linda believe that customer satisfaction is "a psychological state, a state of feeling that arises when the expectations formed by the consumer experience are consistent with the consumer experience" [64], Westbrook and Reilly considered customer satisfaction to be an emotional response [65]. These emotions positively influence customer behavior, increase the likelihood of new purchases, and promote customer loyalty [66]. To explore the relationship between customer satisfaction and service quality, several research models have been proposed in the literature, the most prominent of which are the Johnston model, SERV*OR model, and Kano model [42,67]. However, health services differ from other types of services in several aspects. The health sector's service quality is more important than that of other sectors because high-quality health services have a significant impact on the health and well-being of individuals [42,45,67,68]. As a result, assessment tools that analyze this multidimensionality of needs are required. Studies have shown that the Kano model is effective for comprehensively assessing the quality of healthcare services [69,70]. Therefore, the Kano model is used as an evaluation method that adapts to the objectives of this study since previous models have limitations for identifying and classifying attributes that define satisfaction, dissatisfaction, and customer satisfaction [71].

Herzberg's motivation–hygiene theory is one of the content theories of job satisfaction. He suggests that there are two types of employee satisfaction in daily work: motivational factors and hygiene factors. Motivational factors indicate the achievement, recognition, and responsibility that comes from the job itself; hygiene factors refer to company policies and management, technical supervision, salary, working conditions, and interpersonal relationships [72]. Many academics consider Herzberg's theory to be the most successful needs fulfillment model employed in healthcare organizations [73,74].

According to satisfaction theory research, not all factors have a one-dimensional effect on user satisfaction. When certain factors are provided, they may not necessarily gain user satisfaction, and sometimes they may cause dissatisfaction. Sometimes certain factors are provided or not provided, and users sometimes believe that there is no difference at all [72,75]. To overcome this one-dimensional limitation, the Kano model adopts a two-dimensional approach. The Kano model is inspired by Herzberg's motivation–hygiene theory. Noriaki Kano, a professor at the Tokyo Institute of Technology, presented a research paper "Attractive Quality and Must-be Quality" at the 12th Annual Conference of the Japan Quality Management Conference in 1982, in which he proposed this two-dimensional model of satisfaction as a useful tool for classifying and prioritizing user needs. The Kano model was invented to introduce satisfaction and dissatisfaction criteria into the field of quality management for the first time, based on an analysis of the impact of user needs on user satisfaction [71]. In Japan at that time, the problem of improving products and services was a pressing issue.

The Kano model classifies product quality into five dimensions based on the importance users place on product quality factors and customer satisfaction [58,71,76]: (1) mandatory or "must-be" (M), (2) attractive (A), (3) one-dimensional (O), (4) reverse (R), and (5) indifferent (I) quality (Figure 1). Must-be quality, where user satisfaction does not significantly increase when this type of requirement is provided but decreases significantly when it is not provided, is a basic requirement that must be guaranteed. For one-dimensional quality, user satisfaction increases when this type of requirement

is provided and decreases when it is not. This category should be prioritized to ensure maximum improvements. For attractive quality, user satisfaction does not decrease when such requirements are not provided but increases significantly when they are provided. For indifferent quality, user satisfaction does not significantly change with or without the provision of such requirements. In the case of limited conditions, this requirement may not be given priority. For reverse quality, the user does not have such a requirement and providing it would lead to a decrease in satisfaction. The five types of quality are obtained using the Kano questionnaire, the evaluation form, and the outcome form, and the Kano quality types also show that not all elements are better if they are provided in greater numbers, but some elements are counterproductive.

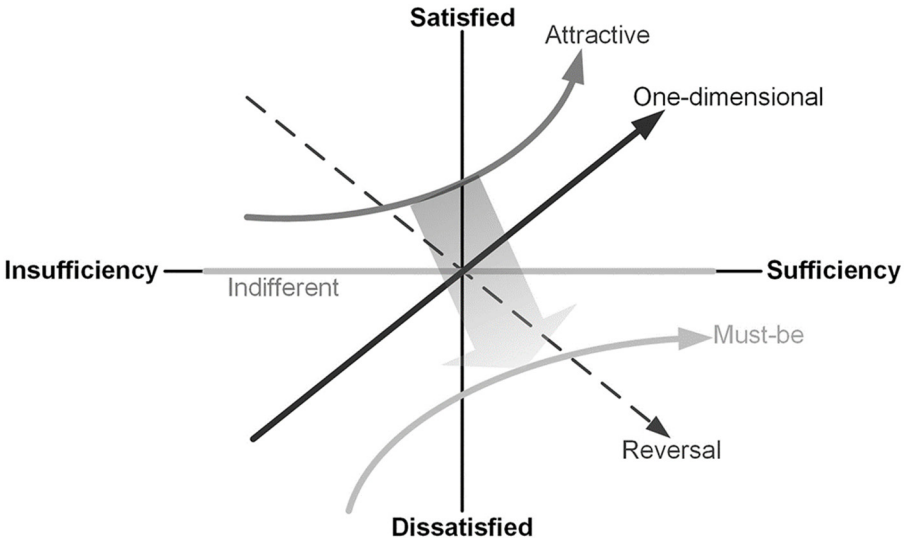

Figure 1. The relationship between demand satisfaction and user satisfaction in the Kano model.

The Kano model has been widely used in hardware and software product design, service quality research, and user needs identification after years of extensive practice and application. The Kano model has also been used in the field of public service demand decision making to determine which public services are most urgently needed under limited circumstances, and the results of the Kano model's demand quality classification are useful for the formulation of supply policies. Table 1 shows an evaluation of the Kano model.

Table 1. Evaluation of the Kano model.

		Negative Form				
		Like it	**Expect it**	**Neutral**	**Tolerate**	**Dislike**
Positive form	Like it	Q	A	A	A	O
	Expect it	R	I	I	I	M
	Neutral	R	I	I	I	M
	Tolerate	R	I	I	I	M
	Dislike	R	R	R	R	Q

To maximize service quality and satisfaction, reverse quality should be eliminated, indifferent quality should be reduced, must-be quality guaranteed, one-dimensional quality improved, and attractive quality satisfied. The hospital signage system is a public service and a facility product that ultimately aims to meet the user needs for guidance and has a high degree of fit with the Kano model. The Kano model is used in this study to investigate demand for hospital signage systems via questionnaires to quantify and compare various demand indicators, and finally to filter and rank the quality and importance of user-based demand.

3. Methods

3.1. Usage Requirements Index of the Hospital Signage System

From March 2022 to May 2022, we conducted field research in three large general hospitals in Guangzhou and communicated with hospital management and people who used signage systems. In addition, based on Lu et al.'s [77] classification of the usage requirements of urban signage systems and public information guidance systems—Guidelines for planning and design issued by the National Standardization Management Committee in 2020 (GB/T 38654-2020) [78]—we finally classified the needs of hospital signage systems into four types through optimization and screening: functional level, design level, use level, and attractive level; each level contains specific indicators. The total number of indicators is 32. The indicators of the hospital signage system usage requirements are shown in Table 2.

Table 2. The indicators of hospital signage system usage requirements.

Dimension	Code	Requirements	Description
Functional level	A1	Entrance reminder	Appropriate signage at the hospital entrance or parking lot
	A2	Route guide	Route guidance and channel diversion signage tips
	A3	Current location	With the function of prompting the specific location of the user in the hospital
	A4	Specialist introduction	With the function of introducing the experts in each department of the hospital
	A5	Consultation flow	Visualization of the consultation process
	A6	Floor guide	with floor-by-floor guide function, showing departments and sections on each floor
	A7	Departmental guidelines	Departmental entrance indicators, such as gynecology and radiology
	A8	Danger indication	Indicates danger, such as flammable objects and toxic danger
	A9	Emergency evacuation	Emergency evacuation instructions, emergency evacuation channels, etc.
	A10	Important advice	Important advice, such as beware of bumping heads
	A11	Healthcarepopularization	Public healthcare, such as flu self-test knowledge.
Design level	B1	Layout format	A more standardized typographic format design
	B2	Information hierarchy and density	Reasonable classification and hierarchy of signage
	B3	Text and terminology	Use of appropriate typography and standardized terminology
	B4	Signage symbols	Signage symbols are designed to be simple, descriptive, and easy to understand
	B5	Colors	Use of eye-catching and appropriate color design
	B6	Mounting position	Installed in a reasonable location
	B7	Signage size	The size of the signage is appropriate for the hospital space
	B8	Standardization	The signage system has a uniform style
Use level	C1	Visibility	The signage is easily noticeable
	C2	Legibility	Signage is easy to understand
	C3	Signage planning	Good layout planning to cover nodes where it is easy to get lost
	C4	Number setting	A reasonable number of signs to avoid missing signs or unnecessary duplication
	C5	Safety	The signage is stable and secure to reduce safety hazards
	C6	Durability	Signage is durable and not easily damaged
	C7	Update and maintenance	Signage is updated and maintained regularly

Table 2. *Cont.*

Dimension	Code	Requirements	Description
	C8	User inclusive	Inclusive signs for children, elderly people, those who speak different languages, etc.
Attractive	D1	Visual form	Signage system with an attractive visual form
	D2	Fun and stylish	Signage system with an interesting and unique design style
	D3	Cultural elements	The signage system incorporates local cultural characteristics
Level	D4	Harmonization with the environment	The signage system is environmentally friendly
	D5	Digital intelligence	The signage system has intelligent digital functions, such as interactive screens

Firstly, the functional level classifies the signage functions of the hospital signage system, aiming to understand user demand for each signage function. Secondly, the design level mainly extracts and classifies the design elements of the logo system layout to understand user perceptions of the design elements of the logo layout. Thirdly, the use level includes factors that may affect the use of the signage system and aims to determine which factors may cause inconvenience to the daily use of the signage system. Fourthly, the attractive level includes positive features that can enhance the signage system in order to understand which features are more in line with user expectations.

3.2. Questionnaire Design

The first part of the study was a basic questionnaire, including questions on gender, age, education, hospital disorientation experience, reasons for disorientation, and hospital wayfinding aid preference. The second part was a Kano questionnaire with specific indicators, each containing both positive and negative questions [71]. The positive questions asked users how they feel about the signage system having this function; the negative questions asked users how they feel about the signage system not having this function [42]. In this study, the five-level classification (Like it; Expect it; Neutral; Tolerate; Dislike) proposed by Matzler and Hinterhuber to assess consumer expectations was used to analyze the two-dimensional Kano model [79]. The Kano model questionnaire is shown in Table 3, and both positive and negative questions have five levels of options: all questions were scored using the Likert scale: "Like it—5; Expect it—4; Neutral—3; Tolerate—2; Dislike—1".

Table 3. The Kano model questionnaire form.

Function	Question	Like it	Expect it	Neutral	Tolerate	Dislike
Entrance reminder	With this function	☐	☐	☐	☐	☐
	Without this function	☐	☐	☐	☐	☐

The questionnaire had 32 questions related to the Kano model shown in Table 2. The number of questionnaires is 10 times the number of indicators, which is in line with the principle of questionnaire design. Among the questions, "Which way to find the way in the hospital" and "Main reason for getting lost in the hospital" were ranked, and the average composite score of "K" was obtained by calculating the weights and frequencies of the options. Based on the number of options, the first option was assigned 4 and 6 points, and the second option was assigned 3 and 5 points. The calculation formula is

$$K = (\Sigma \text{ number of frequencies} \times \text{weight}) / \text{number of completions}$$

3.3. Identification of Requirement Quality Types

The traditional Kano quality classification method is a two-dimensional categorization of attributes, and it is straightforward to determine statistical indicators by aggregating them and matching them with the Kano evaluation table. However, when the statistical values of two quality types are close to each other, quality attributes can be misjudged. Since the management of some hospital signage systems has been lacking for a long time, a large number of users have become accustomed to the status quo of the city's signage system and believe that, regardless of whether it is upgraded, it will have little impact on their life travel. From the preliminary results of the Kano questionnaire on the use of hospital signage systems, the indifferent quality (I) is close to other qualities, which is not conducive to correctly identifying the real quality type of this indicator. Therefore, it is necessary to implement the better–worse coefficient calculation method [80], which is calculated as follows:

Calculation of Customer's Satisfaction Coefficients (CSC):

$$\text{Better/SI} = (\text{O} + \text{A})/(\text{M} + \text{O} + \text{A} + \text{I})$$

$$\text{Worse/DSI} = (\text{O} + \text{M})/(\text{M} + \text{O} + \text{A} + \text{I}) \times (-1)$$

The better–worse coefficient indicates the effect on user satisfaction or dissatisfaction when demand is increased or decreased; the better coefficient indicates user satisfaction when a demand is satisfied, and the worse coefficient indicates user dissatisfaction when a demand is not satisfied. One-dimensional quality (O) is determined when both the better and worse values are >0.5. Indifferent quality (I) is when both better and worse values are <0.5, attractive quality (A) when both better >0.5 and worse <0.5, and must-be quality (M) when better <0.5 and worse >0.5.

3.4. Reliability and Validity Testing

The reliability and validity of the Kano questionnaire for hospital signage system usage requirements were tested using SPSS 22.0 software, as shown in Table 4. The overall Cronbach's α value was 0.805, including 0.824 for positive questions and 0.809 for negative questions, both of which were greater than 0.8, indicating that this questionnaire has a good reliability. For validity testing, the KMO measure value was 0.776, with a validity between 0.7 and 0.8, and Bartlett's sphere test statistic value of significant probability was 0.000, which is less than 0.01 and has a positive correlation, indicating that the data were suitable for a factor analysis. The cumulative variance contribution using a principal component analysis was 70.243%. This questionnaire had good structural validity and was suitable for a Kano model analysis.

Table 4. The analysis of the Kano questionnaire reliability and validity.

Item		Value
Cronbach's α value		
All questions		0.805
Positive questions		0.824
Negative questions		0.809
KMO sampling suitability measure		0.776
Bartlett's sphere test	Sig.	0.000
Cumulative variance contribution		70.243%

4. Results

4.1. Demographic Characteristics of the Sample

The questionnaire was distributed in both online and offline forms, and the survey period lasted from March 2022 to May 2022. A total of 320 questionnaires were distributed during the survey period, 100 online questionnaires were distributed using Questionnaire

Star media (WeChat, various social media and QQ), and 220 offline questionnaires were distributed, including 80 from Guangdong Provincial Hospital of Traditional Chinese Medicine, 80 from Guangzhou First People's Hospital, and 60 from the First Affiliated Hospital of Sun Yat-sen University. A total of 300 valid questionnaires were collected after eliminating 20 invalid questionnaires, which included those filled out too quickly and those with simple answers, and the characteristics of the Kano questionnaire respondents are shown in (Table 5). Among the respondents, 56.7% were males and 43.3% were females. The age of the respondents ranged between 18 and 45 years old, their education level ranged from high school to a bachelor's degree, and the respondents had a good cognitive ability to understand the hospital signage system. The majority of respondents experienced getting lost in the hospital (79%). The most common methods of wayfinding around the hospital are "Asking others for directions", using "Mobile App Navigation", and using the "Signage System". The main reasons for getting lost in the hospital are "Cannot understand the signage", "The hospital is crowded", and "Complex medical process".

Table 5. Demographic characteristics of the sample.

Item	Indicator	Frequency	Percentage/Sort
Gender	Male	170	56.7%
	Female	130	43.3%
Age	<18	9	3.0%
	18–30	123	41.0%
	31–45	85	28.3%
	46–60	12	4.0%
	>60	71	23.7%
Education level	Primary school and below	36	12.0
	Junior high school	108	36.0
	High school/junior college	59	19.7
	Undergraduate	62	20.7
	Master's and above	35	11.7
Lost in the hospital experience	Rarely	24	8%
	Occasionally get lost	131	43.67%
	Often lost	106	35.33%
	Always lost	39	13%
Hospital wayfinding method	Asking others for directions	3.02	1
	Mobile app navigation	2.62	2
	Signage system	2.35	3
	Brochure map	2.01	4
Reasons for getting lost in the hospital	Cannot understand the signage	5.20	1
	The hospital is crowded	5.14	2
	A complex medical process	3.61	3
	Complex building structure	3.21	4
	Personal reasons	2.27	5
	Other reasons	1.56	6

4.2. Results of Demand Quality Type

Classification using the better–worse coefficient makes up for the shortcomings of the traditional classification method to a certain extent, but it cannot determine reverse quality (R). Since reverse quality (R) is less frequent in practical situations and can be quickly judged using the traditional classification method, this study identifies reverse quality (R) and questionable results (Q) using a traditional classification and then classifies them using the better–worse coefficient, which can more comprehensively identify the type of demand quality for the use of hospital signage systems. The statistics and classification of demand quality type of hospital signage system are shown in Table 6.

Table 6. Hospital signage system demand quality type statistics and classification.

Function	A	O	M	I	R	Q	Type	Better	Worse	R
A1	47	62	114	77	0	0	M	0.36	0.59	0.690
A2	138	72	40	50	0	0	A	0.70	0.37	0.793
A3	63	41	84	112	0	0	I	0.35	0.42	0.542
A4	66	57	67	110	0	0	I	0.41	0.41	0.582
A5	102	65	62	71	0	0	A	0.56	0.42	0.699
A6	111	85	47	57	0	0	A	0.65	0.44	0.788
A7	52	65	100	83	0	0	M	0.39	0.55	0.674
A8	58	131	58	53	0	0	O	0.63	0.63	0.891
A9	99	42	50	109	0	0	I	0.47	0.31	0.561
A10	87	53	54	106	0	0	I	0.47	0.36	0.587
A11	78	54	72	96	0	0	I	0.44	0.42	0.608
B1	61	73	96	70	0	0	M	0.45	0.56	0.719
B2	110	36	35	119	0	0	I	0.49	0.24	0.541
B3	85	44	62	109	0	0	I	0.43	0.35	0.557
B4	62	71	88	79	0	0	M	0.44	0.53	0.691
B5	88	82	64	66	0	0	A	0.57	0.49	0.747
B6	130	56	40	74	0	0	A	0.62	0.32	0.698
B7	97	69	54	80	0	0	A	0.55	0.41	0.689
B8	113	68	54	65	0	0	A	0.60	0.41	0.728
C1	92	56	53	99	0	0	I	0.49	0.36	0.613
C2	112	45	47	96	0	0	A	0.52	0.31	0.607
C3	110	38	38	114	0	0	I	0.49	0.25	0.555
C4	80	42	72	106	0	0	I	0.41	0.38	0.557
C5	122	74	38	66	0	0	A	0.65	0.37	0.752
C6	73	87	72	68	0	0	O	0.53	0.53	0.752
C7	138	46	28	88	0	0	A	0.61	0.25	0.661
C8	76	65	66	93	0	0	I	0.47	0.44	0.642
D1	78	87	83	52	0	0	O	0.55	0.57	0.790
D2	77	75	77	71	0	0	M	0.51	0.51	0.717
D3	122	36	38	104	0	0	A	0.53	0.25	0.582
D4	97	80	65	58	0	0	A	0.59	0.48	0.763
D5	66	39	82	113	0	0	I	0.35	0.40	0.534

M: must-be, A: attractive, O: one-dimensional, R: reverse, I: indifferent, Q: questionable qualities.

The results of this questionnaire showed no reverse quality (R) and questionable results (Q). The must-be quality (M) is focused on the functional level and design level, including "A1-Entrance Reminder", "A7-Departmental Guidelines", "B1-Layout format", and "B4-Signage symbols". The above four elements indicate what users believe is important to the hospital signage system. The above four elements show that users have strong functional and design needs for hospital signage systems. Although the provision of these features cannot bring about an increase in user satisfaction, the failure to provide the above features will lead to a significant decrease in user satisfaction; therefore, hospital managers and signage designers should focus on the essential demand services. The top four one-dimensional quality (O) aspects that users care most about are "A8-Danger indication", "C6-Durability", D1-Visual form", and "D2-Fun and stylish". This indicates that user

satisfaction increases when the signage system provides this feature and decreases when it does not. Attractive quality (A) accounts for a large proportion of the functional level, design level, and attractive level, indicating that a user's satisfaction and loyalty will be greatly enhanced by the improvement of these three levels and that user satisfaction will not be reduced when this feature is not provided. The indifferent quality (I) aspect is generally focused on the functional level, "A3-Current Location", "A4-Specialist Introduction", "A9-Emergency evacuation", "A10-Important Advice", and "A11-Healthcare popularization". These are features that users do not care about; regardless of whether they are provided or not, they do not affect user satisfaction.

4.3. Better–Worse Analysis

4.3.1. Demand Importance Ranking Rules

Traditional classification combined with better–worse classification was used to categorize the Kano model quality types for the usage requirements metrics of the hospital signage system. This was used to determine which were required, desired, attractive, irrelevant, and reverse qualities, but the additional importance ranking of each indicator was needed to clarify the degree of impact. The ranking of the importance of the usage requirements was carried out in two steps.

Step 1: Between the same type of function, it is recommended to give a higher priority to the better coefficient and a lower priority to the worse coefficient. According to the importance ranking obtained from the long-term practice of the Kano model theory, the ranking of function priority is general, and can be divided into four levels: must-be quality (M) > one-dimensional quality (O) > attractive quality (A) > indifferent quality (I).

Step 2: By calculating the better–worse sensitivity values, a secondary ranking of the usage demand indicators of the same quality type is performed. Using the better value as the horizontal coordinate and the absolute value of the worse value as the vertical coordinate, a demand sensitivity matrix is created and brought into each demand indicator to visualize the sensitivity intensity in the matrix. The value of "R" indicates the sensitivity of each indicator to the user, and the size of the value is the distance from the point to the origin of the matrix. The importance of each indicator is further determined by comparing the size of R-value. The farther the distance from the point to the origin of the matrix, the larger the R-value, the higher the sensitivity, and the greater the impact on the user. The smaller the R-value, the lower the sensitivity of the quality trait, which can be temporarily disregarded, the better–worse sensitivity matrix scatter diagram is shown in Figure 2. The distance of each point to the origin of the matrix coordinates is calculated as follows:

$$\mathrm{R} = \sqrt{(Better\ value)^2 + (|Worse|value)^2}$$

4.3.2. Different Attributes and Their Relationship with User Satisfaction

According to the better–worse coefficients, the R-value of different demand indicators (Table 6), and the four-quadrant diagram of better–worse coefficients (Figure 2), we can analyze user satisfaction with various functions of hospital signage systems. Among the 32 functional attributes, 4 are must-be quality (M), 4 are one-dimensional quality (O), 12 are attractive quality (A), and 12 are indifferent quality (I). A four-quadrant diagram was created based on the better–worse coefficients of the different functional attributes of the hospital signage system in Table 6, as shown in Figure 2. Many attributes are a mixture of various features, and this figure helps to more precisely indicate the must-be and other types of attributes (Fu et al. 2023) [54]. There are four functional attributes: A1 (entrance reminder), A7 (departmental guidelines), B1 (layout format), and B4 (signage symbols), located in the lower right corner of the quadrant diagram, and they are must-have qualities. These features are must-have attributes for hospital signage systems; otherwise, users will be reluctant to use their services and will be less satisfied. The four functional attributes, namely A8, C6, D1, and D2, are located in the upper right corner of the map, and they all relate to one-dimensional quality. According to the relationship between the influence of

the classification and satisfaction in the Kano model requirements [54,58], hospital signage systems may increase user satisfaction when they have the functional attributes desired by users. Moreover, most of the functional attributes are distributed in the upper left and lower left corners of the quadrant diagram, indicating that they are attractive or indifferent qualities. When a hospital signage system has attractive qualities, it may increase user satisfaction, while indifferent qualities have little effect on user satisfaction.

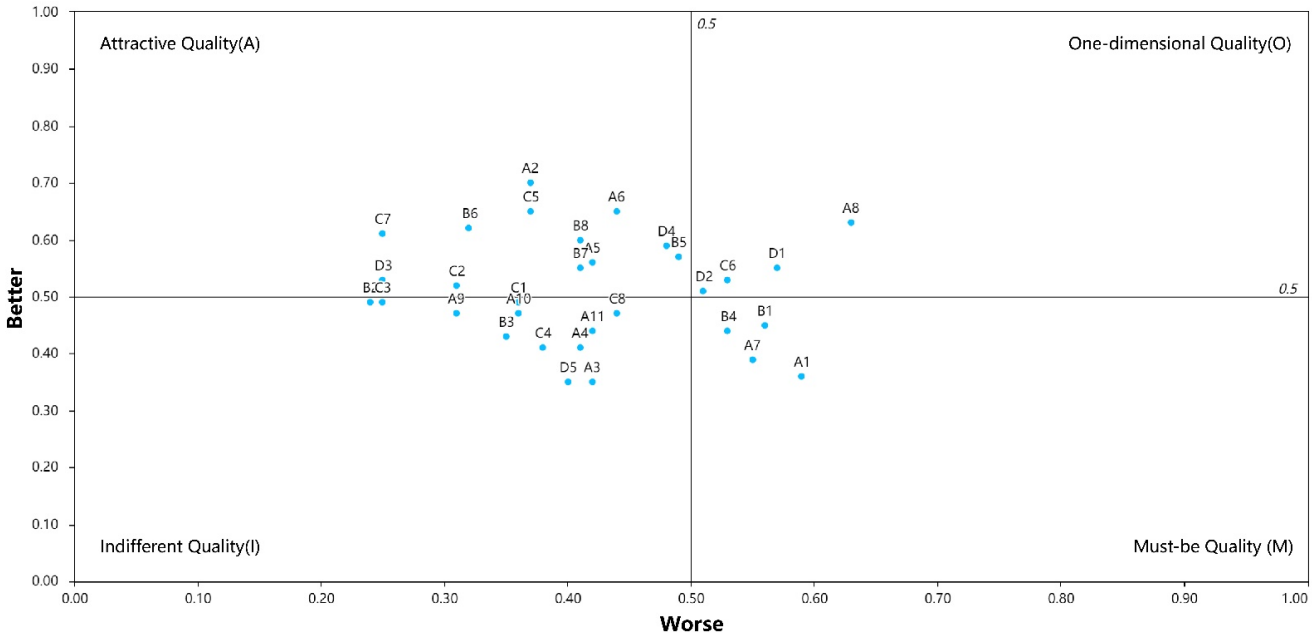

Figure 2. Four-quadrant diagram based on the better–worse coefficient.

4.3.3. Demand Importance Ranking and Analysis

The first level of must-be quality (M) has the highest importance. In terms of sensitivity ranking, these indicators are B1 (layout format), B4 (signage symbols), A1 (entrance reminder), and A7 (departmental guidelines), in that order. The second level of one-dimensional quality (O), in order of sensitivity, is A8 (danger indication), D1 (visual form), C6 (durability), and D2 (fun and stylish), indicating that these are the usage requirement indicators that can greatly increase user satisfaction. The third level of attractive quality (A) has more indicators: A2 (route guide), A6 (floor guide), and D4 (harmonization with the environment), C5 (safety), B5 (colors), B8 (standardization), and A5 (consultation flow), B6 (mounting position), B7 (signage size), and finally C7 (update and maintenance), C2 (legibility), and D3 (cultural elements). The fourth level has the most indicators of indifferent quality (I), among which the indicators at the feature level are the most negative. The ranking of the importance of hospital signage system requirements is shown in Table 7. In general, use level indicators are the most important, and the demand for functional level is more likely to account for other indicators, most likely because some functions are optional for users.

Separately, at the functional level, A1 (entrance reminder) and A7 (departmental guidelines) are must-be quality (M) requirements, so they are of utmost importance. In second place is A8 (danger indication) for one-dimensional quality (O), followed by attractive quality (A) for A2 (route guide), A6 (floor guide), and A5 (consultation flow). All indicators at the functional level can be seen through the sensitivity, and the setting should focus on securing A1 (entrance reminder) and A7 (departmental guidelines), two types of signage, and improving the signage for A8 (danger indication). At the same time, adding three types of signage, namely A2 (route guide), A6 (floor guide), and A5 (consultation flow), can greatly enhance the satisfaction of users.

Table 7. Demand importance ranking of the hospital signage system.

Ranking Method	Demand Importance Ranking
Functional level	A1 > A7 > A8 > A2 > A6 > A5 > A11 > A10 > A4 > A9 > A3
Design level	B1 > B4 > B5 > B8 > B6 > B7 > B3 > B2
Use level	C6 > C5 > C7 > C2 > C8 > C1 > C4 > C3
Attractive level	D1 > D2 > D4 > D3 > D5
Must-be (M)	B1 > B4 > A1 > A7
One-dimensional (O)	A8 > D1 > C6 > D2
Attractive (A)	A2 > A6 > D4 > C5 > B5 > B8 > A5 > B6 > B7 > C7 > C2 > D3
Reverse (R)	
Indifferent (I)	C8 > C1 > A11 > A10 > A4 > A9 > C4 > B3 > C3 > A3 > B2 > D5

At the design level, B1 (layout format) and B4 (signage symbols) are the must-be quality (M) requirements and are ranked first. The most concentrated needs for attractive quality (A) include B5 (colors), B6 (mounting position), B7 (signage size), and B8 (standardization). Based on the sensitivity ranking, the respondents have a higher demand for the layout design, icon symbol design, color design, mounting position, and standardization level of hospital signage. B2 (information hierarchy and density) and B3 (text and terminology) belong to indifferent quality (I), indicating that the respondents have a higher demand for the information quality of signage, and text terminology are two types of features that respondents do not care about.

At the use level, the one-dimensional quality (O) ranking was C6 (durability), which ranked first in sensitivity, followed by attractive quality (A) needs, including C5 (safety), C7 (update and maintenance), and C2 (legibility). From the first four items in the sensitivity ranking—durability, readability, safety, and ability to be effectively maintained— hospital signage systems are in much higher demand than the other indicators. It is worth noting that C8 (user inclusive) and C1 (visibility) are considered as indifferent quality (I) but their sensitivity is still higher.

At the attractive level, D1 (visual form) and D2 (fun and stylish) are one-dimensional quality (O). The attractive quality (A) includes D3 (cultural elements) and D4 (harmonization with the environment); D5 (digital intelligence) is the indifferent quality (I). The sensitivity ranking shows that the interesting and well-designed appearance and integration of local cultural elements in the signage system are also the top-ranked demand indicators. Moreover, intelligent signage is considered an irrelevant quality, likely because digital intelligent signage is difficult to operate, and users prefer to rely on traditional physical signage systems for wayfinding in the hospital environment.

5. Discussion

Research on hospital signage systems with user requirements as the starting point is helpful to provide targeted optimization direction and measures in the pre-design, mid-implementation, and post-maintenance stages to improve satisfaction with the hospital signage system, ultimately to promote the humanized development of China's hospital signage system [31,41]. This study used the Kano model to conduct a questionnaire survey on the usage requirements of hospital signage systems at four levels: functional, design, usage, and attractiveness levels. The results of this study provide a ranking of the quality types and importance of each usage requirement indicator of hospital signage systems, identifying attributes that need to be improved or reduced and attributes that promote higher satisfaction.

The survey results show that improvement in the five essential attributes of hospital signage systems A1 (entrance reminder), A7 (departmental guidelines), B1 (layout format), B4 (signage symbols) is a challenge, because the improvement in these attributes does not generate greater satisfaction. On the contrary, their absence has led to great dissatisfaction. Among these attributes, A1 (entrance reminder), A7 (departmental guidelines), B1 (layout format), and B4 (signage symbols) belong to the functional level and design level. Based

on previous research, the entrance reminder signage, the departmental guide signage, the clarity of signage layout, and the comprehensibility of signage symbols help users find their way, and thus have a high demand [41,81,82]. Therefore, this result is consistent with the results of the previous study.

In addition, via one-dimensional quality (O)—A8 (danger indication), D1 (visual form), C6 (durability), D2 (Fun and stylish)—and attractive quality (A)—A2 (route guide), A6 (floor guide), and D4 (harmonization with the environment)—the improvement in these attributes can greatly enhance user satisfaction. Hospital management can increase efforts to develop the attractive attributes of a signage system, enhancing user goodwill and confidence, to aid the sustainability of hospital services [51,52,60]. The high level of demand for the functional level attributes A2 (route guide), A6 (floor guide), and A8 (danger indication) is because these signs are located in heavy-traffic areas; therefore, wayfinding problems occur frequently [41] (Bubric et al. 2021). C6 (durability), C7 (update and maintenance), and D4 (harmonization with the environment) are important design qualities that contribute to the sustainability of healthcare environmental services, such as the use of environmentally durable and sustainable materials for signage, and the enhancement of ecological attributes and user perceptions of the healthcare environment by improving environmental factors [27]. It is interesting to note that D1 (visual form) and D2 (fun and stylish) is considered as one-dimensional quality (O), that shows the aesthetic features of the design contribute to the comprehension of graphics and symbols, which can enhance the aesthetic quality of the signage and improves the user's favorability [83,84]. Many indicators of graphic symbol demand are based on user perceptions, such as visual form and aesthetic appeal [85–87]. A graphic or symbol's emotional response, such as value (positive vs. negative feelings) and arousal (whether it is calming or thrilling), is becoming increasingly essential [87]. This suggests that the aesthetic quality of a product is a desired attribute to increase user experience and user satisfaction. A9 (emergency evacuation), C4 (number setting), B3 (text and terminology), A3 (current location), B2 (information hierarchy and density), and D5 (digital intelligence) are the least important attributes of indifferent quality (I), most likely because these attributes are not the most common in user wayfinding and have no impact on user experience, regardless of whether signage is provided or not. Although, emergency evacuation signs are important safety warnings, and the design of this kind of signage has been the subject of decades of research, regulatory, and standardization initiatives (ISO 7010:2019) [88]. However, emergency evacuation signage is usually used to help users find their way in dangerous situations [89,90], the probability of hospital visitors using emergency evacuation signage in a usual situation will be low. Digital intelligence signage is costly to install; therefore, it is not the first choice for most people to find their way around, especially the elderly [29,91,92]. The design details of the signage, namely number setting, text and terminology, current location, information hierarchy, and density, can somewhat influence the visual preferences and wayfinding efficiency of users [13,41,93,94], but they do not have a significant impact on user demand and satisfaction in existing hospitals.

6. Conclusions

The objective of this study was to use the Kano model in three hospitals in Guangzhou, China, to assess user needs for hospital signage systems via a multidimensional approach. The Kano model was used to classify the quality attributes of the hospital signage system, identified the attributes that users regard and disregard, and discussed the relationship between various quality attributes and user satisfaction. To our knowledge, this is the first article published in China that explores the Kano model and its relationship with hospital signage systems. In this way, it is a pioneering study that helps to fill the existing gaps in the literature on the subject.

However, this study has some limitations. Although it was conducted in three hospitals in Guangzhou, China, the results should be carefully handled and interpreted when extrapolating them to other populations with different demographic, cultural, and ur-

ban infrastructures, and different hospital characteristics. The sample size of this study is limited, and more research is needed to further verify whether these attributes have sustainable value and can improve user satisfaction. In addition, research has shown that the Kano model is particularly useful in the design phase of a product/service; however, a drawback of the Kano model is that it does not reveal the relative importance of various attributes in the overall customer assessment of the product/service, or how the analyzed attributes relate to each other in this regard [95]. Therefore, a penalty–reward contrast analysis (PRCA) could be utilized in the future to further evaluate the relationship between the quality attributes of hospital signage systems.

This study provides a new perspective on sustainability research in the healthcare service industry by linking the quality of hospital signage system design to the sustainability of the hospital environment in terms of user satisfaction with the requirements for using hospital signage systems. Overall, hospital signage systems, as part of healthcare services, have multidimensional attributes, and maintaining a sustainable high level of user satisfaction is a long-term challenge for hospital management [42,47].

Author Contributions: Writing—original draft, L.D.; Writing—review & editing, B.Z.; Supervision, N.H.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Bosch, S.J.; Gharaveis, A. Flying solo: A review of the literature on wayfinding for older adults experiencing visual or cognitive decline. *Appl. Ergon.* **2017**, *58*, 327–333. [CrossRef]
2. Grierson, L.E.M.; Zelek, J.; Carnahan, H. The Application of a Tactile Way-finding Belt to Facilitate Navigation in Older Persons. *Ageing Int.* **2009**, *34*, 203–215. [CrossRef]
3. Webber, L.S.; Charlton, J.L. Wayfinding in Older Adults. *Clin. Gerontol.* **2001**, *23*, 168–172. [CrossRef]
4. Wilkniss, S.M.; Jones, M.G.; Korol, D.L.; Gold, P.E.; Manning, C.A. Age-related differences in an ecologically based study of route learning. *Psychol. Aging* **1997**, *12*, 372–375. [CrossRef]
5. Al-Sharaa, A.; Adam, M.; Nordin, A.S.A.; Mundher, R.; Alhasan, A. Assessment of Wayfinding Performance in Complex Healthcare Facilities: A Conceptual Framework. *Sustainability* **2022**, *14*, 16581. [CrossRef]
6. Jia, Z.; Nourian, P.; Luscuere, P.; Wagenaar, C. Spatial decision support systems for hospital layout design: A review. *J. Build. Eng.* **2023**, *67*, 106042. [CrossRef]
7. Jiang, S.; Verderber, S. On the Planning and Design of Hospital Circulation Zones. *HERD Health Environ. Res. Des. J.* **2016**, *10*, 124–146. [CrossRef] [PubMed]
8. Pouyan, A.E.; Ghanbaran, A.; Shakibamanesh, A. Impact of circulation complexity on hospital wayfinding behavior (Case study: Milad 1000-bed hospital, Tehran, Iran). *J. Build. Eng.* **2021**, *44*, 102931. [CrossRef]
9. Morag, I.; Pintelon, L. Digital wayfinding systems in hospitals: A qualitative evaluation based on managerial perceptions and considerations before and after implementation. *Appl. Ergon.* **2020**, *90*, 103260. [CrossRef]
10. Ransolin, N.; Saurin, T.A.; Zani, C.M.; Rapport, F.; Formoso, C.T.; Clay-Williams, R. The Built Environment Influence on Resilient Healthcare: A Systematic Literature Review of Design Knowledge. *HERD Health Environ. Res. Des. J.* **2022**, *15*, 329–350. [CrossRef]
11. Zhang, W. Research on the Design of Public Space of Large General Hospital from the Perspective of Wayfinding. Master's Thesis, Beijing University of Architecture, Beijing, China, 2019. Available online: https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201902&filename=1019103903.nh (accessed on 16 June 2019).
12. Qi, F.; Chen, Y. A pilot study of satisfaction with outpatient spatial environment in a general hospital. In Proceedings of the 2020 Annual Academic Conference of the Architectural Society of China, Guangzhou, 20 April 2020; pp. 133–137. [CrossRef]
13. Iftikhar, H.; Shah, P.; Luximon, Y. Human wayfinding behaviour and metrics in complex environments: A systematic literature review. *Arch. Sci. Rev.* **2021**, *64*, 452–463. [CrossRef]
14. Jamshidi, S.; Ensafi, M.; Pati, D. Wayfinding in Interior Environments: An Integrative Review. *Front. Psychol.* **2020**, *11*, 549628. [CrossRef] [PubMed]
15. Passini, R. Wayfinding: A conceptual framework. *Urban Ecol.* **1981**, *5*, 17–31. [CrossRef]
16. Passini, R. Wayfinding design: Logic, application and some thoughts on universality. *Des. Stud.* **1996**, *17*, 319–331. [CrossRef]

17. Arthur, P.; Passini, R. Wayfinding: People, Signs, and Architecture. 1992. Available online: https://trid.trb.org/view/367500 (accessed on 13 August 1993).
18. Carpman, J.R.; Grant, M.A.; Simmons, D.A. Hospital Design and Wayfinding. *Environ. Behav.* **1985**, *17*, 296–314. [CrossRef]
19. Tommy, G.; Anders, B.; Erik, L. Spatial orientation and wayfinding in the designed environment: A conceptual analysis and some suggestions for postoccupancy evaluation. *J. Archit. Plan. Res.* **1986**, *3*, 55–64. Available online: http://www.jstor.org/stable/43028787 (accessed on 3 April 1985).
20. Rodrigues, R.; Coelho, R.; Tavares, J.M.R.S. Healthcare Signage Design: A Review on Recommendations for Effective Signing Systems. *HERD Health Environ. Res. Des. J.* **2018**, *12*, 45–65. [CrossRef]
21. Wu, N.Y. A preliminary study on improving outpatient experience. *China Rural. Health Care Manag.* **2019**, *39*, 656–658. Available online: https://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&&dbname=CJFDTOTAL&filename=ZNWS201909014 (accessed on 1 March 2019).
22. Chris, C.; David, V.-E. *Signage and Wayfinding Design. A Complete Guide to Creating Environmental Graphic Design Systems*, 2nd ed.; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2015; Available online: https://onlinelibrary.wiley.com/doi/book/10.1002/9781119174615 (accessed on 2 June 2015).
23. Gibson, D. *The wayfinding Handbook Information Design for Public Places*; Princeton Architectural Press: New York, NY, USA, 2009; Available online: http://worldcatlibraries.org/wcpa/oclc/1022836509 (accessed on 21 January 2009).
24. Boyd, D.R. Creating Signs for Multicultural Patrons. *Acquis. Libr.* **1993**, *5*, 61–66. [CrossRef]
25. O'Neill, M.J. Effects of Signage and Floor Plan Configuration on Wayfinding Accuracy. *Environ. Behav.* **1991**, *23*, 553–574. [CrossRef]
26. Tzeng, S.-Y.; Huang, J.-S. Spatial Forms and Signage in Wayfinding Decision Points for Hospital Outpatient Services. *J. Asian Arch. Build. Eng.* **2009**, *8*, 453–460. [CrossRef]
27. Anåker, A.; Heylighen, A.; Nordin, S.; Elf, M. Design Quality in the Context of Healthcare Environments: A Scoping Review. *HERD Health Environ. Res. Des. J.* **2016**, *10*, 136–150. [CrossRef] [PubMed]
28. Elf, M.; Nordin, S.; Wijk, H.; Mckee, K.J. A systematic review of the psychometric properties of instruments for assessing the quality of the physical environment in healthcare. *J. Adv. Nurs.* **2017**, *73*, 2796–2816. [CrossRef] [PubMed]
29. Devlin, A.S. Wayfinding in Healthcare Facilities: Contributions from Environmental Psychology. *Behav. Sci.* **2014**, *4*, 423–436. [CrossRef] [PubMed]
30. Melo, S. The role of place on healthcare quality improvement: A qualitative case study of a teaching hospital. *Soc. Sci. Med.* **2018**, *202*, 136–142. [CrossRef]
31. Pati, D.; Harvey, J.T.E.; Willis, D.A.; Pati, S. Identifying Elements of the Health Care Environment That Contribute to Wayfinding. *HERD Health Environ. Res. Des. J.* **2015**, *8*, 44–67. [CrossRef]
32. Carpman, J.R.; Grant, M.A.; Simmons, D.A. Wayfinding in Hospitals: Solving the Maze. *Environ. Behav.* **1984**, *25*, 743–760.
33. Kalantari, S.; Tripathi, V.; Kan, J.; Rounds, J.D.; Mostafavi, A.; Snell, R.; Cruz-Garza, J.G. Evaluating the impacts of color, graphics, and architectural features on wayfinding in healthcare settings using EEG data and virtual response testing. *J. Environ. Psychol.* **2022**, *79*, 101744. [CrossRef]
34. McLachlan, F.; Leng, X. Colour here, there, and in-between—Placemaking and wayfinding in mental health environments. *Color Res. Appl.* **2020**, *46*, 125–139. [CrossRef]
35. Rangel, M.; Alvão, C.M. Color and wayfinding: A research in a hospital environment. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting, Los Angeles, CA, USA, 1 September 2011; Volume 55, pp. 575–578. [CrossRef]
36. Estates, N.H.S. *Wayfinding: Effective Wayfinding and Signing Systems: Guidance for Healthcare Facilities (Supersedes HTM 65 'Signs')*, 2nd ed.; Stationery Office: London, UK, 2005.
37. Foster, J.J.; Afzalnia, M.R. International assessment of judged symbol comprehensibility. *Int. J. Psychol.* **2005**, *40*, 169–175. [CrossRef]
38. Jones, S. Symbolic Representation of Abstract Concepts. *Ergonomics* **1978**, *21*, 573–577. [CrossRef]
39. Rousek, J.; Hallbeck, M. Improving and analyzing signage within a healthcare setting. *Appl. Ergon.* **2011**, *42*, 771–784. [CrossRef] [PubMed]
40. Collins, B. Visibility of Exit Signs and Directional Indicators. *J. Illum. Eng. Soc.* **1991**, *20*, 117–133. [CrossRef]
41. Bubric, K.; Harvey, G.; Pitamber, T. A User-Centered Approach to Evaluating Wayfinding Systems in Healthcare. *HERD Health Environ. Res. Des. J.* **2020**, *14*, 19–30. [CrossRef] [PubMed]
42. Barrios-Ipenza, F.; Calvo-Mora, A.; Criado-García, F.; Curioso, W. Quality Evaluation of Health Services Using the Kano Model in Two Hospitals in Peru. *Int. J. Environ. Res. Public Health* **2021**, *18*, 6159. [CrossRef] [PubMed]
43. Larsen, D.L.; Attkisson, C.; Hargreaves, W.A.; Nguyen, T.D. Assessment of client/patient satisfaction: Development of a general scale. *Eval. Program Plan.* **1979**, *2*, 197–207. [CrossRef]
44. Marshall, G.N.; Hays, R.D.; Sherbourne, C.D.; Wells, K.B. The structure of patient satisfaction with outpatient medical care. *Psychol. Assess.* **1993**, *5*, 477–483. [CrossRef]
45. Merkouris, A.; Papathanassoglou, E.D.; Lemonidou, C. Evaluation of patient satisfaction with nursing care: Quantitative or qualitative approach? *Int. J. Nurs. Stud.* **2004**, *41*, 355–367. [CrossRef]
46. Quintana, J.M.; González, N.; Bilbao, A.; Aizpuru, F.; Escobar, A.; Esteban, C.; San-Sebastián, J.A.; De-La-Sierra, E.; Thompson, A. Predictors of patient satisfaction with hospital health care. *BMC Health Serv. Res.* **2006**, *6*, 102. [CrossRef]

47. De Oliveira, K.B.; de Oliveira, O.J. Making Hospitals Sustainable: Towards Greener, Fairer and More Prosperous Services. *Sustainability* **2022**, *14*, 9730. [CrossRef]
48. Chiarini, A.; Vagnoni, E. Environmental sustainability in European public healthcare. *Leadersh. Health Serv.* **2016**, *29*, 2–8. [CrossRef] [PubMed]
49. Zadeh, R.S.; Xuan, X.; Shepley, M. Sustainable healthcare design. *Facilities* **2016**, *34*, 264–288. [CrossRef]
50. Rodríguez, R.; Svensson, G.; Ferro, C. Assessing the future direction of sustainable development in public hospitals: Time-horizon, path and action. *Health Policy* **2020**, *125*, 526–534. [CrossRef] [PubMed]
51. Tarkar, P. Role of green hospitals in sustainable construction: Benefits, rating systems and constraints. *Mater. Today: Proc.* **2022**, *60*, 247–252. [CrossRef]
52. Williams, S.J.; Radnor, Z.J. Moving from service to sustainable services: A healthcare case study. *Int. J. Prod. Perform. Manag.* **2021**, *71*, 1126–1148. [CrossRef]
53. Brambilla, A.; Lindahl, G.; Dell'Ovo, M.; Capolongo, S. Validation of a multiple criteria tool for healthcare facilities quality evaluation. *Facilities* **2020**, *39*, 434–447. [CrossRef]
54. Fu, Y.; Wang, Y.; Ye, X.; Wu, W.; Wu, J. Satisfaction with and Continuous Usage Intention towards Mobile Health Services: Translating Users' Feedback into Measurement. *Sustainability* **2023**, *15*, 1101. [CrossRef]
55. Gustavsson, S.; Gremyr, I.; Sarenmalm, E.K. Using an adapted approach to the Kano model to identify patient needs from various patient roles. *TQM J.* **2016**, *28*, 151–162. [CrossRef]
56. Materla, T.; Cudney, E.A.; Antony, J. The application of Kano model in the healthcare industry: A systematic literature review. *Total. Qual. Manag. Bus. Excel.* **2017**, *30*, 660–681. [CrossRef]
57. Dcunha, S.; Suresh, S.; Kumar, V. Service quality in healthcare: Exploring servicescape and patients' perceptions. *Int. J. Health Manag.* **2019**, *14*, 35–41. [CrossRef]
58. Chen, M.-C.; Hsu, C.-L.; Lee, L.-H. Service Quality and Customer Satisfaction in Pharmaceutical Logistics: An Analysis Based on Kano Model and Importance-Satisfaction Model. *Int. J. Environ. Res. Public Health* **2019**, *16*, 4091. [CrossRef]
59. Hejaili, F.F.; Assad, L.; Shaheen, F.A.; Moussa, D.H.; Karkar, A.; Alrukhaimi, M.; Barhamein, M.; Al Suwida, A.; Al Alhejaili, F.F.; Al Harbi, A.S.; et al. Culture-Related Service Expectations. *Qual. Manag. Health Care* **2009**, *18*, 48–58. [CrossRef]
60. Hamed, S.; El-Bassiouny, N.; Ternès, A. Evidence-Based Design and Transformative Service Research application for achieving sustainable healthcare services: A developing country perspective. *J. Clean. Prod.* **2017**, *140*, 1885–1892. [CrossRef]
61. Yang, J.; Liu, W. Survey on the current situation of patients' satisfaction with hospital signage guidance system and analysis of related factors. *Abil. Wisdom* **2017**, *35*, 227.
62. Lam, S.S.K. SERVQUAL: A tool for measuring patients' opinions of hospital service quality in Hong Kong. *Total. Qual. Manag.* **1997**, *8*, 145–152. [CrossRef]
63. Sureshchandar, G.; Rajendran, C.; Anantharaman, R. The relationship between service quality and customer satisfaction—A factor specific approach. *J. Serv. Mark.* **2002**, *16*, 363–379. [CrossRef]
64. Oliver, R.L.; Linda, G. Effect of Satisfaction and Its Antecedents on Consumer Preference and Intention. *ACR N. Am. Adv.* **1981**, *8*, 88–93. Available online: https://www.acrwebsite.org/volumes/9746 (accessed on 1 September 1981).
65. Westbrook, R.A.; Reilly, M.D. Value-Percept Disparity: An Alternative to the Disconfirmation of Expectations Theory of Consumer Satisfaction. *ACR N. Am. Adv.* **1983**, *10*, 256–261. Available online: https://www.acrwebsite.org/volumes/6120/volumes/v1 (accessed on 1 November 1983).
66. Schneider, B.; Bowen, D.E. Understanding customer delight and outrage. *Sloan Manag. Rev.* **1999**, *41*, 35–45.
67. Barrios-Ipenza, F.; Calvo-Mora, A.; Velicia-Martín, F. Patient satisfaction in the peruvian health services: Validation and application of the HEALTHQUAL scale. *Int. J. Environ. Res. Public Health.* **2020**, *17*, 5111. [CrossRef]
68. Rose, R.C.; Uli, J.; Abdul, M.; Ng, K.L. Hospital service quality: A managerial challenge. *Int. J. Health Care Qual. Assur.* **2004**, *17*, 146–159. [CrossRef]
69. Khan, N.; Puthussery, S. Stakeholder perspectives on public-private partnership in health service delivery in Sindh province of Pakistan: A qualitative study. *Public Health* **2019**, *170*, 1–9. [CrossRef] [PubMed]
70. Morea, D.; Gebennini, E. New Project Financing and Eco-Efficiency Models for Investment Sustainability. *Sustainability* **2021**, *13*, 786. [CrossRef]
71. Kano, N. Attractive Quality and Must-Be Quality. *J. Jpn. Soc. Qual. Control* **1984**, *14*, 39–48. Available online: https://ci.nii.ac.jp/naid/10025070768/ (accessed on 30 January 1986).
72. Herzberg, F. *The Motivation to Work*, 2nd ed.; John Wiley & Sons: New York, NY, USA, 1959; Available online: http://worldcatlibraries.org/wcpa/oclc/803681223 (accessed on 30 January 1993).
73. Alrawahi, S.; Sellgren, S.F.; Altouby, S.; Alwahaibi, N.; Brommels, M. The application of Herzberg's two-factor theory of motivation to job satisfaction in clinical laboratories in Omani hospitals. *Heliyon* **2020**, *6*, e04829. [CrossRef] [PubMed]
74. Bohm, J. Two-factor theory—At the intersection of health care management and patient satisfaction. *Clin. Outcomes Res.* **2012**, *4*, 277–285. [CrossRef]
75. Gawel, J.E. Herzberg's Theory of Motivation and Maslow's Hierachy of Needs. *Pract. Assess. Res. Eval.* **1996**, *5*, 11. [CrossRef]
76. Dace, E.; Stibe, A.; Timma, L. A holistic approach to manage environmental quality by using the Kano model and social cognitive theory. *Corp. Soc. Responsib. Environ. Manag.* **2019**, *27*, 430–443. [CrossRef]

77. Lu, M.Q.; Zhou, B.; Tan, M. (2021): The Use Demand of Urban Signage System Based on the Kano Model. *Packag. Eng.* **2021**, *12*, 312–323. [CrossRef]
78. *GB/T 38654-2020, 3/31/2020*; Public Information Guidance Systems—Guidelines for Planning and Design. China Institute of Standardization: Beijing, China. Available online: https://std.samr.gov.cn/gb/search/gbDetailed?id=A24AF19F410B5C2EE05397BE0A0A5E0D (accessed on 31 March 2020).
79. Matzler, K.; Hinterhuber, H.H. How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment. *Technovation* **1998**, *18*, 25–38. [CrossRef]
80. Berger, C.; Blauth, R.; Boger, D. Kano's Methods for Understanding Customer-Defined Quality. *Cent. Qual. Manag. J.* **1993**, *2*, 3–35. Available online: https://www.sid.ir/en/Journal/ViewPaper.aspx?ID=262111 (accessed on 1 January 1993).
81. Lo, C.-W.J.; Yien, H.-W.; Chen, I.-P. How Universal Are Universal Symbols? An Estimation of Cross-Cultural Adoption of Universal Healthcare Symbols. *HERD: Health Environ. Res. Des. J.* **2016**, *9*, 116–134. [CrossRef]
82. Short, E.J.; Reay, S.D.; Douglas, R.A. Designing wayfinding systems in healthcare: From exploratory prototyping to scalable solutions. *Des. Health* **2019**, *3*, 180–193. [CrossRef]
83. Genc, V.; Genc, S.G. The effect of perceived authenticity in cultural heritage sites on tourist satisfaction: The moderating role of aesthetic experience. *J. Hosp. Tour. Insights*, 2022; *ahead-of-print*. [CrossRef]
84. Limerick, H.; Hayden, R.; Beattie, D.; Georgiou, O.; Müller, J. User engagement for mid-air haptic interactions with digital signage. In Proceedings of the 8th ACM International Symposium on Pervasive Displays, Palermo, Italy, 12–14 June 2019; Mohamed, K., Ed.; Association for Computing Machinery (ACM Digital Library): New York, NY, USA, 2019; pp. 1–7.
85. Huang, S.-M.; Shieh, K.-K.; Chi, C.-F. Factors affecting the design of computer icons. *Int. J. Ind. Ergon.* **2002**, *29*, 211–218. [CrossRef]
86. Lin, R. A study of visual features for icon design. *Des. Stud.* **1994**, *15*, 185–197. [CrossRef]
87. McDougall, S.; Reppa, I.; Taylor, J. Nudge and bias in subjective ratings? The role of icon sets in determining ratings of icon characteristics. *Behav. Res. Methods* **2022**, 1–18. [CrossRef] [PubMed]
88. *ISO 7010:2019*; Graphical Symbols-Safety Colours and Safety Signs-Registered Safety Signs. International Organization for Standardization: Geneva, Switzerland, 2019.
89. Ding, N.; Chen, T.; Zhu, Y.; Lu, Y. State-of-the-art high-rise building emergency evacuation behavior. *Phys. A Stat. Mech. Its Appl.* **2020**, *561*, 125168. [CrossRef]
90. Kubota, J.; Sano, T.; Ronchi, E. Assessing the compliance with the direction indicated by emergency evacuation signage. *Saf. Sci.* **2021**, *138*, 105210. [CrossRef]
91. Salawu, A. Implications of Signage on Wayfinding Behaviour of Users: Towards Inclusive Design of Hospital Environment in Nigeria. *Environ. Technol. Sci. J.* **2022**, *13*, 85–97. [CrossRef]
92. Sato, H.; Urata, M.; Yoguchi, K.; Arakawa, N.; Kanamaru, N.; Uchida, N. Linking digital signage with mobile phones. In Proceedings of the 2011 15th International Conference on Intelligence in Next Generation Networks (ICIN), Berlin, Germany, 4–7 October 2011; pp. 86–91.
93. Iftikhar, H.; Asghar, S.; Luximon, Y. A cross-cultural investigation of design and visual preference of signage information from Hong Kong and Pakistan. *J. Navig.* **2020**, *74*, 360–378. [CrossRef]
94. Shinar, D.; E Dewar, R.; Summala, H.; Zakowska, L. Traffic sign symbol comprehension: A cross-cultural study. *Ergonomics* **2003**, *46*, 1549–1565. [CrossRef]
95. Mikulić, J.; Prebežac, D. A critical review of techniques for classifying quality attributes in the Kano model. *Manag. Serv. Qual. Int. J.* **2011**, *21*, 46–66. [CrossRef]