Diversity & Equality in Health and Care
ISSN: 2049-5471

Open Access Research Article

Applying Design Principles to Support Healthcare Interiors

Diane Guevara*

Department of Technology, Eastern Michigan University, Ypsilanti, USA

ABSTRACT

The purpose of this study aimed to continue the research from a previous peer reviewed pilot-study. In the pilot-study, data was collected and applied to healthcare interior design and renovation recommendations. This current study continued the analysis of that data and added links to Research Informed Design (RID), Evidence-Based Design (EBD) principles, and Universal Design (UD) principles. The objective of the study is to produce a data collection instrument for use in any healthcare interior, not solely healthcare patient rooms, and to recommend the use of inclusive UD principles by healthcare interior designers and facility managers when considering new and renovated of healthcare facilities.

The method in this study used pilot-study data, conducted a review of the literature, and added a systematic method for applying UD principles to support ant healthcare interior design renovation recommendations.

The results of this study included the proposed data collection instrument, with pilot-study data applied, and a 40% increase (over the pilot study) in design guidelines for practice.

The conclusion of this article summarizes with implications for practice for healthcare interior design and renovations.

Keywords: Evidence-based design; Healthcare; Interior design; Observation instrument; Qualitative; Universal design

Abbreviation: RID: Research Informed Design; EBD: Evidence-Based Design; UD: Universal Design

INTRODUCTION

Healthcare facilities are spaces where patients, families, and staff come together to improve and ensure long-term well-being of patients [1]. Generally, healthcare centers are specialized medical facilities than offer interdisciplinary care related to health that is more comprehensive that general facilities or care centers [2]. These facilities offer comprehensive healthcare for patients, from routine care and health maintenance to preventive care, to targeted treatment of health-related diseases, to innovative or cutting-edge care options. Most often, healthcare centers are outpatient facilities that are staffed by providers across specialties and

Received:	02-July-2023	**Manuscript No:**	IPDEHC-23-16829
Editor assigned:	04-July-2023	**PreQC No:**	IPDEHC-23-16829 (PQ)
Reviewed:	18-July-2023	**QC No:**	IPDEHC-23-16829
Revised:	03-January-2025	**Manuscript No:**	IPDEHC-23-16829 (R)
Published:	10-January-2025	**DOI:**	10.36648/2471-8564.22.1.56

Corresponding author: Diane Guevara, Department of Technology, Eastern Michigan University, Ypsilanti, USA; E-mail: dguevara@emich.edu

Citation: Guevara D (2025) Applying Design Principles to Support Healthcare Interiors. Divers Equal Health Care. 22:56.

from other facilities, such as surgery, radiology, pathology, oncology, general practice, and others [3].

The design of interior healthcare facilities is an area of importance to both patients and staff and can have an emotional and physical impact on all users, and well-designed spaces can lead to more positive emotions and better rates of healing. The personal nature of healthcare treatment can lead to a variety of impacts on patients, families, and staff in healthcare settings. Facilities that are comfortable, accessible, aesthetically pleasing, and in alignment with healthcare and legal standards are more likely to result in better outcomes for patients, their families, and the facility staff.

Establishing design guidelines based on research support patient wellbeing. Design guidelines have been informed by numerous variables used for designing and renovating patient areas in healthcare centers. Designers of healthcare facilities should aim to have their designs embody a number of qualities that promote comfort. To achieve this goal, designers must have a method to collect data to inform decision making for interior design and renovations.

This research fills an existing gap in the field by producing a data collection instrument for use in any healthcare interior, not solely healthcare patient rooms, and to recommend the use of UD principles by healthcare interior designers and facility managers, when considering interior design and renovations of healthcare facilities. This study was developed from a previous pilot-study and the data resulting from it. This study produced implications for practice, a data collection instrument, and a 40% increase in design guidelines, over the original the pilot study.

This article will begin with a review of the literature, including three interior design frameworks, Research Informed Design (RID), Evidence-Based Design (EBD), and Universal Design (UD). Next, the methodology section will provide an overview of the pilot-study and the current study, including the development and testing of the instrument, as well as the impetus for change. The implications for practice will follow. Finally, the conclusion will provide an overview of the study and its findings.

MATERIALS AND METHODS

Healthcare centers are unique spaces in the medical community because the need for healthcare can be a sensitive topic for patients. Therefore, offering an atmosphere that calms and comforts patient is important to overall health outcomes [4]. Individuals and organizations responsible for designing and maintaining healthcare centers must think critically about their design choices to create spaces that can provide a sense of well-being. An effective healthcare center design will benefit patients and their loved ones, as well as the medical professionals providing care. The design guidelines for patient spaces in healthcare centers are frequently informed by the theoretical frameworks of Research Informed Design (RID), Evidence-Based Design (EBD), and Universal Design (UD). Creating comprehensive, data-driven observational design guidelines *via* a data collection instrument for healthcare centers to support health and wellness is the intention of this study. Creating a set of guidelines for use in any healthcare interior, not solely healthcare patient rooms, and to recommend the use of UD principles can offer healthcare interior designers and facility managers a better-informed and more inclusive option for healthcare space designs.

Theoretical Frameworks

Three theories support both the testing and refinement of the observational instrument for healthcare interiors in this article: RID, EBD and UD. Practitioners and academics have varying opinions on what research is and what evidence is, so although the definitions and goals of RID and EBD are similar, the terms are very different [4].

Research Informed Design (RID)

According to Peavy and Vander Wyst, RID is when credible research is applied in conjunction with project, client, or population-specific empirical inquiry in order to achieve project objectives and to aid in the creation of environmental design. Data, information, and knowledge gained from RID can be used by informed individuals to guide decisions. The use of the word “informed” in Peavy and Vander Wyst’s definition suggests that RID is best used in research where little prior knowledge exists [5].

Evidence-Based Design (EBD)

Peavy and Vander Wyst outlined that EBD is the process of basing decisions about the built environment on credible research to achieve the best possible outcomes. Researchers recognize the importance of using EBD to support interior design decisions. When practicing EBD, design professionals must consider not only the physical spaces used by individuals in the facilities for example, administrative and employee spaces, common areas, family or child spaces, patient spaces, and general visual appeal but also the non-physical aspects of a space acoustics or auditory appeal, technology currently used or future technological advances, and security [6]. The principles in this theory can be observed and tracked in a systematic format, and the observations can support both the inclusion and exclusion of the EBD principles. Using observational data collection tools within the framework of EBD will be informative for designing healthcare facilities.

Peavy and Vander Wyst offer a new definition of evidence-based design. The new definition defines evidence-based design as integrating available credible evidence, practitioner design expertise, and client population needs, preferences, and resources to make decisions about the creation of an environmental design and to achieve project objectives. Peavy and Vander Wyst’s new definition differs from the classic definition in that it allows for the inclusion designer creativity and practice knowledge in the solution. Prior to the new definition of EBD, EBD narrowly applied a wide base of evidence and RID broadly applied a narrow base of evidence to create a design.

According to Peavy and Vander Wyst, despite sharing overlapping elements, EBD and RID are separate designs (**Table 1**).

Table 1: Matrix of critical attributes for EBD and RID

Attributes	RID	EBD
Process	Identification of problem and goals; iterative testing, learning and application: and part of project delivery schedule	Identification of problem, goals and vision fluid inclusion of the eight-step EBD process as part of project delivery schedule
Resources	Credible research, empirical exploration, and client and population information	Credible evidence, interdisciplinary team expertise, and client and population information
Evaluation	Evaluation of research strength, quality, and applicability: testing/prototyping to facilitate design decisions: and evaluate design alternatives	Evaluation of evidence strength, quality, and applicability, and measurement of impact after completion
Application	Apply knowledge gained from project-specific empirical inquiry, prototyping. and research literature review to inform an environmental design	Project specific, context dependent, application of evidence, and client preferences to create an environmental design
Goal orientation	Focused on continuous improvement in designing to achieve project objectives within given constraints (e.g., design that meets the needs of the client and population) and share process and lessons learned	Focused on designing to achieve project objectives (e.g., patient outcomes) and add evidence for future projects through post-occupancy results
Definitions	RID: The process of applying credible research in integration with project, client, or population-specific empirical inquiry to inform the creation of environmental design and achieve project objectives	EBD: The process of making decisions about the creation of an environmental design by critically and appropriately integrating the sum of credible evidence, practitioner design expertise, client or population needs, and preferences and resources, in the context of the project, in order to achieve project objectives

The misuse of the terms, especially EBD, hinders interdisciplinary progress and collaboration [7]. However, using the RID and EBD terminology properly can assist in clearing up the expectations of researchers, clients, and practitioners; the new definition of EBD and Universal Design (UD) can aid in clarification as well.

RID and EBD both aid in the creation of an environmental design and have contributed to the interior design field. While RID uses research from project-specific and research-driven inquiry, EBD applies evidence gained through context-dependent inquiry, such as client preferences. The new definition of EBD from Peavy and Vander Wyst borrows from both classic RID and classic EBD practices, but there are still gaps in the design. Universal design addresses these gaps more completely; UD takes into account the needs of all people, including those with physical or mental restrictions and those with differing social identities. Universal design is useful to design an environment that is inclusive and can be efficiently used by a greater number of people than those designed solely with RID or EBD.

Universal Design (UD)

Universal design emerged in response to American accessibility laws, particularly the architectural barriers act of 1968, section 504 of the rehabilitation act of 1973, the fair housing act amendments of 1988, and the Americans with disabilities act of 1990 [8]. These acts specify minimum accessibility requirements for products and built environments. Universal design was developed to comply with the accessibility laws and to allow for the use of products and built environments across the greatest number of people. The concept of universal design was expanded into education curricula and classroom environments for those with and without disabilities. This concept, Universal Design for Learning (UDL) would benefit the greatest number of children with the least amount of modification to classrooms and curricula. There has been a recent public outcry for more responsive and compassionate health care, and UD can be applied to help remedy the issue. Thus, there is an imperative to develop a universal design, similar to that in education, to address a wide range of people's health needs [9].

The center for universal design noted that UD is the intentional design of products and environments such that they can be used by people of all ages and abilities/disabilities to the greatest extent possible. As with RID and EBD, the principles of UD theory can be observed and tracked in a systematic manner for both the inclusion and exclusion of its principles. When planning interior spaces, designers must consider aesthetics, the incorporation of nature (a practice

known as biophilic design), lighting, privacy, and more. However, there are additional considerations to be made outside of the aesthetic appeal of a space. Designs inclusive of all patient abilities, while incorporating RID and EBD, make UD important in spaces designed for individuals with physical or mental restrictions.

Universal design layouts can also be used by individuals without restrictions. Chou et al. noted that the design of healthcare institutions should be designed in a gender sensitive and comfortable manner to serve male and female patients equally, applying UD to gender disparities in healthcare. The research done by Chou et al., showed that gender friendly hospital environments, or those that were designed with UD, positively impacted patients' perceptions of the care they received. Universal design not only better serves individuals with restrictions, but, as in the case of gender-sensitive healthcare environments, also better serves individuals without restrictions.

Design Factors

Based on EBD, a set of best practices in design (EBD 1 to EBD 11) can be considered and implemented in renovating healthcare facilities (**Table 2**).

Table 2: Source chart in revised observation instrument; EBD Principles EBD 1 to EBD 11*.

Healthcare outcomes / Design strategies or environmental interventions	EBD1 Single bed rooms	EBD2 Access to daylight	EBD3 Appropriate lighting	EBD4 Views of nature	EBD5 Family zone in patients rooms	EBD6 Carpeting	EBD7 Noise reducing finishes	EBD8 Ceiling lifts	EBD9 Nursing floor layouts	EBD10 Decentralized supplies	EBD11 Acuity adaptable rooms
Reduce hospital - acquired infections	**										
Reduce medical errors	*		*				*				*
Reduce patient falls	*		*		*	*			*		*
Reduce pain		*	*	**			*				
Improve patients' sleep	**	*	*				*				
Reduce patient stress	*	*	*	**	*		**				
Reduce depression		**	**	*	*						
Reduce length of stay		*	*	*							*
Improve patient	**				*		*				

privacy and confidentiality											
Improve communication with patients and family membersn	**				*		*				
Improved social support	*				*	*					
Increase patient satisfaction	**	*	*	*	*	*	*				
Decrease staff injuries								**			*
Decrease staff stress	*	*	*	*			*				
Increase staff effectiveness	*		*				*		*	*	*
Increase staff satisfaction	*	*	*	*			*				

The factors discussed in Ulrich et al., include safety, patient outcomes, and staff outcomes. These factors have therefore been incorporated into this analysis as key areas of focus. When making decisions concerning interior design, designers and facilities managers must plan for the abilities and identities of all the individuals who may be using the space [10]. In healthcare interiors specifically, the individuals using an area may be of varying gender identities or abilities and may require assistive technologies or accommodations. Safety, patient outcomes, and staff outcomes in relation to UD are discusses below.

Safety: In healthcare environments, safety for staff and patients is a paramount concern. While there are medically necessary cleanliness safety standards to follow, there are also design safety concepts to implement. Universal design aids in the creation of a healthcare environment that is safe and can be used by people of varying abilities. Examples of safety-centered UD in healthcare include ventilation, finish materials, door locations, lighting, equipment, single-occupancy patient rooms, and private bathrooms.

Patient outcomes: Inclusive UD affects patients' perceptions of their treatment. The stimuli that patients experience in the hospital environment affect their reactions to the care they received. These reactions, in turn, affect how the patients perceive their experience in the hospital environment, shaping their future loyalty to the hospital and their willingness to pay for their treatment. Chou et al., found a universally designed, specifically a gender-friendly designed, hospital environment, had a positive impact on the patients' experience.

Staff outcomes: Universally designed healthcare environments positively impact staff outcomes. In comparison to a non-informed design environment, senior-level staff was more inclined to perform informed-design services in a UD environment [11]. Thus, in a UD healthcare environment, staff outcomes were positively impacted, allowing for better care for patients using UD rather than any other more commonly used designs.

Pilot-Study Design

This pilot-study collected and analyzed data applying the methodologies of observation, interview, and quantitative surveys. The researcher collected data on breast care center interior design best practices. Photographs of breast care centers from various countries were analyzed to provide data on common design practices.

One local breast care center was selected to be a field location for study and was evaluated for its design. For the purposes of this study, this center will be called the breast care center. The breast care center is a breast care center that offers many breast-related services, such as mammography, diagnostic services, pre-surgery, surgery, post-surgery, routine care, and treatments [12]. The number of services offered means that the center provides support for patients in all stages of their breast care journeys and must provide sufficient facilities for all manner of diagnosis, treatment, and staff activities. The coordinator of the breast care center answered interview questions to offer more information on how the interior design of the facility affected individuals, their interactions, and their care. The coordinator also suggested a survey be sent to staff about specific design features specifically, wheelchair maneuverability and auditory privacy could provide more in-depth and accurate information related to the design of the breast care center. In response, the researcher developed a survey on those topics and the design of the breast care center for distribution and analysis. The survey was designed to gather information on staff perceptions of the design of the space, focusing on what they would prioritize in a remodel and what portions of waiting areas were preferable. To this end, the check-in and mammogram procedural waiting rooms were compared [13]. In total, nine staff members received and returned the survey, which underwent a quantitative correlational analysis using data analysis software, Qualtrics (v3.11.0).

The survey data was analyzed in the previous study, so its analysis was not a priority in this recreation of the original study with new tools. Second, observations were conducted with an emphasis on the interior design features of three patient environments utilized by patients and staff. The data collected through quantitative surveys and interview was applied and produced 12 design guidelines/implications for practice. However, the pilot-study qualitative data was saved for application to this current study to assist in developing a data collection instrument.

Current Study

The pilot-study data was applied to the current study to create additional guidelines/implications for practice [14]. The additional guidelines/implications for practice produce a data collection instrument that can be used in any healthcare interior, not solely healthcare patient rooms. The new data collection instrument also allows researchers to recommend the use of UD principles to healthcare interior designers and facility managers when considering interior design and renovations of the facilities.

RESULTS

The result show in **Figure 1**.

ITEMS	AREA NAME: CHECK IN/WAITING
Visual Privacy	☐Seated privacy xStanding privacy NOTES: Could see patients from one check desk to the next.
Auditory Privacy	☐ White noise ☐ Voices muffled x Voices heard clearly NOTES: Could hear patients from one check desk to the next. White noise units placed in waiting area seating instead of in check in area.
Circulation	X Poor ☐Good NOTES: Large decorative circular columns restricted circulation through waiting area seating.
Way Finding	X Poor ☐Good NOTES: Family zone not visible for patients, nor families.
Intimacy Feel	X Poor ☐ Good NOTES: Apply literature review design guidelines from 2021 study.
EBD Principle* NOT applied	x Single-bed rooms x Daylight ☐ Appropriate lighting x Views of nature x Family zone in patient room x Carpeting x Noise reducing finishes☐ Ceiling lifts x Nursing floor layout☐ Decentralized supplies x Acuity-adaptable rooms. NOTES: Once patient is robed, single room not provided;no outdoor views; family zone not visible for patients, nor families; nursing layout includes a second waiting area where robes patients wait in a group.
UD Principle** NOT applied	x Equitable Use ☐ Flexibility in Use x Simple and Intuitive Use x Perceptible Information ☐ Tolerance for Error ☐ Low Physical Effort x Size and Space for Approach and Use. NOTES: No auto door openers in patient circulation areas; large round decorative columns blocking views of patient to nursing staff.
NOTES	

Figure 1: Proposed data collection instrument for healthcare interior environments renovations.

Instrument Development, Testing, and Improvements

Note taking was used for data collection at the time of the pilot-study. From the notes, an improved data collection instrument was developed for the current study (**Table 3**). EBD and UD principles were added to the pilot-study items to test the data collection instrument [15]. The addition of the EBD and UD principles resulted in eight additional design guidelines/implications for practice (from 12 guidelines/implications to 20), or a 40% increase (**Table 4**).

Table 3: Improvements to the pilot-study qualitative data collection instrument.

Serial no.	Improvements	Why
1	Added sub-variable prompts into visual privacy category	To improve ease of interpreting visual privacy data
2	Added sub-variable prompts into auditory privacy category	To improve ease of interpreting auditory privacy data
3	Inserted "ease" prompt in circulation category	To prompt the data collector
4	Inserted "visual cues" in way finding category	To prompt the data collector

5	Inserted "poor" and "good" into intimacy feel category	To prompt the data collector
6	Inserted all Evidence-Based Design (EBD) principles and source chart	To prompt the data collector
7	Inserted EBD source chart	To support ease of applying data to a valid design recommendation in source chart
8	Inserted all Universal Design (UD) principles and source chart	To prompt the data collector
9	Inserted UD source chart	To support ease of applying data to a valid design recommendation in source chart
10	Removed ADA code violation category	ADA codes need to be interpreted by an NCIDQ certified interior designer or licensed architect. Data collector might not be.

Table 4: Result of eight additional design guidelines.

Apply	Recommendation	Effect	In pilot-study implications for practice?
Apply EBD 1	Once patient is robed, provide single patient room	Reduce patient stress	No
Apply EBD 4	Views to outside nature	Reduce patient stress	No
Apply EBD 5	Move family zone to be visible from patient area	Improve communication with family	No
Apply EBD 9	Move white noise units to each check in area	Improve patient privacy	No
Apply EBD 9	Revise nursing floor layout by removing 2nd waiting room	Increase staff effectiveness	No
Apply EBD 11	Acuity adaptable patient room	Increase staff effectiveness	No
Apply UD 1a and 3c	Add auto door opener button	Same means of use and accommodate all language skills	No
Apply UD 7a	Remove decorative (non-structural) columns	Improved patient care giver communication	No

Improvements to the Pilot-Study Qualitative Data Collection Instrument

In the current study, the instrument incorporated seven improvements over the pilot-study note taking. **Table 2** lists the improvements and the reasoning for each improvement.

DISCUSSION

Implications of the Findings

When considering the interior design and renovations of healthcare facilities, design guidelines/implications for practice must be produced *via* a valid data collection instrument. A valid data collection instrument that uses UD principles can support researchers' design guidelines and renovation recommendations for any healthcare interior, not just patient rooms [16]. Using the alignment of design guidelines and RID and EBD principles (*via* source charts), with an emphasis on inclusive UD principles, researchers are more likely to report valid and effective results and recommendations to healthcare interior design decision makers.

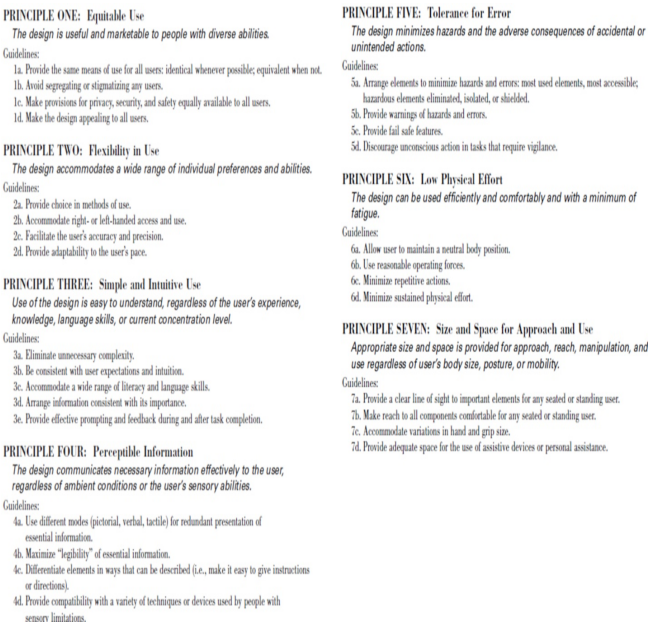
The breast care center pilot-study produced 12 design guidelines/implications for practice. With the post-pilot-study addition of the improved qualitative data collection instrument, eight additional design guidelines resulted [17]. This addition produced a 40% increase in design guidelines/implications for practice for the breast care center interior design renovation recommendations.

Implications for Practice

- Assists in the observational qualitative data collection for pre-renovation of healthcare interiors.

- Identifies opportunities for pre-renovation design guidelines linked to RID and EBD principles.
- Identifies opportunities for pre-renovation design guidelines linked to universal design principles.
- Identifies opportunities for healthcare interiors to be renovated in ways that allow for the inclusion of safety, patient outcomes, and staff outcomes, in any healthcare facility, and in an affirming manner for all patients.
- Supports the validity of future study results, utilizing observational qualitative data, qualitative interviews, quantitative surveys, and triangulation of the various data sets.

A healthcare center that is effectively designed can support all individuals who interact with the space regardless of their role; this premise is central to the "do no harm" tenet of healthcare, which refers to physical harm as well as emotional, psychological, or mental harm that can be caused by a lack of accommodations [18]. The support specific user needs depends on the individual, so healthcare centers must be designed to provide multiple accommodations rooted in the UD principles (UD 1 to UD 7) (**Figure 2**).



PRINCIPLE ONE: Equitable Use

The design is useful and marketable to people with diverse abilities.

Guidelines:

1a. Provide the same means of use for all users: identical whenever possible; equivalent when not.
1b. Avoid segregating or stigmatizing any users.
1c. Make provisions for privacy, security, and safety equally available to all users.
1d. Make the design appealing to all users.

PRINCIPLE TWO: Flexibility in Use

The design accommodates a wide range of individual preferences and abilities.

Guidelines:

2a. Provide choice in methods of use.
2b. Accommodate right- or left-handed access and use.
2c. Facilitate the user's accuracy and precision.
2d. Provide adaptability to the user's pace.

PRINCIPLE THREE: Simple and Intuitive Use

Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

Guidelines:

3a. Eliminate unnecessary complexity.
3b. Be consistent with user expectations and intuition.
3c. Accommodate a wide range of literacy and language skills.
3d. Arrange information consistent with its importance.
3e. Provide effective prompting and feedback during and after task completion.

PRINCIPLE FOUR: Perceptible Information

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

Guidelines:

4a. Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information.
4b. Maximize "legibility" of essential information.
4c. Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).
4d. Provide compatibility with a variety of techniques or devices used by people with sensory limitations.

PRINCIPLE FIVE: Tolerance for Error

The design minimizes hazards and the adverse consequences of accidental or unintended actions.

Guidelines:

5a. Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.
5b. Provide warnings of hazards and errors.
5c. Provide fail safe features.
5d. Discourage unconscious action in tasks that require vigilance.

PRINCIPLE SIX: Low Physical Effort

The design can be used efficiently and comfortably and with a minimum of fatigue.

Guidelines:

6a. Allow user to maintain a neutral body position.
6b. Use reasonable operating forces.
6c. Minimize repetitive actions.
6d. Minimize sustained physical effort.

PRINCIPLE SEVEN: Size and Space for Approach and Use

Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Guidelines:

7a. Provide a clear line of sight to important elements for any seated or standing user.
7b. Make reach to all components comfortable for any seated or standing user.
7c. Accommodate variations in hand and grip size.
7d. Provide adequate space for the use of assistive devices or personal assistance.

Figure 2: Source chart in revised observation instrument; UD Principles 1 to 7**.

Such accommodations may include UD for individuals with mental and physical disabilities as well as gender-sensitive design. Gender-friendly hospital environments have been proven to positively affect patients' satisfaction, and in turn their loyalty and willingness to pay. Gender-friendly bathrooms, signs, symbols, and images are important aspects of a healthcare environment that enhance the quality of healthcare services and increase gender equality in healthcare.

The current study aims to advance the body of knowledge for interior design by continuing the research from a previous pilot-study which identified interior design and renovation recommendations for healthcare patient rooms [19]. The objective of the current study is to address the gaps left by the pilot-study, find a design applicable to all medical areas, to include UD as a more inclusive and sensitive design type, and to create a data collection instrument for any healthcare interior to produce design recommendations. The study also aims to move the field of interior design forward with the creation of the data collection instrument. The literature review aimed to justify the need for the current study by addressing UD and gender-sensitive design needs in a healthcare environment inclusive of more than just patient rooms [20].

CONCLUSION

Researchers have the daunting task of applying meticulous observation methods to capture valid data. Relying on a single method to capture data, as well as inconsistencies in the criteria for observation, can threaten the validity of research results. Combining more than one type of data collection tool, such as qualitative observation, qualitative interview, and quantitative surveys, results in triangulation and supports the validity of the results. Researchers agree that analyzing safety, patient outcomes, and staff outcomes using RID, EBD, and UD principles can aid in identifying the strengths and weaknesses of healthcare interiors. Interior designers can then apply the strengths and weaknesses of existing healthcare interiors to the renovation in any healthcare interior, not solely healthcare patient rooms, and to recommend the use of inclusive UD principles by healthcare interior designers and facility managers.

In the previous pilot-study, data collected produced 12 design guidelines/implications for practice. This study expanded on the previous case study, proposed a data collection instrument and produced eight additional design guidelines resulted. This was a 40% increase in design guidelines/ implications for practice for the pilot-study breast care center interior design renovation recommendations. This instrument is provided for researchers, interior designers, and facilities managers to fill a gap in the industry for assessing renovations needed for healthcare interiors.

The objective of the study was to produce a data collection instrument to identify strengths and weaknesses of any healthcare interior, not solely healthcare patient rooms. While cognizant of RID and EBD principles, the data collection instrument can be largely informed by inclusive UD principles. The data collection instrument can be used by researchers and facility managers when considering the interior design of new or renovated healthcare facilities.

LIMITATIONS

The first limitation is individuals may not want to answer certain questions, may not remember something accurately and may not be entirely truthful.

The second limitation is time and expense. Quantitative research studies can be very expensive and take a lot of time. This must be considered when conducting what is needed to

achieve accurate results in a quantitative study. For these limitations, whether they are sampling or non-sampling, the survey data used in this current study was analyzed in the earlier, pilot study. To avoid sample bias, the researcher carefully insured at the participants was representative of the target population in the pilot study.

The third limitation consists of specific geographic location and population, differing levels of knowledge, experience, and influences, answer validity, and misinterpretation of results. This can lead to having population specific answers and not be applicable to other areas or populations.

For the limitations, the researcher previously conducted the aforementioned pilot-study, and the portion related to the interviews was vetted to assist in developing the data collection instrument discussed in this article.

REFERENCES

1. Alvaro C, Wilkinson AJ, Gallant SN, Kostovski D, Gardner P (2016) Evaluating intention and effect: The impact of healthcare facility design on patient and staff well-being. HERD. 9(2):82-104.
2. Bassuk EL, Latta RE, Sember R, Raja S, Richard M (2017) Universal design for underserved populations: Person-centered, recovery-oriented and trauma informed. J Health Care Poor Underserved. 28(3):896-914.
3. Chou YC, Dang VT, Yen HY, Hsu PS (2018) Developing a measurement scale of gender-friendly hospital environments: An exploratory study of customer perceptions in Taiwan. Int J Environ Res Public Health. 15(10):2227.
4. Couillard E, Higbee JL (2018) Expanding the scope of Universal Design: Implications for gender identity and sexual orientation. Educ Sci. 8(3):147.
5. Dolph E (2021) The developing definition of universal design. J Access Des. 11(2):178-194.
6. Fogli D, Arenghi A, Gentilin F (2020) A universal design approach to wayfinding and navigation. Multimed Tools Appl. 79(45):33577-33601.
7. Guevara D (2021) Specialty space: Breast care centers. HERD. 14(3):358-373.
8. Hamilton DK (2019) Evidence, intuition, and experiment: Partners in the design process. HERD. 12(3):66-71.
9. Huber AM (2021) Exploring informed design services during the project–defining phases in commercial interior design. J Inter Des 46(2):11-33.
10. Korstjens I, Moser A (2018) Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. Eur J Gen Pract. 24(1):120-124.
11. Lorusso L, Lee JH, Worden EA (2021) Design thinking for healthcare: Transliterating the creative problem-solving method into architectural practice. HERD. 14(2):16-29.
12. McCusker K, Gunaydin S (2015) Research using qualitative, quantitative or mixed methods and choice based on the research. Perfusion. 30(7):537-542.
13. Moore T, Kalms N (2020) Exploring gender-sensitive design. Architecture Australia. 109(5):18-19.
14. Paluch J, Kohr J, Squires A, Loving V (2022) Patient-centered care and integrated practice units: embracing the breast care continuum. J Breast Imaging. 4(4): 413-422.
15. Raskind IG, Shelton RC, Comeau DL, Cooper HL, Griffith DM, et al. A review of qualitative data analysis practices in health education and health behavior research. Health Educ Behav. 46(1):32-39.
16. Quan X, Joseph A, Nanda U (2017) Developing evidence based tools for designing and evaluating hospital inpatient rooms. J Inter Des. 42(1):19-38.
17. Stichler JF (2018) Ensuring shared understanding: Defining and analyzing concepts. HERD 11(3):6-10.
18. Ulrich RS, Zimring C, Zhu X, DuBose J, Seo HB, et al. A review of the research literature on evidence based healthcare design. HERD. 1(3):61-125.
19. Ulrich RS, Bogren L, Gardiner SK, Lundin S (2018) Psychiatric ward design can reduce aggressive behavior. J Environ Psychol. 57:53-66.
20. Yin RK (2018) Case study research and applications. 6th Edition. Thousand Oaks, CA: Sage.