Needs Realization Management Process (NRMP)

A Shift of Focus to Need-Centred Healthcare Service Design & Management in Jordan

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Submitted in Partial Fulfilment for the Requirements for the Award of the Degree of

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Date of Submission
February, 2021

Declaration

I, Rawan Suleiman Juma, do hereby declare that:

Whilst registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award.

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Date of Submission
February, 2021

Word Count

Full-Text *No Excluded Text*	Main Body *Excluding Index, Tables, Bibliography & Appendices*
94,380	**67,000**

Abstract

Context

There is not much agreement among scholars as to what the term "needs" refers to in the context of healthcare. The ambiguity surrounding patient needs has had many negative implications for the application of theoretical findings of this research in practical healthcare settings. Given the magnitude of the evidence pointing towards a strong relationship between environmental design and patient needs and outcomes, it is essential to examine the degree to which environmental design in contemporary healthcare facilities contributes to the realization and satisfaction of patient needs.

Aims

The primary aim of this study is to explore the nature and extent to which the built environment can potentially affect patient needs and outcomes, evaluating the extent to which said environment could contribute to patients' healing processes. The study culminates in the introduction of a new design decision and management framework, which is aimed at addressing the performance gap that currently exists in the field.

Design

The design of this study is observational in nature, drawing on researcher observations and empirical data to obtain the study's findings. The study uses deductive and inductive approaches to analysing the data, using these approaches to conduct a confirmatory analysis of existing evidence.

Methods

A systematic review is used by the researcher to gather data from solid experimental and non-experimental sources of knowledge. These sources are used to develop a conceptual framework, which will serve to guide the development of two questionnaires, distributed to patients and clinical staff.

Sampling

The final sample population of the study constitutes 216 patients and 102 healthcare staff members at 6 Jordanian hospitals, located in Amman.

Findings

The findings of the study support earlier research findings establishing a strong link between the built environment and patient needs and outcomes. Three key design dimensions were explored: spatial, ambient, and functional, all of which were found to influence patient needs in certain key design categories, including lighting, flooring, acoustic quality, visual quality, indoor quality, and accessibility.

Implications

The study concludes with the development of a design decision and management framework centred around patient needs and outcomes.

Originality

This study provides a framework outlining a proposed approach to evaluating how healthcare design solutions should be applied in practice—a commonly neglected theme in the literature.

Keywords

Environmental Design; Built Environment; Healthcare; Patient Outcomes; Patient Needs; Design; Policy; Evidence-Based Design; Framework

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Acronyms

ACSQHC	Australian Commission on Safety and Quality of Health Care
AHMAC	Australian Health Ministers' Advisory Council
AHPSR	Alliance for Health Policy and Systems Research
AHRQ	Agency for Healthcare Research and Quality
AIA	American Institute of Architects
ALS	Amyotrophic Lateral Sclerosis
ANA	American Nurses Association
ANOVA	Analysis of Variance
APA	American Psychological Association
BRM	Benefits Realization Management
CALM	Comfort Always Matters
CHD	Centre for Health Design
CHSD	Centre for Health Service Development
CIBSE	Chartered Institution of Building Services Engineers
CQHCA	Committee on Quality of Health Care in America
DASI	Duke Activity Status Index
dBA	Decibels (A-Weighted)
DOS	(Jordanian) Department of Statistics
EBD	Evidence-Based Design
EBM	Evidence-Based Medicine
ECU	Emergency Care Unit
ED	Environmental Design
EDR	Environmental Design Research
ELM	Electronic Library of Medicine
EPA	Environmental Protection Agency
FIDIC *French*	Federation Internationale des Ingenieurs Conciels *International Federation of Consulting Engineers*
GDP	Gross Domestic Product

GHEU	Global Health Ethics Unit
GNP	Gross National Product
HCF	Health Care Facility
HHC	(Jordanian) High Health Council
HRQOL	Health-Related Quality of Life
HSE	Health Service Executive
ICF	Inner City Fund (International)
ICU	Intensive Care Unit
ILO	International Labour Organization
IOM	(U.S.) Institute of Medicine
JCR	Joint Commission Resources
JEA	Jordan Engineers Association
JPFHS	Jordan Population and Family Health Survey
KAUH	King Abdullah University Hospital
KHH	King Hussein Hospital
MEAP	Multiphasic Environmental Assessment Procedure
MENA	Middle East & North Africa
MOR	Multi-Occupancy Room
NCBI	National Centre for Biotechnology Information
NGO	Non-Governmental Organization
NRMP	Needs Realization Management Process
OCLC	Online Computer Library Centre
ODC	Overseas Development Council
PCA	Principal Component Analysis
POE	Post-Occupancy Evaluation
PQLI	Physical Quality of Life Index
PRO	Patient-Reported Outcome
PROM	Patient-Reported Outcome Measure
PSD	Psychologically Supportive Design
QOL	Quality of Life
RCT	Randomized Control Trial
RID	Research-Informed Design
RMS	Royal Medical Services

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ROB	Risk of Bias
ROBINS-I	Risk of Bias in Non-Randomized Studies — of Interventions
SOR	Single-Occupancy Room
SPSS	Statistical Package for Social Sciences
SSN	Social Support Network
UN	United Nations
WHO	World Health Organization
WHOQOL	World Health Organization Quality of Life Assessment

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Introduction

Chapter Overview

Chapter 1 presents a general introduction to the topic of this study and outlines the main purpose and rationale to undertaking research in the field of environmental design in the health sector. The chapter begins by providing some background and context to the research topic, with the aim of tackling the issue of using design to improve the quality of care and patient outcomes. Following a general overview of the topic, the problem statement is made, and the purpose, aims, objectives, and questions of the study are presented thereafter. Finally, the chapter concludes by outlining the structure and content of chapters to follow,

1.1 Research Motivation

1.1.1 Background & Rationale

The conceptualization of human needs has been a widely contested field of study in the literature, and a consistent definition outlining what a human need comprises has yet to emerge, let alone be developed for universal applications (Asadi-Lari et al., 2003). Healthcare research has had particularly difficult time conceptualizing patient needs (Dover, 2003), despite the importance of developing a consistent definition of the term "patient needs" in this field.

Ever since the earliest conceptualizations of needs in the context of social research (Bradshaw, 1978) and psychology (e.g. Maslow, 1943; 1970, 1971), the need for establishing and defining human needs saw the interest of many scholars across different fields of research. Among the most recent fields is incorporating the construct of human needs into architectural design.

This correlation between design and human needs has been most thoroughly examined in healthcare applications, establishing the requirement to incorporate human needs into the design of healthcare facilities to establish a healing environment (Huisman et al., 2012; Ulrich et al., 2008; 2013).

While the term "healing environment" itself has only been coined anew, the concept of healing environments dates to the days of Ancient Greece, where facilities known as Asklepieia were constructed, the aim of which was to surround patients with nature, music and artwork. According to Jonas & Chez (2004), Asklepieia are thought to have been built to "restore harmony and promote healing [of patients]." In much a similar way to modern healing environments, an Asklepion offered a more holistic approach to healing, rather just focusing on maintaining the physical wellbeing of patients (Fani & Artemis, 2010).

Healing environments are but one manifestation of the recent shift in focus towards rethinking healthcare systems that have taken hold over the course of the past two decades (Carpman et al., 1986; Malkin, 1992, Becker & Douglass, 2008). At the heart of this shift lies the patient, wherein healthcare providers and regulators, in response to changes in the medical practice and consumer demand, have realized the need understand how key environmental variables can be best manipulated to develop a facility with patients at its heart (McCollough, 2009).

Not only did the increase in consumer demand result in this subsequent shift, but so has growing international awareness among healthcare administrators and medical professionals, and healthcare staff; who, while also partially motivated by enhancing quality of care for patients, are all motivated by the fact that they also stand to gain from this shift in trend (Ulrich, 1991). In other words, while the redesign of healthcare facilities is at its heart focused on patient healing, healthcare staff stand to benefit as well by facilitating a better medium through which they can perform their duties; while management can utilize redesign to cut back on costs and address sustainability concerns (McCollough, 2009).

In understanding how to improve the built environment, one must first examine the issue from the perspective of the environment's most frequent user groups, obtaining feedback from them on what changes they think matter, and how this environment could be designed in accordance with their needs. Obtaining feedback directly from the primary user groups of a facility is an essential step for quality improvement in the field of healthcare first, as such users are most familiar with the issues they encounter daily while using the environment.

In the context of healthcare environments, the two primary user groups who come into the most direct contact with the facility are hospital in-patients who use those facilities, and the clinical care staff whose job it is to provide care services to those patients (Hopkins et al., 1994).

1.1.2 Problem Statement

There is not much consensus in the literature as to what the term needs refers to the context of healthcare (Lightfoot, 1995; Culver, 1998; Asadi-Lari et al., 2003; Asadi-Lari et al., 2004). This vagueness is especially exemplified in cases where a need cannot be restricted to any one field or domain; such is the most commonly recurring theme in discussions of healthcare vs. social needs (Asadi-Lari et al., 2004).

The ambiguity surrounding healthcare needs has had many negative implications for practical research applications in healthcare and has made transitioning from service-led healthcare to need-led healthcare a much more difficult task, drastically halting applications such as EBD (Evidence-Based Design) in healthcare practice (Parry-Jones & Soulsby, 2001).

Given the compelling amount of evidence indicating a strong relationship between the built environmentand patient needs and outcomes (both physiological and psychological outcomes, which are elaborated on further in Section 2.7) (Huisman et al., 2012; Ulrich, 1984, 1991; Ulrich et al., 2008), it is essential to consider the opportunity costs that remain unrealized to this day, in terms of patient healing, their various needs, the needs of their healthcare providers, along with the administrative needs of maintaining low costs and maximizing operational efficiency (McCollough, 2009).

This issue is especially relevant in the context of Jordan today, as the Jordanian healthcare delivery system is the primary factor influenced by the massive influx of refugees from neighbouring countries following the Arab Spring. This saw demand for healthcare increase dramatically over the past few years, which has resulted in considerable strain on the healthcare sector as a whole; dramatically reducing the quality of care provided to patients. However, as is indicated by the research of Rawabdeh & Khassawneh (2018), as well as markers such as Jordan's GDP, the ratio of healthcare expenditures went down instead of rising, which is cause for concern as the reduced expenditure may be a strong indicator of a compromise in the quality of care provided to patients (Stepovich, 2019).

1.1.3 Need & Significance

1.1.3.1 Conceptualization of Human Needs

Academia has long acknowledged the study of human needs as an imperative field of research to model and conceptualize, which has culminated in many theories of human need over the past few decades. Such frameworks are typically multidimensional—not confined to one area of study; but rather, they span across a multitude of different academic disciplines, including Socio-Politics (Dover, 2013; Reamer, 1998), Psychology (Maslow, 1943, 1971; Pittman & Ziegler, 2007), and Medicine (IOM, 2001; Petersen & Alexander, 2001).

However, as studies exploring the impact of environmental design on human needs are relatively recent in comparison to other fields of study relating to human needs, this warrants and urges theoretical conceptualizations of human needs in this context, such that future empirical work may be conducted on the basis of a well-established framework; improving upon it as new findings are discovered (McCollough, 2009).

While academic sources, such as the works of Sahs et al. (2017) and Prior et al. (2019), widely support the claim that implementing healthcare reform can have considerable benefit to patient outcomes in comparison to the costs expended to implement this change. Similarly, authors exploring patient needs specifically cite similar potential benefits resulting from the proper conceptualization of human needs (Asadi-Lari et al., 2003; 2004; Donabedian, 1984; Fortney et al., 2011).

1.1.3.2 Bridging Literary Gaps

While the topic of this research has emerged as a widely popular field of study in recent years, the majority of that research has been conducted in developed nations with well-matured healthcare systems (Peabody et al., 2006; Tsekleves & Cooper, 2017). In contrast, emerging economies, such as the Kingdom of Jordan, receive little attention in such fields; though an argument can be made that such applications are needed even more in those countries; as to compensate for the comparatively lower quality of care provided by their healthcare systems (Han, 2012).

In Jordan specifically, research on how human needs can translated in design applications is very scarce, and what few articles that could be found were either methodologically unsound or were estimated to have a very high degree of bias—based on a systematic evaluation of the literature (See Section 3.43.5.4, which details the shortcomings and limitations of works conducted by authors such as AlZoubi & Al-Rqaibat, 2014; and Muhsein et al., 2017, both of which were conducted in Jordanian hospitals).

Furthermore, the findings of Eid AbuRuz and his colleagues indicate a slight tendency by practising nurses in private Jordanian Hospitals to be somewhat more knowledgeable of and have better attitudes towards the field of EBD; in comparison to those working in public hospitals, though the study's findings indicate that only for the male population of the study (AbuRuz et al., 2017). Such findings urge the need to identify the extent to which environmental design applications are prevalent in Jordanian Healthcare Sector, what the impact of such applications is on the users of local healthcare facilities; and the extent to which the private and public healthcare systems in the region differ in terms of the quality of care provided to patients.

Aside from the theoretical gaps present in the literature, some practical performance gaps are also evident in practice (See Section 2.5.2). This application is of the utmost importance, and should not only be considered from the practitioners' perspective, but from the perspective of researchers as well, as the usability of the established frameworks largely sets the stand for whether they are implemented in application or not (Fortney et al., 2011).

A need can therefore be established to conduct a well-constructed evaluation of environmental design in Jordan, as hospitals begin to take initiatives addressing hospital design in the private sector. An article by Laitinen (n.d.) claims that the entirety of the design overhaul of KHH (King Hussein Hospital) was based on EBD interventions, aimed at enhancing wayfinding, offering a family-centred design, greater privacy and views, integrated technology, and improving material quality. However, the source article (Laitinen, n.d.).

There were no sources elaborating on the theories underlying the design interventions made, nor does it detail how the interventions were monitored to ensure that patients benefitted as a result of the reform.

1.2 Research Purpose

1.2.1 Statement of Aims

Traditionally, the design of healthcare facilities has emphasized certain concerns of functional efficiency, cost, and providing an effective platform to host the best medical treatment and technology (Ulrich, 1992). However, a need to focus on different aspects of the built environment emerged over the past few decades, and consumer demand for a supportive healing environment increased subsequently (McCollough, 2009).

However, healthcare facility redesign stands to impact more than just the patients who stand to benefit from such supportive healing environments. Other stakeholders in healthcare, including staff, family members, and healthcare administration/management, took notice of the overwhelming difference in benefit between a traditional healthcare facility, and an optimized one (McCollough, 2009).

As ample evidence already exists, indicating the presence of a performance gap regarding the development of healing environments based on patient needs—especially in less economically developed regions of the world (Codinhoto et al., 2009), this research pursues this aspect as a secondary aim.

Having established that, the primary aim of this research is to introduce a facility design decision framework by exploring the nature and extent to which a healing environment designed in line with a patient's needs stands to benefit patients' outcomes, evaluating the extent to which the internal built environment could be said to contribute to a patient's healing process.

The secondary aim is to identify which design aspects of the built environment in healthcare contribute the most to patients' healing and satisfaction with the quality of care. Achieving both aims will help in developing a conceptual framework laying down the foundations of healthcare design interventions for maximizing quality of care and patient satisfaction.

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1.2.2 Objectives

To ensure that the primary and secondary aims of the study are attained, the following research objectives are developed in line with the purpose of the research:

1. *To examine the conceptualization of patient needs in literary works, and explore the practical implications of these conceptualizationsin hospital settings*

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2. *To investigate the nature of the relationship between redesigning the built environment[1] to be more patient centred on the outcomes of patients, as well as other stakeholders such as staff, management, and regulatory authorities.*

Commented [A4]: [3] Added explanation of what a built environment encompasses in the scope of this research

3. *To assess the role that healthcare environmental[2] design plays in improving patient healing processes, and if possible, isolate causal therapeutic impacts arising from certain design interventions[3]*

Commented [A5]: [6] Limited the scope of the term "healthcare"

Commented [A6]: [2] Added footnote explaining what a design intervention is

4. *To evaluate whether a performance gap exists between theoretical and practical healthcare environmental design applications, and how a framework can be designed to close such a performance gap*

5. *To introduce a facility design decision framework, centred around meeting patient (and other users') needs and improving outcomes, conceptualized based on empirical and theoretical research findings*

1.2.3 Questions

In line with the research objectives detailed in the section above, the research questions were developed to serve as a guideline to conducting the research:

1. *Which healthcare environmental design factors are expected to have a significant impact on patient needs/outcomes, based on the results of past research?*

2. *To what degree are patient needs/outcomes[4] currently accounted for in current healthcare environmental design practice?*

Commented [A7]: [5] Added footnote cross-referencing where the terms are detailed
[8] What should I change the terms to instead?

3. *When is the most appropriate time to consider patient needs/outcomes in the design process?*

[1] Built environment refers to hospital rooms where inpatients reside throughout their hospital stay (does not include any other rooms or facilities such as a surgery room)

[2] Defined as a private hospital setting in the scope of this research

[3] Defined as any design change made to within a hospital setting intended to improve quality of care or the aesthetic look of a facility

[4] Patient needs and outcomes are differentiated and discussed in detail in Chapter 2: Theoretical Background

4. *How can current healthcare environmental design practices be developed to maximize patient needs/outcomes?*

5. *To what extent are healthcare facility users' needs/outcomes intercorrelated in the context of environmental design? More specifically, does patient satisfaction particularly contribute to the attainment of other expected outcomes?*

6. *Would it be beneficial to develop a design approach that is centered around the realization and management of patient needs/outcomes? If so, then how can such a framework be implemented in practice?*

1.3 Research Contributions

1.3.1 Contributions to Theory & Knowledge

1.3.1.1 Conceptual Framework Development

The conceptual framework developed in this research, titled the "Needs Realization Management Process", provides a general method of applying general steps to the evaluation and implementation of design changes in different environments, focusing on the needs of a single/multiple user group(s).

Although the framework was developed in relation to the field of healthcare and the attainment of healing environments, the steps outlined are general in nature, and can be applied to any other environment focusing on the needs of the environment's users. Furthermore, the framework itself provides a solid foundationfor future research to improve upon, integrating additional steps and advancing the model for practical applications based on theory.

1.3.1.2 Systematic Review of Contemporary Research

Rashid (2013) states that, with a few exceptions, proponents of using design focused on human needs have yet to make considerable progress in systematically reviewing the available sources of evidence in the field of healthcare redesign, positing the need for more systematic reviews to summarize empirical findings.

Furthermore, most contemporary systematic reviews in healthcare environmental design are either univariate in nature (examining the impact of a single design variable on one or more patient outcomes). While such a method may be most appropriate to ensure the homogeneity of the reviewed studies (Higgins et al., 2019), it is also characterised by the drawback that it does not allow for the simultaneous side-by-side comparison of the effects of different design factors.

For instance, a systematic review by Hadi et al. (2019) examined the effect of light on sleep (and sleep-related physiological factors). Dixit et al. (2019) examined the impact of flooring material and finishes on patient outcomes. In a similar fashion, Fay et al. (2018) examined the impact of nursing station decentralization on patient safety and quality of care received, seeking to establish whether one design change could be adapted to fulfil the needs of two user groups at once.

However, most of these systematic reviews are relatively small in scale, and the largest major review identified by this research was the one conducted by Ulrich et al. (2008). While there have been subsequent reviews,such as Calkins et al. (2012), Huisman et al. (2012), Malkin et al. (2012), and Hadi et al. (2019), none could be said to match up to the standard established by Ulrich and his colleagues. Therefore, this research hopes to tread the same path as the authors of that review, creating a more up to date systematic review of the environmental design factors affecting patient needs and outcomes.

1.3.2 Contributions to Policy & Practice

According to Stankos & Schwarz (2007), recent trends in healthcare design strongly advocate the consideration of human needs in practical environmental design applications, including the construction and renovation of healthcare facilities.

EBD is an approach primarily focused on the design of the built environment (Wanigarathna et al., 2019), and it places emphasis on ensuring the critical application of robust and tested design interventions to facilitate the creation of a therapeutic healthcare environment (Hamilton & Watkins, 2009).

However, while the evidence constituent of EBD certainly serves to promote evidence-backed applications of good design reform (Hamilton, 2003; Hamilton & Watkins, 2009; Stichler, 2007), the current EBD literature focuses mostly on identifying which therapeutic elements benefit facility users the most, neglecting to discuss how practitioners could put the identified elements to good use (Wanigarathna et al., 2019).

Seidel (1980) summarizes the issue quite well in two concluding statements on applications of social research in architecture and design, stating that:

> “architectural education does not have a tradition of explicitly using the results of social research.”
>
> “[and] `social research does not have a tradition of formulating itself in ways that would produce results useful to professional decision-makers.”
>
> **Andrew Seidel**, Seidel (1980)

According to Rashid (2013), the lack of practical applications of human needs in healthcare stem not from the fact that designers and proponents do not understand the process and how to apply it. Rather, emerging fields such as Evidence-Based Design (EBD), that look to use research to back-up practical reform, require time for the theory to inform the development of evidence-based models (Anderson, 2012). This idea is expanded upon further in Chapter 7, where potential solutions are provided as to how the issue should be approached, given the current state of implementation and integration of design solutions in healthcare, particularly to Jordan, and countries facing similar economic distress.

1.4 Research Outline

1.4.1 Outline of the Research Methods

In an editorial published in the BMJ (British Medical Journal) over two decades ago, Sackett & Wennberg (1997) point out how much researchers need to stop “squabbling over the best methods” in studies of EBD. The authors argue that too much time has been wasted expending intellectual and emotional energy exploring whether some methods are better suited for design interventions, or whether a more general approach to the design ought to be used.

> "Each method should flourish, because each has features that overcomes the limitations of the others when confronted with questions they cannot reliably answer…"
>
> **David Sackett & John Wennberg**
>
> Sackett & Wennberg (1997, p. 1)

Given the focus on the concept of EBD, which emphasizes the role of evidence quality above all else in decision-making and utilizing results in practice, this research draws on evidence obtained using several different research methods. Referring back to Section 1.2.2, the means used to gather the data for each of the above-stated objectives is outlined in Table 1.

Table 1

Research Objectives &Corresponding Method

Objective Ref	Description	Data Type	Cross-Reference
O1	Examine the current understanding of needs and outcomes in healthcare	Secondary	Literature Review
O2	the relationship between built environment and patient needs and outcomes	Primary	Patient Questionnaire
			Staff Questionnaire
		Secondary	Systematic Review
			Theoretical Review
O3	Identify and assess the role of environmental design components on patient's needs and outcomes	Primary	Patient Interview
			Staff Questionnaire
O4	Evaluate whether a performance gap exists, and how a framework could be designed to address it	Secondary	Theoretical Review
		Primary	Staff Questionnaire
		(Output)	NRMP Framework
O5	To introduce a facility design decision framework, centred around patient needs / outcomes	(Output)	NRMP Framework

Based on a preliminary review of the literature, the researcher identified several commonly used research designs in the context of healthcare environmental design. Most notably, an emphasis is placed on experimental research designs in this field, as those methods provide real and measurable test differences between patients situated within different environments.

Expanding further, a theoretical review was adopted to identify the relevant needs and outcomes of hospital patients, and to establish a good theoretical background which will be used in constructing the conceptual framework of the study. A systematic review was adopted in this research to examine how each design component ties to the various patient needs identified in the theoretical review.

However, some authors argue against this view, making the claim that some aspects of the built environment are better analyzed using other quantitative/qualitative research designs [See Section 3.2.3].This is indeed the case for the purposes of this study, as no one experimental design can be developed to assess multiple design components at once, let alone all of them. While not technically impossible, an experimental design of this scale would require massive amounts of funding, coordination on the scale of a whole institution, and would entail some question marks regarding its ethicality.

1.4.2 Outline of the Chapters

This thesis is structured into seven chapters in total, excluding the bibliography and appendices sections. To help the reader better understand the logical underpinnings of this study's development, a summary of the chapters is outlined below:

Chapter 2

Theoretical Review

The second chapter presents the theoretical review of this study, in which key relevant ideas and concepts will be identified, defined, and explored, prior to any further discussion in later sections. The chapter will also draw on the work of past theoretical models to better understand the modelling process developed in this study.

Chapter 3

Systematic Review

The third chapter presents a systematic review of the literature on healthcare environmental design, examining which factors have a significant impact on meeting patient needs and delivering outcomes. The chapter outlines the process undertaken to conduct the review, how quality and bias were calculated, and presents a summary of the review's findings.

Chapter 4

Methodology

The fourth chapter outlines the methodological framework and design of the study, how the hospital and participant samples were selected, the methods used for data collection, extraction, and synthesis, and any ethical considerations undertaken by the researcher.

Chapter 5

Findings & Discussion

The fifth chapter outlines the methodological framework and design of the study, how the hospital and participant samples were selected, the methods used for data collection, extraction, and synthesis, and any ethical considerations undertaken by the researcher.

Chapter 6

Conclusions & Recommendations

The sixth chapter presents the final concluding remarks, based on the findings of the systematic review, along with the primary empirical findings of the study. The chapter also offers some recommendations for future theory and practice, present's the study's limitations, and how those limitations can be accounted for in future studies.

Chapter 7

NRMP: Design Framework

The seventh and final chapter details a design framework developed by the researcher, titledNRMP (Needs Realization Management Process), which is intended to help model a framework for use in translating literary findings into practice, focused on establishing a need-centred design for healthcare facilities.

2 Conceptual Review

Chapter Overview

The second chapter presents a conceptual review of the literature on human needs, healthcare environments and their users, and the field of environmental design in general. Terminologies and past theoretical models are considered in this chapter and play a major role in shaping this research, building upon those concepts to develop a design framework, that is presented in Chapter 7.The chapter first explores the human needs and environmental design. Then concludes with an analytical section, in which the researcher will briefly explore and identify the categorical lists of design dimensions of healthcare facilities, patient needs, and outcomes, which formulates the basis of the systematic review and methodological design of this research.

2.1 Introduction to Conceptual Review

The literature review process in this research was divided into two primary components. In the first component, literary sources are used to obtain a sufficient theoretical and conceptual background on the topics of environmental design and human needs, exploring conceptual, contextual and theoretical backgrounds on each topic individually. As such, this component of the literature review forms the backbone of the conceptual framework used to conduct the research, which is presented at the end of the next chapter.

- The second component of the literature review process comprises a systematic review of the evidence linking healthcare environmental design to patient needs and outcomes, providing a more critical and evaluative approach to eliminating biased empirical work, and presenting methodologically and analytically sound evidence on the range of impacts resulting from interventions in healthcare environments.
- Most sections/sub-sections throughout the chapter are labelled with one of the following terms:**“Conceptual Background of…”**

  These sub-sections are often presented at the beginning of each section, and they explore the relevant terminology relating to the topic of the chapter, which is used to detail the meaning of each term used in the research, and distinguishing between concepts in different contexts.
- **“Contextual Analysis of…”**

  These sub-sections detail an analysis of a topic/theory as applied in different contexts and situations, which are often unrelated but intertwined. These subsections are used to distinguish how the same terms/concepts have been used to convey/explore different issues throughout the literature.
- **“Theoretical Background of…”**

  These sub-sections provide a brief evaluation of the most relevant theoretical frameworks and models pertaining to each topic, examining their validity, considering criticisms of the theories, and exploring whether they are applicable to the context of this study.
- **“Critical Analysis of…”**

  Finally, these sections present the results of examining the previously mentioned sub-sections which are used to identify the most useful factors from theory to be integrated into the conceptual framework of the research.

2.2 Terminology

In analysing the literature, it sometimes appeared that the field of EBD was such an arbitrarily composed field, especially when it came to the categorisation of the facilitating/mediating factors that relate design features to user needs/outcomes (identified in this study as the ***Functions*** of design). In fact, Rashid (2013) states that the entirety of classifications used in the literature are "arbitrary, imposed, and politically charged," arguing that many EBD terms often carry misrepresentative implied meanings—the primary aim of which is to elicit a response from the listener; usually for the sake of obtaining funding for projects.

However, it is only normal for classifications of a system to be designed in such a way that they express imposed constructs, in the case the term's users are able to correctly identify such imposed constructs in the natural structures of practical research and application.

After all, a catchphrase term whose terminological expression matches up with the true nature of the impact does not necessarily have to be a bad thing; it just must avoid deliberate mistruth for the sake of personal agendas.

There is considerable philosophical debate in the literature as to whether all of the different classifications offered by researchers are with merit, or are just meaningless (or in some cases, even misleading) jargon that ought to be substituted for simpler, more meaningful terms that are true to the expression.

Terminology & taxonomy is particularly important for the case of a "research-based" field such as EBD, as there is no easy way for the classification of knowledge, especially when the field only grew into popularity over the past two decades or so.

Even though the use of systematic reviews and meta-analyses has particularly grown a lot over the past few years, the current knowledge base is not yet at a point that urges so-called "Taxonomists" to develop an official terminology of the field (Conklin, 1969; Franklin, 1971); given how little is currently known of the impacts of the built environment on patient needs and outcomes.

While conducting the systematic review of this study, the researcher also observed that practitioners are gravitating towards the use of the term RID to encompass the aspect of translating EBDR into practically applicable forms. This observation also supported by the work of Peavy & Vander Wyst (2017), who conducted a comparative analysis between the two concepts. The authors explain this trend as a direct consequence of EBD's terminological rigidity and misapplication in real life.

According to Winter (2014), as *scientific research* is a term often used for describing/explaining the present state of things in the fields of sciences, the terms*science* or *scientific research*are often used synonymously to explanatory research, though some semantic differences may be ascribed to the two. This terminological difference is important as the framework differentiates between scientific and empirical measurement, wherein the former will be used about measurements taken using specialized tools, while the latter while be used to the classic trial and error approach to research.

Commented [A8]: [9] Rephrased for clarity

2.3 An Overview of Human Needs

2.3.1 Conceptual Background of Human Needs

2.3.1.1 Basic Human Needs

2.3.1.1a Defining Basic Human Needs

As many researchers (Armstrong, 1982; Crooks et al., 2020; Doyal & Gough, 1984;Fitzgerald, 1977; 2016; Human et al., 2017) point out, the concept of a need is largely dependent on the context, and as yet there is no universally applied definition. As such, to proceed with the development of a conceptual framework focused on how the environment could be adapted to help realize human need, it is of critical importance that the different conceptualizations of the construct be explored; preferably in different contexts, as that will help isolate the conceptual points of focus pertinent to each context.Human needs are defined by Michalos (2014) as:

Commented [A9]: [10] Updated to include newer references

> *"the drivers of peoples' actions, the motives behind human behavior."*

Commented [A10]: [11] Added definition of human needs

The difference between this description of human needs and wants is best clarified by Dierksmeier (2014), who elaborates on both concepts, referring to wants as "artificially generated", implying that life can persevere without the fulfilment of wants. This is contrary to needs, implying the existence of a much bigger negative connotation to not fulfilling needs than wants.

Commented [A11]: [11] Added further explanation to clarify the difference between both terms and define wants

In the context of development policy, the construct of a basic (or fundamental) human need is often used to denote the fundamental, minimum standard of living that social policy ought to assign to its poorest citizens.

In the 1976 World Employment Conference, the ILO (International Labour Organization) (ILO, 1976) states that basic human needs are comprised of two primary elements:

1. Firstly, they include the basic requirements of a typical household, which are primarily made up of basic commodities, such as:

   e.g. *Food, Shelter, Clothing, Basic Household Items*

2. Secondly, they include a community's basic service requirements.

e.g. *Safe Drinking Water, Adequate Service Utilities, Public Transport Systems, Educational Institutions, Healthcare Institutions*

While survival and physical wellbeing are often the first items considered in discussions of basic human needs, the construct is not so rudimentary as to just comprise these two elements (Gough, 2014). *Ergo*, restricting basic needs to an individual's health would fail to adequately capture the term's intended meaning. As Sen (1948) points out, the concept of a need ought to be interpreted a lot more passively than the concept of capability, in that needs imply certain aspects such as independence and autonomy, along with many other elements that extend far beyond mere survival.

Although many authors (Galtung, 1980; Mallmann & Marcus, 1980; Arbulu, 1987) often consider the adjective basic an adjunction to the term, this adjective is contextually used as an attribute that dissociates the construct from including higher human needs, such as growth and self-fulfilment (Denton, 1990).

2.3.1.1b Distinguishing Needs from Wants

Needs are frequently confused with wants, in both literary and practical views (Camerelli, 2017; Gasper, 2007). The distinction between the two concepts is critical to decision-making, as implementing decisions to help fulfil needs outweighs doing so to fulfil wants. This research chose to explore the aim in the context of healthcare as this context is a real medium of application with real, measurable ramifications to those affected by the implementation of design changes, which further emphasizes the significance of research in this field of study.

The notion of a human need can be best eluded to by distinguishing it from a human want. While there may be some points where two constructs overlap, there is some consensus in the literature as to the distinction between the two; although the topic has been of much contention in the past (McGregor et al., 2009).

In a general sense, the distinction between the two is that the term need is typically used to refer to goal categories that are, as Gough (2014) coins it, universalifiable; meaning that they can be generalized across a wide range of societal groups and peoples.

In contrast to wants, the universality of a need stems from the fact that considerable harm is expected to result in the case a need goes unfulfilled (Wiggins, 1998; 2005).

The universality of a need—though not always eluded to using this terminology, is often recognised and accepted as the distinguishing feature separating need and want categories.

Wherein needs are thought to be universal in nature, wants are typically seen as either temporal (relating to historical timeframe), spatial (relating to geographical region), or personal (relating to an individual's characteristic traits or demographics) (Arbulu, 1987).

Accordingly, differentiating needs and wants upon the basis of universality would define the former in terms of globally applicable standards of living, irrespective of cultural and economic elements, and the latter as any goals or ambitions supplementary to those established standards.

2.3.1.2 Healthcare Needs

2.3.1.2a Defining Healthcare Needs

Many literary sourcespoint out that there isnot much consensus among scholars as to what the term human needs means in the context of healthcare environments (Lightfoot, 1995; Culver, 1998; Asadi-Lari et al., 2003; Asadi-Lari et al., 2004). Furthermore, the overlap in terminology between factors that coincide in the realms of human needs and outcomes does not make it easier to ascertain a comprehensive set of human needs that are across patient groups.

Among the earliest definitions of needs in healthcare is the one proposed by Donabedian (1974), who defines a healthcare need as "some disturbance in health and well-being." This approach to the definition of needs focuses on the identification of issues that may cause suffering to human beings and is less concerned with whether and how the identified needs could potentially be addressed.

Countering this view, authors including Matthew (1971) and Cochrane (1976) have urged researchers to recognize the existence of healthcare needs only when they can be met with some potential resolution with positive utility for the affected individuals, with reasonable costs. In line with this counterview, Acheson(1978)argues that considerations must be provided to the costs and utility gained by identifying how a need could be fulfilled first, and then defining a need based on resource availability, and whether anything could be done to address this need (Acheson, 1978, Glass, 1976).

According to Wright (1998), need in healthcare is commonly defined as "the capacity to benefit." In much the same way that previous authors require the availability of a positive outcome for something to constitute a "need", the author states that there is no ample cause to identify a "need" as one if no benefit could be brought about by intervention, or there are not enough resources available to make said intervention.

More recently, the WHO (2011) defines “health needs” as:

> “Objectively determined deficiencies in health that require health care.” – WHO (2011)

Furthermore, the WHO (2011) glossary subcategorizes health needs into the following three groups:

1. **Perceived Health Needs:** The need for health services as experienced by the individual and which he/she is prepared to acknowledge; which may not coincide (2) Professionally defined need or (3) Scientifically confirmed need.
2. **Professionally Defined Health Needs:** The need for health services as recognized by healthcare professionals from the point-of-view of the benefit obtainable from advice, preventive measures, management or specific therapy; which may not coincide with (3) Scientifically confirmed need.
3. **Scientifically Confirmed Need:** The need for health services as confirmed by objective measures of biological, anthropometric, or psychological factors, expert opinion or the passage of time; which is generally considered to conform to at least one internationally acknowledged classified disease.

2.3.1.2b Distinguishing Healthcare Needs from Social Care Needs

Care is a very broad term, and difference in terminology between Healthcare needs and social care needs must be established to clarify what distinguishes the two terms.

In a revised version of the U.K. ***National Framework for NHS Continuing Healthcare and NHS-Funded Nursing Care*** (Department of Health and Social Care, 2018), the guideline establishes the difference between health and social care by stating that:

> "Some needs are clearly health needs and some needs are clearly social care needs; and some needs may be either or both."
>
> "Whilst there is not a legal definition of a health need … in general terms it can be said that such a need isrelated to the treatment, control, management or prevention of a disease, illness, injury or disability, and the care or aftercare of a person with these needs (whether or not the tasks involved have to be carried out by a health professional)."
>
> "Similarly, there is not a legal definition of the term 'social care need'… however … eligibility criteria for care and support to determine when an individual or their carer has eligible needs which the local authority must address, subject to means where appropriate. These criteria set out that an individual has eligible needs … where these needs arise from (or relate to) a physical or mental impairment or illness which results in them being unable to achieve two or more … outcomes [listed in the document] which is, or is likely to have, a significant impact on their wellbeing."
>
> (Department of Health and Social Care, 2018)

Based on this distinction, it is evident that social care services, can mostly be considered a constituent of healthcare needs in general, and encompasses services provided by a welfare program. On the other hand, a healthcare need is much more expansive than that, especially regarding the inclusion of the phrase "the care or aftercare of a person with those needs," identifying the care process (inside or outside healthcare facilities) as an essential component of a healthcare needs.

Commented [A12]: [12] Edited basic grammar for clarification

2.3.1.3 Concluding Remarks

This section concludes by proposing a definition for needs in healthcare, which shall be used throughout the remainder of this thesis. In line with the conceptualizations of the authors presented throughout this section, particularly the definition proposed by WHO (2011), the researcher defines needs in healthcare as:

An objectively defined and measurable necessity, resulting from a health-related deficiency; to which intervention could be potentially applied, yielding benefit to the individual suffering as a result of the deficiency.

2.3.2 Contextual Analysis of Human Needs

2.3.2.1 Human Needs in the Context of Social Work

The concept of a social need is an essential component of social justice and studies. Recognizing human needs has been a critical reference point in defining the relationship between individuals and their social collective groups and forms the very backbone upon which standards of life in a society are built (Sahlins, 1974).

The earliest instances of the concept of a *need* appear in historical evaluations of past civilizations, wherein it often manifested in some form of collective action(s) undertaken by society at large to help those individuals viewed to be in need (McGregor et al., 2009). Studies of the social sciences, therefore, are typically concerned with understanding the impacts of human needs on a society, and what actions can be taken into account for meeting those needs (Bradshaw, 1972).

Among the most vocal and consistent proponents of human needs in the social context is David Gil, who, in recognizing the importance of the discussion on human needs to societal development, adopted a hierarchal division of needs, built on the work of Maslow (1943).

From a social perspective, Gil (1992; 2004) identified a set of 5 human needs that included:

1. Meaningful Relationships
2. Meaningful Work
3. A Sense of Security
4. Self-Actualization
5. Spiritual Needs

Aside from serving as a model for discussions in the studies of economics, political sciences, anthropology, and sociology (Dover, 2013), Gil's model is still among the most popular base models in practical applications to modern social policy.

Not only did Gil's early work focus on theoretically examining human needs, but the author was also a strong proponent of integrating human needs theories into social policies. Gil's stance was that human needs is a critical matter that ought to be addressed to achieve the higher principles of social justice (Gil, 2004; Dover, 2013).

According to Dean (2010), human needs theories contribute a great deal to research and applications in social policy, more so in recent times, as to address issues such as climate change and consumption (Gough, 2015). Social policy, thereafter, plays a critical role in determining the minimum quality standards of healthcare set out by authorities.

2.3.2.2 Human Needs in the Context of Management

Theories of human needs have seen their fair share of application in managerial and motivational contexts. For instance, Maslow's Hierarchy of Needs [See Section 2.3.3.1] is widely used model of human behaviour, often used in managerial theory, and adapted into managerial models to better understand how to maximize employee productivity and boost sales.

In such a context, needs are important as they help management understand how fulfilling human needs can improve their work productivity and output andmaximising organisational profitability in the long run. This issue will be brought up in more detail in the framework of this study (See Chapter 6), where the same theme emerges in terms of fulfilling staff needs to maximize their outcomes, in turn, indirectly contributing to patient needs.

An example of this would be minimizinga nurse's walking distance via the use of decentralized nursing stations, which reduces their average walking distance/time, addressing nurses' comfort needs, while also contributing to patients' care needs by ensuring timely delivery of care.

Commented [A13]: [13] Fixed from maximizing to minimizing

While Maslow's Hierarchy is one of the oldest—and most contested theories in motivational literature, it remains one of the most frequently applied models in management to do this day, in both theory and practice (Silton et al., 2011).

2.3.2.3 Human Needs in the Context of Healthcare

Healthcare stands out as one of the most extensively researched fields in terms of the research done on the recognition and satisfaction of human needs (Asadi-Lari et al., 2003).According to the AHRQ (AHRQ, 2018), a primary goal of healthcare management is to align the care provided with the general needs of the population receiving this care, making identifying and addressing those needs an essential component of healthcare service provision.

The topic is often brought up in discussions of maximising patients' psychological and physiological outcomes, along with many other subtopics of this study, including Evidence-Based Medicine(EBM)[5]

Commented [A14]: [29] Defined EBM at first point of use

2.3.2.4 Human Needs in the Context of Engineering

In his book, ***Being Successful as an Engineer***, William Roadstrum, connects the engineering process to human needs by stating that:

> "The engineer's work is not just technology (or just technical knowledge)! It is a doing—an ***application of technical knowledge to human needs***."
>
> ***William Roadstrum***
>
> ***[Emphasis Added]*** (Roadstrum, 1998)

Emerging trends in the fields of engineering and design have also seen in-depth integration of human needs into conceptual and practical models. One such instance is a key theme to this study, which is the development of healing environments, in which designers consider the human element first and foremost andfollow up with the actual design process later.

2.3.2.5 Concluding Remarks

This section concludes by summarizing the four contexts in which needs have been explored in the literature and differentiating the focus points of each of those contexts, as is presented in Table 2.

Table 2

Theoretical & Practical Contexts of Human Needs Research

Theoretical Field(s)	Practical Field(s)	Area of Focus
Sociology	**Social Policy** **Social Change**	Culminated in the use of human needs theory in the development of social policy aiming to resolve the issues leading to those needs
Psychology	**Management** **Employee Motivation** **Customer Motivation**	Culminated in the use of human needs theory in managerial applications to enhance

[5] The implementation of practice in medicine using the most meritable evidence

Theoretical Field(s)	Practical Field(s)	Area of Focus
		employee behaviour and increase productivity
Medicine	**Healthcare Policy** **Healthcare Reform** **Healing Environments**	Culminated in the use of human needs theory in the development of healthcare policy, change, and reform, as well as the development of healing environments
Engineering	**Healing Environments** **Environmental Design** **Evidence-Based Design**[6]	Culminated in the use of human needs theory to aid in the practical applications of the construction of human-centred environments, as well as fields of study and application such as EBD (Evidence-Based Design)

2.3.3 Theoretical Background of Human Needs

2.3.3.1 Maslow's Hierarchy of Needs

2.3.3.1a Contextand Influences

Among the most widely recognized models of human need is the one proposed by Maslow (1943), shown in Figure 1. In Maslow's Hierarchy of Needs, Maslow depicts human needs in a hierarchal structure, in which needs are presented in such a way that implies that an individual cannot transition towards fulfilling their higher needs until they have fulfilled their more basic needs.

Maslow's study of human needs is grounded in managerial and behavioural contexts, ultimately aiming to investigate what drives humans to pursue the satisfaction of different categories of need. However, despite the theory's origins lying in this realm of theory, Maslow's model has influenced countless research articles in several different fields of study; including some of the earliest conceptualizations of human need from a nursing perspective (Silton et al., 2011).

This is largely attributed to the generalizability of Maslow's model (Jackson et al., 2014), which it maintains while still focusing on the human element in human needs. The theory's influence extends to the modern day, aiding practitioners foster a culture of change in their

[6] See **Section 2.3.1.2: Evidence-Based Design**

respective fields of study. The model's use in healthcare contexts has also seen its fair share of application over the past few decades (Nyden et al., 2003; Abraham, 2011).

2.3.3.1b Theory and Model

Figure 1andTable 3shows Maslow's Hierarchy in its revised (extended) form, in which Maslow expanded upon the theoretical model beyond the originally proposed five-stage model, to include three additional growth needs: Cognitive, Aesthetic, and Transcendence (Maslow, 1970; 1971).

Commented [A15]: [14] Introduced table 3

Figure 1

Theories of Need, Maslow's Hierarchy of Needs — Extended Model

Source: Adapted from Maslow (1943; 1970; 1971)

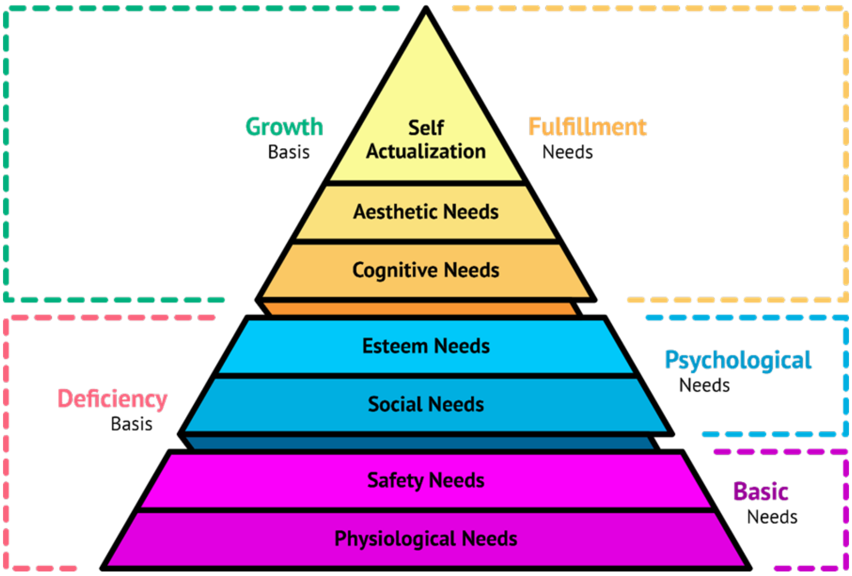


Table 3

Maslow's Hierarchy of Needs, Descriptions of Need Categories

Source: Adapted from Maslow (1943; 1970; 1971)

Grouping			Description		
Category	**No.**	**Subcategory**	**Definition**	**Examples**	
Deficiency-Based Needs					
Basic	1	Physiological	Primary requirements for mere survival	*Air*	*Water*
				Shelter	*Sleep*
	2	Safety	An assurance to meet	*Security*	*Order*

Grouping			Description		
Category	**No.**	**Subcategory**	**Definition**	**Examples**	
			future basic needs	*Law*	*Health*
Psychological	3	Social	Seeking interaction with loved ones	*Family*	*Affection*
				Work	*Intimacy*
	4	Esteem	Self-esteem and recognition	*Award*	*Status*
				Reputation	*Achievement*
Growth-Based Needs					
Fulfilment	5	Cognitive	Desire to understand and solve problem	*Knowledge*	*Meaning*
				Awareness	*Curiosity*
	6	Aesthetic	Appreciation and search for beauty	*Beauty*	*Balance*
				Form	*Structure*
	7	Actualization	Reaching one's personal potential	*Growth*	*Dreams*
				Development	*Goals*
	8	Transcendence	Helping others reach their potentials	*Sense-making*	*Meaning*
				Oneness	*Selflessness*

Needs in ***Maslow's Hierarchy*** are often grouped into 2 categories: *deficiency-basedneeds*, and *growth-based needs*:

1. **Deficiency-Based Needs**

   Needs arising from the deprivation of a basic physiological or psychological requirement. Needs that fall under this grouping would not drastically affect an individual if met but would have a detrimental effect if not met; hence, the deficiency.

2. **Growth-Based Needs**

   Needs arising from one's desire to grow as an individual and achieve their aspirations in life. Needs that fall under this grouping are expected to change an individual's life once met, not for the lack thereof.

The primary difference between these two groupings of need is in their impact an individual's motivation to satisfy/fulfil said need. In the case of *deficiency-based needs*, an individual would not care to satisfy the need any further once it is initially met; while *growth-based needs*, on the other hand, drive an individual to pursue them even further once they are first attained.

As for the needs themselves set out by Maslow, the core focus of the model is on the transition from basic, physiological elements, such as food and water, to higher needs that are associated with appreciating beauty, actualizing one's true meaning in life, and helping others derive meaning from theirs.

2.3.3.1c Criticism and Relevance

Many a researcher has criticized Maslow's hierarchy, and a few reasons are commonly cited. Methodological discrepancies in Maslow's approach (Mittelman, 1991), miscategorised elements in the model (Kendrick et al., 2010), and the very nature of a hierarchal model itself (Hofstede, 1984) are the most frequently cited sources of criticism of Maslow's approach to addressing human needs.

Such criticisms are fundamental to Maslow's model at its core, and while the model has been revised repeatedly in the past, no amount of revision can remediate a flaw such as the hierarchal nature of the model, and such a flaw would be better accounted for by devising a new framework altogether (Rosenberg et al., 1992).

However, despiteall the criticisms outlined above, Maslow's hierarchy remains one of the most influential theories in the literature on human needs, decades after its original publication, and continues to influence research in numerous fields of study (Silton et al., 2011).

While there have been some instances of researchers directly integrating Maslow's framework in healthcare environmental research (Benson & Dundis, 2003; Nyden et al., 2003), several arguments can be made against such an application, and they can be summarized as follows:

- **Research has failed to demonstrate the relevance of growth needs in the context of environmental design**

A noteworthy consideration to make is that similar studies integrating Maslow's framework into their research designs often fail to illustrate the relevance of growth needs in environmental design. For instance, Nyden et al. (2014) conducted a qualitative research study on older patients in Swedish ECUs (Emergency Care Units), who were asked to self-report on the perceived impact of environmental design on their various needs, which were based on the need categories defined in Maslow's original five-stage model. While the respondents all made statements corresponding to their deficiency-based needs, not a single statement by the patients even remotely related to patients' self-fulfilment or growth.

However, this is not such a surprising finding, given that the users of healthcare environments, in most cases, are individuals too caught up in addressing their immediate deficiencies (ailments)—making it unlikely for them to pay any immediate attention to things like growth and fulfilment (Nyden et al., 2014; Logan & Everall, 2019; Zalenski & Raspa, 2006).

- **Research has failed to validate the use of a hierarchal model to represent needs**

As Rosenberg et al. (1992) put it, while Maslow's model may be intuitively appealing, little research supports its validity as a research tool. Studies attempting to validate the hierarchal nature of Maslow's model mostly come up short, and empirical evidence at best supports such a structure partially, but never fully (Bridwell & Wahba, 1976; Hofstede, 1984). Furthermore, Maslow's hierarchy is focused on the transition from deficiency to growth needs, which further voids the need for a hierarchal model altogether.

- **Applications of the framework may be limited in cases extending beyond its original motivational/behavioural context**

As stated earlier, Maslow's Hierarchy was initially developed to serve as a guide to human behaviour (Maslow, 1943; 1971). While understanding human behaviour can have some useful implications in the context of environmental design, the model itself contains no reference to the physical environment and would fail to adequately capture the influence of an environment on its user's needs. Furthermore, a result of the framework's generalizable nature, it can be very limited in examining how the needs of different healthcare stakeholders' factor are realized through different design features.

2.3.3.2 Bradshaw's Taxonomy of Needs

2.3.3.2a Context & Influences

In his seminal publication: ***A Taxonomy of Social Need***, Jonathan Bradshaw developed a taxonomy of human needs that contributed a great deal to shaping how needs are understood in modern social work (Bradshaw, 1972). Bradshaw's model somewhat differs from the work of other authors in that it does not identify any categories of need (such as *Safety* or *Belongingness*), but rather, it categorizes needs into 4 different groupings, based on how, and by whom those needs are identified in any given context, making no further efforts to identify any subcategories down the chain. Among the benefits of such a design is that the model is quite flexible in adapting to user-defined need categories.

According to McGregor et al. (2009), Bradshaw's Taxonomy is most useful and applicable in social policy circles. This view is supported by Asadi-Lari et al. (2003), who indicate the framework's usefulness for social and healthcarepolicy-making; as is evident by itswidespread use in social policy circles and the number of current healthcare policies advocating its use (McGregor et al.,2009, Asadi-Lari et al., 2003).

2.3.3.2b Theory & Model

Bradshaw (1972) categorizes needs into the following 4 groupings:

1. **Normative Needs**

   Refer to needs which are identified and defined by experts in their respective field. Groups/Individuals falling below a certain established standard are identified to be *in-need*.

   e.g. An educated decision made by a healthcare expert that an ill person is in need for medical treatment.

2. **Felt Needs**

   Refer to needs which represent how an individual/group feels about a certain issue and are interpreted based on the individual/group's personal experience and perspective.

   e.g. Pain for which someone has not yet acted to resolve

3. **Expressed Needs**

   Refer to felt needs turned into actions, which are expressed by an individual/group's demand for the need.

   e.g. Pain for which someone seeks help from a healthcare professional

4. **Comparative Needs**

   Refer to needs which are identified by comparing the services received by an individual/group to those received by a comparable individual/group.

   e.g. Recognizing the need for medication in a poor town, as this medication is available in a neighbouring town.

What makes Bradshaw's model useful in both theory and practice is that it does not restrict users to any predefined set of criteria. Rather, the model classifies needs into different groupings based on their estimated credibility and applicability in the context in which they are applied. According to McGregor et al. (2009), this is very much the reason the model is still applied in frameworks developed to this day, in several different fields' contexts, including healthcare (Asadi-Lari et al., 2003).

One consideration to make regarding Bradshaw's method of categorization is that it allows a single need to fall under multiple need categories, and various configurations could result from researchers attempting to classify the same needs (William, 1983; Gasper, 2004). This is apart from expressed needs, which are a variant of felt needs—and are defined by Bradshaw as such. This can either be beneficial or detrimental for use in building a conceptual framework, depending on whether the user of the framework requires that distinctions be made between different needs or not.

Normative needs are generally thought of as the most credible category of need, for which action is to be taken. As a result, normative needs typically comprise the standard used by policymakers and social scientists in decision-making (William, 1983). According to Carver et al. (2008), Bradshaw's taxonomy can be one a useful model in healthcare applications, since his taxonomy does not identify any needs, but rather, it distinguishes them based on their relevant frames of reference, focusing on the perspective of an individual.

2.3.3.2c Criticism &Relevance

Despite its many contributions and applications in social work, several criticisms are commonly cited about using Bradshaw's taxonomy. Bradshaw himself went on to downplay the magnitude of his model's impact on subsequent research in community care, describing it as a relatively simplistic framework, set in a much bigger research context (Seeling et al., 2008). Bradshaw also stated that his conceptualization of needs was mainly restricted by the inherent issues associated with the very definition of a need (Bradshaw, 1994; as cited in Asadi-Lari et al., 2003).

Furthermore, Clayton (1983) identifies five general limitations to Bradshaw's taxonomy, which the author argued made them unfit for use in policymaking:

- Data for all four categories are unlikely to be available all at once, which makes a comprehensive needs assessment virtually impossible.
- A service-based approach to needs assessment is flawed to begin with, as many different services can often satisfy the same needs.
- Abuse of power may result from relying solely on the role of experts—whose judgement is stipulated for a need to be classified as Normative. It can also be difficult to identify who those experts to start off, which allows for subjectivity
- The model ignores that people who are in need lie across a spectrum and cannot be restricted to those in need or not in need.
- Finally, many social, economic, and political factors are inherent to policy determination, which are entirely ignored in the model.

Bradshaw's taxonomy has seen its fair share of application in different literary contexts. For instance, Ashworth (1987), who examined the model in the context of healthcare, points out that the needs tended to the most by healthcare professionals and management were often normative needs, while the other three types of need were often disregarded; either for not being real needs (in reference to *felt* and *expressed* needs) or for a lack of information (in reference to *comparative* needs). While Ashworth recognizes the importance of the other three categories of need, the author also states that these needs are often impossible to identify or define with complete objectivity, which limits how useful it is in actual healthcare policy-making, given that practitioners ought to identify very precise health needs and outcomes, so that they are able to address these needs and outcomes to the best of their abilities.

All these points considered, it is important to note that Bradshaw's model is most useful in the context for which it was developed: Implementation in Policy (William, 1983; Seeling et al., 2008)—despite criticisms such as the ones made by Clayton (1983).

Directly applying those categories of needs to the theoretical framework of an environmental design study would serve little purpose, since it does not directly reference any patient-specific needs (e.g. patient safety or comfort, See Section2.6). Furthermore, the need to identify specific needs (in contrast to broader categorical constructs, such as Bradshaw's) stems from the fact that broad categories do not make for very reliable model of assessing individual needs, as different individual needs are often measured in non-comparative ways, making it redundant to group them (Asadi-Laari et al., 2003).

2.3.3.3 Concluding Remarks

This section briefly explored two of the most applied theories in studies exploring the design of healthcare environments. These theories included the Hierarchy of Needs, developed by Abraham Maslow (Maslow, 1943; 1970; 1971) and the Taxonomy of Needs, developed by Jonathan Bradshaw (Bradshaw, 1972).

Upon critically evaluating both theories and exploring the realms of application and critiques of the use of both in contemporary research, it was concluded that both theories were unfit for direct application as theoretical frameworks guiding this research, due to limitations that would serve to restrict the development of the variables used in quantitatively describing needs in healthcare. However, the useful components pertaining to each will be identified, selected, and implemented into the conceptual framework proposed by the researcher in Chapter 6.

2.4 An Overview of Healthcare Settings

2.4.1 Conceptual Background of Healthcare

2.4.1.1 Health& Healthcare Outcomes

2.4.1.1a Defining Health Status

The WHO (World Health Organization) defines health as:

> "A state of complete physical, mental, and social wellbeing and not just the absence of disease or infirmity."
>
> ***World Health Organization***
>
> (World Health Organization, 1948)

This definition of health sheds some light as to what constitutes need in the context of healthcare, in that patient needs do not just refer to a patient's physiological well-being, but is also reflected through other aspects of care, including their psychological and social needs.

Referring back to Maslow's Hierarchy of Need, the definition provided by WHO (1948) identifies patient needs as belonged within the first 3 levels of the hierarchy: Physiological, Safety, and Social Needs.

Partick et al. (1982) defined health as an individual's level of function, in the context of which function is assessed by comparing standards of life—both global and local; as well as well-being; which accounts for both mental and physical aspects of well-being.

However, as will be pointed out in the following section, is distinction is often made between the term health, and HRQOL (Health Related-Quality of Life), although the two may appear to be similar at first glance.

2.4.1.1b Defining Patient Outcomes

According to Johns (1991), the term patient outcomes comes up quite frequently in healthcare research. However, the author also notes that there does not seem to be any consistent use or definition of the concept, and that the term is often used differently by different authors.

For instance, the measures of patient outcomes used by Aiken et al. (2011) include the rates of failing to rescue patients, and monthly mortality rates. Suhonen et al. (1993) uses HRQL, patient autonomy/choice, and patient satisfaction. Mallidou et al. (2004) used quality of care and adverse patient events, such as medical errors, patient falls and nosocomial infections[7]; and the list goes on.

Commented [A16]: [22] Added brief explanation of what a nosocomial infection is with reference

The systematic use of the term patient outcomes in evaluations of healthcare began in the period of the Crimean War, with Florence Nightingale's early recordings and examinations of care conditions for military patients. Nightingale saw early on how relevant the built environment is to managing patient outcomes (Salive, 2018). Ever since, analysis of patient outcomes has recurred on a periodical basis, usually centred on different disciplines, and often targeting medical treatment.

At first, patient outcomes were treated as mere clinical endpoints, such as (symptoms and signs, lab values, and mortality rates), functional status (physical, mental, and social), general well-being (health perceptions, energy, fatigue, pain, and satisfaction with life), as well as satisfaction with the quality of care (access to care, convenience of receiving care, financial coverage of healthcare, and general quality of care (Harbor & Atkins, 2006).

Beginning in the mid-1960s, patient outcomes saw their first use in nursing care evaluations; and would then move forth towards becoming a commonly used term in healthcare literature, too frequently, in too wide a variety of context, and comprising far too many definitions and conceptualizations for there to be a common understanding of what the term means today.

2.4.1.1c Defining Quality of Life

Among the most used terms in healthcare environmental design literature is the term QOL (Quality of Life), which was first popularized in the early 1960s, and was delimited to discussions of more wealthy individuals, in contrast to discussions of basic healthcare needs of those living in poorer regions. Even after derived concepts such as PQLI (Physical Quality of Life Index) grew popular in the 1980s, the term was hardly ever referred in to in academic literature, and publications did not come to use the term to the extent that they currently do up until approximately two decades ago (Gasper, 2007).

[7] Infections acquired within hospital settings (Rosenthal et al., 2012)

The WHOQOL [World Health Organization Quality of Life (Project)] an evaluation and assessment program developed by the WHO, defines the term QOL as:

> "An individual's perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards, and concerns."
>
> ***World Health Organization Quality of Life Project***
>
> \` WHOQOL (n.d.)

A similar definition is also adopted in the work of Rejeski & Mihalko (2001), who define QOL as a conscious and cognitive way to assess one's satisfaction with their general well-being and satisfaction pertaining to aspects related to their lives.

Broad, non-contextual definitions, such as the ones outlined above, add to the confusion as to which aspect the term QOL encompasses, encouraging the use of subjective measures in empirical assessments of the term. Although using subjective (patient-reported) measures does not necessarily equate to a method of research, they can be among the most suitable methods of measuring patient outcomes—if applied correctly. However, if the use of subjective measures is to be allotted, a minimum requirement is that rigorous testing must be done to ensure the validity and reliability of the research instrument used.

In much a similar way to the concept of healthcare need, it is extremely difficult to establish a clear set of boundaries for what constitutes a healthcare outcome (Codinhoto et al., 2009). Furthermore, it is important to differentiate between the concept of a Healthcare Outcome, and Health in general or a Healthcare Need.

2.4.1.1d Defining Health-Related Quality of Life

Wilson & Cleary (1995) define HRQOL as an individual's level of satisfaction/happiness with general health-influenced domains of their life and well-being. An individual's symptoms, health perceptions, and general well-being are often included as part of the conceptual domain of HRQOL (Ware, 1994).

Such definitions are common throughout the literature, where HRQOL is loosely defined in correlation to QOL, which has resulted in confusion as to the meaning of each in different contexts. Guyatt et al. (1993) indicates that the term's introduction was originally intended to distinguish it from QOL, in order to resolve the issue that QOL often refers to both non-medical and medical aspects of well-being—while HRQOL was only meant to address the latter. This claim is also supported by Luckettetal. (2009), who states that an increased number of studies have begun to use the term HRQOL as a PRO.

Although numerous studies claim to examine and measure HRQOL, a considerable portion of those studies fail to even identify what the term is in reference to in a clear, meaningful way—instead, just using it in general contexts (Nilsson, 2012).

2.4.1.2 Healthcare Stakeholders& Users

2.4.1.2a Defining Stakeholders in Healthcare Settings

The design of healthcare facilities must incorporate elements that account for all of the different stakeholders and users of those facilities. Successful approaches to the implementation of new models and policies of healthcare to achieve better patient outcomes must account for the stakeholders that affect and are affected by these healthcare environments (Elf et al., 2015).

Therefore, identifying who those stakeholders are, as well as their contributions and intercorrelations, has become another important topic of discussion in academic literature (Keele et al., 1987).

The term *stakeholder*generally refers to:

> "All those people and institutions who have an interest in the successful design, implementation, and sustainability of the project. This includes those positively and negatively affected by the project.
>
> Howlett & Nagu (1997)

According to Guo (2008), a wide range of stakeholders are concerned with Quality Management in Healthcare Settings, including: governments, policy-makers, patients and their families, healthcare providers, and tax-payers.

Significant investments are often made by professional bodies, public and private payers, accreditation and regulation boards, as well as the healthcare providers themselves (Torres & Guo, 2004).

According to an analysis of the literature (Hamilton, 2003; Snell & Kalantari, 2014), a list of all identified healthcare stakeholders includes a very diverse set of group members, as it includes virtually anyone who would potentially someday receive healthcare, albeit in a much less direct way. A summary of the most commonly identified healthcare stakeholders can be listed as follows:

- Patients
- Patients' Families
- Healthcare Administrators
- Hospital Boards
- Staff
- General Public: Consumer Groups
- Authorities: Regulators; Policy Makers; Governments; etc…
- Contracted Groups

Ahmadi-Javid et al. (2017) identify the following major bodies in healthcare, explored from a managerial perspective, concerned with the provision of service (which excludes patients, the primary healthcare facility users):

1. **Producers:**

   Health suppliers and medical product manufacturers

2. **Distributors:**

   Links between producers and providers

3. **Providers:**

   Main body of healthcare system who provide medical services

4. **Waste Management:**

   Collect, recycle and dispose of medical waste equipment

2.4.1.2b Defining Users in Healthcare Settings

In discussions directly relevant to healthcare (facility) users, the term *user* is often not directly defined, as it is simply implied to be the patient who is directly in use of the facility, as the primary recipient of care.

In the context of healthcare, a user can also include users who are not past or present users of the healthcare facility, but also potential users of the service, i.e. the general public (Hopkins et al., 1994). However, similarly to the case of healthcare stakeholders (See Section2.4.1.2a), defining environment users on a basis of potential (future) users will be anti-useful for the purposes of this study.

Other definitions of healthcare users (e.g. Dalke et al., 2004), sometimes identify other groups as users of healthcare facilities; most often, visitors and family members of patients. However, as the interactions of patient visitors do not typically last for long periods, and their experience with the environment somewhat differs from the (relatively) prolonged experience of a patient or healthcare staff member typically interacting more with other environmental locations, such as the waiting room. As a result, visitors and family members will remain involved in their capacity as stakeholders for the purposes of this study, but not as primary users of the facilities.

2.4.1.2c Distinguishing Healthcare Stakeholders from Users

The primary point of differentiation between stakeholders and users is in terms of their direct contact with the built environment. Based on this definition and distinction, two users of healthcare facilities become immediately identifiable: Patients, and Healthcare Providers.

As a result, the term user in the context of this study will be used in reference to all past and current users of the facility, and not those who may potentially interact with an environment or system, unless otherwise stated. However, it will not include those stakeholders who do not directly interact with the healthcare facility/environment, such as those in administrative positions.

Such a distinction is typically made implicitly by researchers in this field, and the researchers often employ the use of both terms (stakeholders and users) simultaneously in line with the above-mentioned differentiation points (Huisman, 2012; Gabbay & Neuberger, 1994).

2.4.1.3 Patient-Centred Care

2.4.1.3a Defining Patient-Centred Care

While numerous proposed definitions of patient-centred care often encompass the same core concepts; there is not yet a universally accepted definition of the concept (ACSQH, 2011). Nonetheless, the underlying concept behind patient-centred care is fairly simple to understand; and it involves placing the human element at the centre of healthcare management and provision, treating persons receiving a healthcare service as they wish to be treated—with dignity and respect.

Among the earliest papers discussing the idea of patient-centred care is a 1993 study conducted by the Picker Institute, in coordination with the Harvard School of Medicine

(Gerteis et al., 1993). The study identifies 8 key dimensions of patient centred care, which include:

- Respect for patient preferences
- Providing emotional support to patients
- Physically comforting the patient
- Information, communication, and self-education/education
- Continuity and transitions
- The coordination of care
- The involvement of key stakeholders like family and friends
- Provision and access to healthcare

2.4.1.4 Concluding Remarks

This section explored relevant terms and constructs relating to healthcare services, agents within the healthcare system, as well as the healthcare outcomes of patients, including the concepts of QOL and HRQOL. Furthermore, the section explored the differences between different agents in healthcare, leading to the categorization of healthcare stakeholders and users. The difference between those two groups will form a basis for the development of the conceptual framework of the study, as environmental design relates much more closely to the users of a facility, rather than the all stakeholders who may not directly interact with said facility.

2.4.2 Contextual Analysis of Healthcare Services

2.4.2.1 Healthcare as a Right

In broad terms, healthcare has been explored in the literature from two primary vantage points. On the one hand, proponents of the first perspective treat healthcare as a universal human right, in the sense that the healthcare system should be optimized such that treatment is available free of charge to all those who require it; placing this consideration above all else. On the other hand, a more recent view has emerged where healthcare is viewed as a service in the traditional sense of the term, encouraging the use of capitalistic ideals to raise competition (to some extent) among healthcare providers, and charging patients in accordance with the level of service provided.

Starting off with the first perspective, in which healthcare services are viewed as a universal right; this has been mostly the view held by humanists, which relates closely to the practical application of theory in the development of social and healthcare policy. The primary proponents of this view are major global organizations, such as the WHO (1946) and the UN (1948).

2.4.2.2 Healthcare as a Service

The concept of patient-centred care has also come to be very closely tied to service design in other sectors, in which the matter is approached from the perspective of facilitating an experience, rather than an interaction with an environment. In service design, as Moritz (2005) points out, the primary focus in creating the service to identify features that would be considered useful, usable[8], and desirable from the client's perspective (Lee, 2011; Schmidt & Etches, 2014).

Servicescapes—the physical spaces in which a service takes place, are currently identified as a very important resource in the healthcare industry, as they make for a major impact on the user experience as a whole, and in an indirect way, the service provider's profitability (Fottler et al., 2000).

According to Fottler et al. (2000), the service setting, taken as a whole, is important to health service executives for a number for four primary reasons:

1. Creating an environment that meets customer expectations
2. Creating and enhancing customer and employee mood
3. Creating a memorable healing experience
4. Creating a ***healing environment***

As a result, while healthcare has always been referred to as a service, it is only relatively recently in human history that the act of providing healthcare has come to associated with aspects of the tertiary service industry; in congruence with customer care and other customer-centred fields (John & Shenoy, 2014).

[8]**Note:**
Terminologically speaking, the two terms may appear similar, but useful and usable are very different components of design and the user experience; and are commonly refered to as the idea of *concepts of use.* In short useful refers to a product that allows the user to accomplish a task or objective, while usable is typically used in reference to the complexity of use, and whether a product of service enables the user experience to be simpler and more pleasurable (Schmidt & Etches, 2014).

2.4.2.3 Influence of Research on Policymaking

Transforming research into applicable laws in not really a new phenomenon. In fact, policymaking, especially in the context of healthcare, is particularly reliant on opinions formulated by consensus (Blumgart, 2007). However, examining standards such as the AIA's (American Institute of Architects) Guidelines for the Design and Construction of Healthcare Facilities, it is immediately clear that their focus ison theory first and foremost, and evidence obtained from that theory, for which scholarly consensus has been achieved (Ballard & Rybkowski, 2007).

Referring ahead to the EBD process, outlined in Section 2.5.1.2, it is clear that the final step of the process is solely put in place for policy-making purposes, intended to translate the evidence from results into practice by establishing a solid policy to make that happen.

2.4.2.4 Environmental Design & Healthcare Standards

2.4.2.4a International Standards & Practice

There is an internationally emergent trend where healthcare construction regulations and policy-makers have begun to recognize the importance of implementing evidence-based design in healthcare environment design (Ray, 2006; Clarke, 2016).

Evidence-based design has also begun making its way into working papers and reports published by corporate regulators/standard-makers, such as the JCR (Joint Commission Resources) (JCR, 2015), and on the scale of governmental healthcare departments, such as the UK Department of Health (UK DOH, 2014).

Not only is EBD recognized for its importance in the healthcare context, but this recognition has been lately transforming into legislative action and policy-making, mostly in economically-developed regions such as the U.S. (Pew-MacArthur, 2015).

2.4.2.4b Jordanian Standards & Practice

The FIDIC (Translation: International Federation of Consulting Engineers) are internationally renowned standard regulators for the construction and engineering industry and has been the most followed international standard form of civil engineering works in the MENA (Middle East and North Africa) region. FIDIC regulations are currently adopted and integrated into local standards in Jordan since the first edition was published in 1957 (Sarie-Eldin, 1994; Arrowsmith et al., 2000).

The Jordanian general conditions for public works contracts, issued in 1991, are based on the fourth edition of the FIDIC General Conditions Book (Arrowsmith et al., 2000). Upon reviewing these conditions, the researcher found no regulations relevant to environment design, evidence-based practice, or any of the relevant constructs examined earlier that lead to the creation of patient-centred health facilities.

A government report published by the Jordanian HCC (Higher Health Concil) in 2015, titled The National Strategy for the Health Sector: 2016-2020, outlines the directions that the Jordanian health sector is currently progressing towards (HCC, 2015). The second strategic goal of the strategy is in-line with the overarching bases for evidence-based design, which is to:

> "Provide individual-centred integrated health services and respond to the growing needs (of the Jordanian population)"
>
> HCC (2015)

Several instances of "evidence-based" plans, policies, decisions, and education are mentioned, though there is no direct reference to evidence-based design in particular, and there is no mention of environmental design anywhere in the report, nor is the idea implied in the slightest sense.

The Amman Building & Urban Planning Regulation of 2011, published by the JEA (Jordan Engineers Association) and enforced in the same year of its publication, outlines regulatory building provisions applicable to all sectors, including healthcare (JEA, 2011). While some of the provisions within the regulation may have indirect consequences for the human-centeredness of healthcare facilities, such as restrictions on distances between hospitals and gas stations/wedding halls/ (Articles 53 & 56), and the minimum parking lot requirements for hospitals in square metres (Article 36), there is no indication of a clear and direct human-centred design element in the regulation.

While not much is enforced in Jordanian regulations and standards regarding the use of evidence-based design to provide patient-centred care, a trend has emerged where hospitals and other healthcare facilities have begun to implement evidence-based design in practice.

For instance, an article published by AECOM Technology Corporation states that the currently ongoing expansion of King Hussein Medical City— the largest Medical Centre for Jordanian Armed Forces, has integrated EBD into the new building's design since the earliest concept design stages, in the form of enhanced wayfinding, family-centred design, privacy, view, technology, materials, and many other design aspects (Laitinen, n.d.).

2.4.2.5 Concluding Remarks

The theoretical perspectives explored in this section lead to the conclusion that there is not a single approach that could be applied to healthcare systems in all cases. Standards and regulation in healthcare are often developed to meet both the demands of proponents who view healthcare as a right, and those who view healthcare as a service.

As such, in the implementation of actual healthcare reform and policymaking, both perspectives are equally important, as one places higher value on the equitable treatment of all patients, and the second emphasizes increasing competition among healthcare providers, for ultimately the same purpose; focusing more instead on enacting change at a more rapid pace, albeit at a cost that the consumer must pay.

Both perspectives tie closely to healthcare environmental design and its relationship with human needs, as both are ultimately concerned with meeting the needs and demands of patients, taking two different approaches to doing that.

2.4.3 Theoretical Background of Healthcare Management

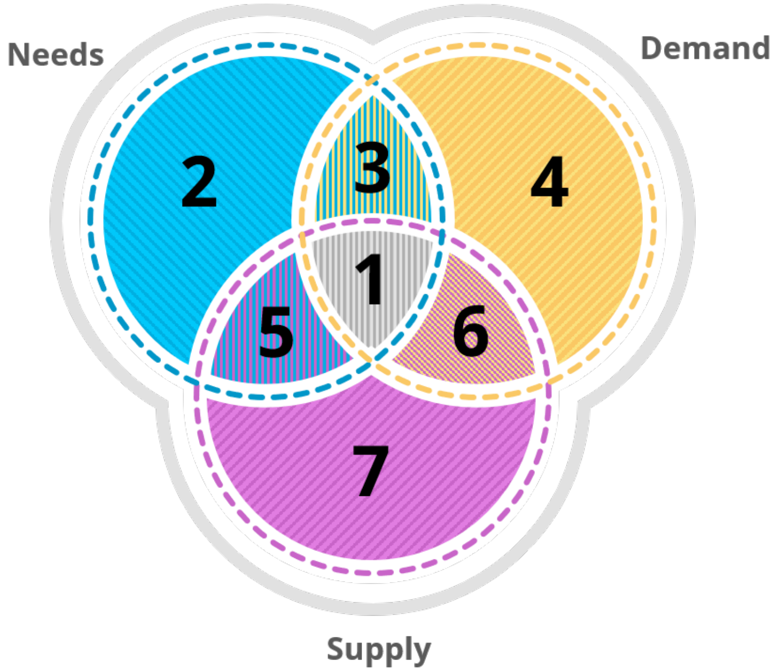
2.4.3.1 Needs Assessment & Service Provision

Ljunggren (2004) identifies needs assessment as the process of establishing the needs of someone using a service— in this case, a patient; and is an essential part of care management. This assessment may then trigger the supply (provision) of services to those patients, based on demand, along with many other influential factors.

The author further conceptualizes this definition into a framework demonstrating the different perspectives in (health)care management, shown in Figure 2.

Figure 2
Perspectives to Consider in Care Management

Source: Adapted from Ljunggren (2004)



	Perspectives			
No.	Needed?	Demanded?	Supplied?	Examples
1	**Yes**	**Yes**	**Yes**	General Hospital Care Services
2	**Yes**	**No**	**No**	Dementia & Psychiatric Care Services
3	**Yes**	**Yes**	**No**	Care Service on Long-Waiting Services
4	**No**	**Yes**	**No**	Baseless Care Service Requests
5	**Yes**	**No**	**Yes**	Preventive Care Services (Vaccines)
6	**No**	**Yes**	**Yes**	Additional Care Services for Assurance
7	**No**	**Yes**	**Yes**	Ineffective & Unproven Care Services

According to Stevens & Gillam (1998), universal *health gain* can be achieved by focusing on the reallocation of resources to fulfil the needs of four groups in particular, comprised of:

- Non-Recipients of Beneficial Healthcare (Those with *Unmet Needs*)
- Recipients of Ineffective Healthcare
- Recipients of Inefficient Healthcare

- Recipients of Inappropriate Healthcare

However, the authors also recognize the difficulty and infeasibility of reallocating resources to such a broad category as those with unmet needs, stating that many factors ought to realistically be considered in transitioning from needs assessment to implementation in real healthcare facilities. On such consideration, for instance, is the size of the group who stands to benefit from the implementation of policy changes or healthcare reform. Another consideration is the cost associated with this implementation, not only in financial terms, but in costs of labour and time as well (Stevens & Gillam, 1998).

2.4.3.2 Healthcare Quality Aims

WHO has repeatedly emphasized the importance of quality management in healthcare settings. Beginning with a report published in 2000 (WHO, 2000), where the organization's stance was that the amount of funding allocated to healthcare was, in the majority of cases, inadequate to achieve the full-performance of healthcare systems. A subsequent report in 2002 (WHO, 2002) identified many health concerns for humans, and further emphasized the role of quality management in addressing those concerns. A later report in 2013 (WHO, 2013) reiterated the same view, urging healthcare providers and governments alike to allocate investment to support research aimed at the improvement of healthcare services.

Adopting a similar stance to that of WHO, the IOM(Institute of Medicine, U.S.) went a step further and outlined a strategy intended to reinvent the U.S. healthcare system by improving its ability to put knowledge into practice and apply new technologies and methods more effectively. Their strategy, introduced in the seminal work: ***Crossing the Quality Chasm – A New Health System for the 21st Century*** (IOM, 2001), outlined six major areas which have much room for future improvement:

1. **Safety**

   Ensure the physical safety and well-being of patients, particularly safety from falls and related injury.

2. **Effectiveness**

   Ensuring the provision of healthcare services that are based on scientific knowledge and well-founded research.

3. **Efficiency**

   Ensuring that healthcare management considers the type of medical equipment used to deliver care, and avoids energy, equipment and supply wastage.

4. **Patient-Centeredness**

   Ensuring that a healthcare service is generally respectful of, and dedicated to patient preferences, needs and values.

5. **Timeliness**

   Ensuring that the healthcare service provider delivers care in a timely manner, as to avoid harmful impacts of delays, and to reduce wait time.

6. **Equity**

   Ensuring that all of the patients in the healthcare facility receive comparable and equitable care that does not vary between patients.

The quality of a given healthcare service is typically assessed upon the basis of the outcomes shown by its respective users. The final outlook on this quality of care is the collective effort of the many sub-systems making it up, which include: people, organizations, technologies, processes, and environments.

2.4.3.3 Concluding Remarks

The theories explored in this section are used to detail how healthcare systems work beyond just the realm of theory, as they explore the factors upon which needs can be evaluated and met in practice, which needs should be prioritized, and how healthcare providers could strive to improve the quality of the services provided at their facilities.

2.5 An Overview of Environmental Design

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2.5.1 Conceptual Background of Environmental Design

2.5.1.1 Environmental Design

2.5.1.1a Defining the Built Environment

In the social and engineering sciences, the term *built environment*, refers to manmade settings for human activity. The (United States) Department of Health and Human Services, as cited in Roof & Oleru (2008), defines the built environment as:

> "The human-made space in which people live, work and recreate on a day-to-day basis. It includes the buildings and spaces we create or modify. It can extend overhead in the form of electric transmission lines and underground in the form of landfills."
>
> ***U.S. Department of Health and Human Services***
>
> As cited in (Roof & Oleru, 2008)

In his book, ***The Meaning of the Built Environment: A Nonverbal Communication Approach***, architect and Environment behaviour founder Amos Rapoport states that use of the term built environment in research appears to be dependent on the context and purpose for its use (Rapoport, 1990). As such, the scope/range of the space it is used in reference is largely defined the researcher's own motivations.

For the purposes of this study, the term will be used in reference to any enclosed space in which human activity takes place, in which humans reside for considerable durations, and which serves a particular purpose. This definition is inclusive of spaces such as hospital rooms and office workspace, however, it excludes other naturally founded spaces and spaces infrequently occupied by humans.

2.5.1.1b Defining Environmental Design

In different applications, the term *environmental design*can be used to refer to a number of different things. As a result, finding a universally accepted definition of the term is impossible. In the context of engineering and physical environments, the term can be defined as “the process of addressing the surrounding environmental parameters in devising plans, programs, policies, buildings, or products” (Caves, 2005).

To add to the confusion, a number of different names have been proposed for environmental design in the past, including *environment-behaviour research*, *architectural psychology*, *environmental psychology*, and *design research* (Demsky & Mack, 2008).

For the purposes of this studythe term *environmental design*will be used to focus on the built environment, encompassing a number of different aspects of this environment, including: natural, work, social or healthcare environments. When need be, a leading term will be added, and will serve to denote the distinction (*e.g.**healthcare**environmental design*).

2.5.1.1c Linking Environmental Design to Human Needs

An explanation by Prof. Richard Wener, a well-acclaimed expert in the field of environmental psychology, makes two direct references to human needsin a general explanation of the concept and goal ofEDR (Environmental Design Research)(Wener, 2008). In the author’s own words, EDR can be best described as:

> "the interface between the design fields and the social and behavioural sciences that address ***human****aspects of*, ***needs****in*, and *responses to* the built and natural environment…
>
> "there is some disagreement about areas of emphasis, and even descriptive names for this field, and it may be useful to consider what makes the body of work in EDR different, special, and/or unique."
>
> "…[What makes the body of work in EDR unique is that] it involves the use of social and behavioural science findings to consider who the clients and user are, and to systematically discover their ***needs***, habits, behaviours, concerns, and uses of space. It uses these data and theories to support, inform, and transform design decisions."
>
> ***Richard Wener***, Wener (2008, p. 283)

2.5.1.1d Practical Applications in Environmental Design

It is a generally accepted principle in the study of EDR, that translating discussions on the impacts of built environments on human needs into practice requires that the findings of an environmental design study be clearly and fully communicated to designers in a format that is "understandable, practical, and meaningful." (Marcus & Francis, 1998; Schmidt, 1985).

Furthermore, due to the massive amount of cost typically associated with intervening and changing aspects of the healthcare built environment—notwithstanding the fact that a hospital cannot be cleared of all patients in critical condition to implement design changes, careful consideration and due diligence must be done by the authorities responsible prior to approving any current recommendations made by researchers, lest future research demonstrate the futility and inapplicability of those recommendations.

2.5.1.2 Evidence-Based Design

2.5.1.2a Terminology: Evidence-Based Design

According to the CHD (Centre for Healthcare Design), EBD is defined as

> "the process of basing decisions about the built environment of credible research to achieve the best possible outcomes."
>
> ***Centre for Health Design***,
> CHD (2012)

The process, defined by the CHD (2012), depicted in Figure 3, states that EBD constitutes the following eight steps:

1. Define Evidence-Based Goals & Objectives
2. Find Sources for Relevant Evidence
3. Critically Interpret Relevant Evidence
4. Create & Innovate EBD Concepts
5. Develop a Hypothesis Based on Past Research
6. Collect Baseline Performance Measures
7. Monitor Implementation of Design and Construction
8. Measure Post-Occupancy Performance Results

Figure 3

Evidence-Based Design, Process, Cyclical

Source: Eppstein Uhen Architects (2019).

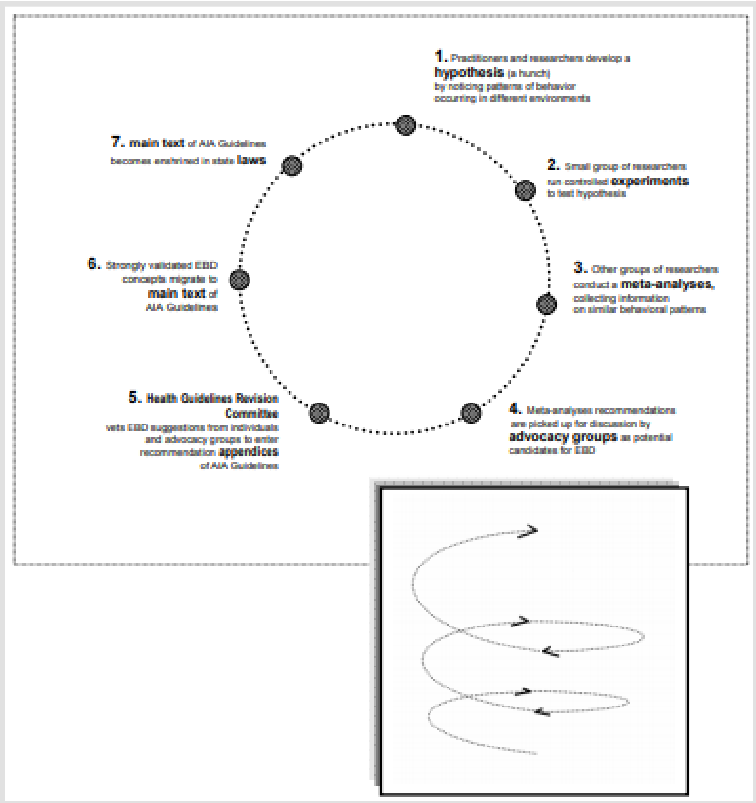
Figure 4 demonstrates the conceptual background behind the development of the EBD process. The process, which constitutes 7 steps in total, is described as an iterative process, in which each iteration brings the hospital's design closer to fulfilling patient needs. The process' iterative nature is suggested through the swirls depicted in the accompanying diagram, and the improvement over existing design is denoted through the upward motion in the same diagram.

Commented [A18]: [28] Added explanation and introduction of both the main diagram and the accompanying figure, so I didn't end up changing it as it is relevant to our framework (especially the swirly motion thing)
See Section 6.1.2

Figure 4

Evidence-Based Design, Process, Iterative

Source: Ballard & Rybkowski (2007)



Stankos & Schwarz (2007) define EBD as"design decisions based on the best available information from credible research and evaluation of existing projects."

In contrast to EBD, normative design practices are typically based on the practitioners' formal educational backgrounds, personal and colleagues' experiences, experience-based intuitions, as well as personal interpretations and *common sense.*

The term *normative* (i.e. traditional) design will be used in reference to design practice that is conducted across disciplines and is characterized as tied to convention and rule of thumb, in contrast to a more evidence-based approach.

All in all, EBD contributes in practice by placing the outcomes of an environment's users at the heart of design practices and using evidence as the primary basis for decision-making in design. For its contributions, EBD is now recognized by many as a core competitive advantage within the healthcare services sector, designing a system based on its ability to benefit its many users.

2.5.1.2b History & Origins of Evidence-Based Design

EBD is often paralleled to a terminologically similar field: EBM(Hamilton, 2003). However, it is yet uncertain whether EBD can be considered analogous to EBM; given the strict quality of evidence typically required by the latter, and the massive amount of quality research that has gone into the field.

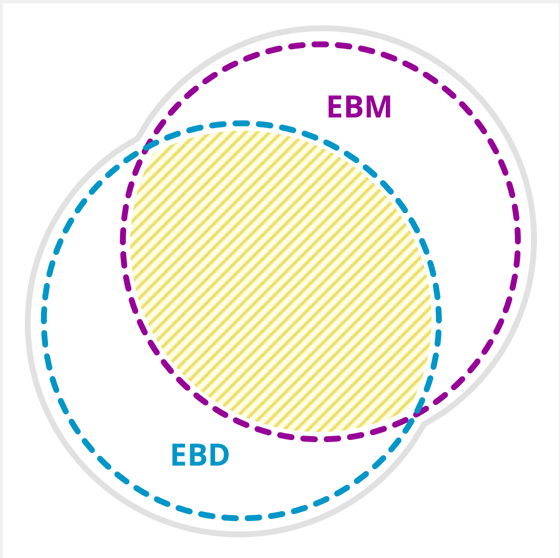
Stankos & Schwarz (2007) state that while EBD has certainly strived for an approach that extends far beyond mere anecdotal evidence, EBD is oftentimes used as a mean of persuasion to convince hospital regulators and authorities to invest in design changes whose outcomes have not yet been thoroughly understood.

A simple diagram, adapted from Ballard & Rybkowski (2007), is shown inFigure 5 and outlines the overlap between the two fields of EBD and EBM. The diagram hints at the fact that while both concepts have the same centre of focus, each is still restrictedby the nature of its mother domain, and certain differences arise in practice between the two frameworks.

Figure 5

Overlap Between Fields of EBD and EBM

Source: Adapted from Ballard & Rybkowski (2007)



However, though the author indicates the overlap between the two fields in this diagram, the diagram does not do much to specify the areas of comparison and cross-over between the two fields (Ballard &Rybkowski, 2007). In fact, none of the sources examining EBD as a constituent of EBM do, as is noted by Richard Saitz (Saitz, 2012), in his analysis of Shepley & Watson's "Evidence-Based Design: Medical & Design Researcher Collaboration" (Shepley & Watson, 2012).

2.5.1.2c Applications in Practice

Previous work on EBD has identified several issues that relate to evidence generation in the field, along with the application of this evidence in practice. While some of the issues found may be apposite only in the particular cases within which they are faultily applied, there are some commonly emerging issues as well. Among the most identified issues with generating evidence is that experiments on design interventions typically require a lot of investment and preparation (Nelson et al., 2005; Joseph &Hamilton, 2008).

Another issue with evidence generation is the very complicated nature of examining how the built environment relates to improving patient and other users' outcomes (Lawson, 2010; Codinhoto et al., 2010; Ulrich et al., 2010; Phiri, 2011). Several approaches and methods have been developed to address these issues, as to integrate EBD research into practice by improving post-occupancy evaluations, but none appear to be widely adopted in the literature.

Issues related to the application of EBD are most often associated with a lack of skill, especially with regard to the aspect of gathering and aptly applying evidence in its most appropriate setting/context (Hamilton, 2010; Martin & Guerin, 2003; Devlin & Arneill, 2003).

In order to reflect on the issues that people often face in EBD practice, scholars often emphasize being critical of the evidence as a major part of the process(Hamilton, 2003; Hamilton & Watkins, 2009; Moore & Geboy, 2010).

How EBD is applied in practice is typically a matter of identifying which patient outcome measures are directly impacted by the introduction or implementation of a certain design feature, either in isolation, or by controlling for the effects of other influential agents. The nature and extent of this impact determines the design's level of success, and whether it should be implemented in practice (Hamilton & Watkins, 2009).

2.5.1.2d Criticism & Limitations

Although it may appear an unerring approach to design at first glance, the concept of EBD has not been without criticism. In fact, one of the most referred to limitation of EBD stems from the very nature of the EBD framework, which places emphasis on the re-use of well-tested and rigorously implemented design features.

For instance, in reference to how EBD limits creativity in design solutions, Hamilton (2003) critiques the framework by stating that:

> "…[EBD] brings cookbook architecture to produce dull, repetitious buildings, stamped from a mould."
>
> ***Kirk Hamilton,*** Hamilton (2003)

Wanigarathna et al. (2019) challenge Hamilton's argument based on two grounds:

1. Designers tend to underestimate the extent to which they unknowingly use and implement previous designs.
2. The built environment is a rather unique field of practice, wherein designs cannot simply be copied and used elsewhere without alteration in the slightest.

The most frequently cited source of criticism of EBD comes in terms of comparisons between EBD and EBM, and of evidence in discussions of theoretical research vs. practical application (Stankos & Schwarz, 2007; Rashid, 2013).

Referring back to the steps of the EBD process, outlined in Figure 4 above, Rashid (2013) states that the limitations in EBD are not just limited to the first 3 of the 8 steps of the process, often trickling down to the following steps, and manifesting to practical applications that claim to be evidence-based, with nothing to actually show for.

2.5.1.3 Post-Occupancy Evaluations

2.5.1.3a Defining Post-Occupancy Evaluation

As defined by Rabinowitz & White (1990), the POE (Post-Occupancy Evaluation) is a process involving the systematic measurement and evaluation about the built environment in use, from the perspective of its various users.

Snell & Kalantari (2014) identify the field of healthcare as one where POEs have become very popular among scholars and professional researchers who seek to evaluate building occupancy from the perspective of different user groups.

According to Goetz et al. (2008), theCHD employ three different types of POEs, which include:

1. **Indicative POEs**

   Used to indicate the major strengths or weaknesses of a building's performance, providing whatever data are required to support the need for a future in-depth evaluation.

2. **Investigative POEs**

   Used to indicate evaluative criteria such as professional guidelines and performance standards, which are defined prior to the launch of a diagnostic POE and involves more sophisticated observation and analysis than indicative POEs.

3. **Diagnostic POEs**

   Used to indicate post-investigative cases where more resources ought to be invested due to major design or operational flaws identified in earlier processes and are the most complex and long-term type of POE.

2.5.1.3b Linking Post-Occupancy Evaluations to Human Needs

According to Shepley (2002), when a POE is used alongside information from focus groups, methodical observation, and other qualitative sources of information, it can serve as a truly excellent tool that provides a comprehensive analysis of how well an environment is able to facilitate the needs of its users.

In much a different way to EBD, whose use is encouraged prior to the construction phase of a building, POEs link human needs to environmental design by considering the human aspect after it has been occupied by users for some time, hence, the term *Post-Occupancy*. This enables practitioners to allocate resources and make design changes that are not experimental in nature, but which stem from a clearly identified human need, as evaluated by the user.

Evaluations of Healthcare Environmental Design—pre- and post-occupancy, are among the most critical areas where the limitations of EBD, discussed in Section 2.5.1.2d, come into effect.

2.5.1.4 Concluding Remarks

This section outlines some of the relevant terms and constructs relating to environmental design, exploring some of the most recurring terms throughout this research, including built environments, environmental design, evidence-based design, and post-occupancy evaluations. As such, this section serves to help develop a general sense of each construct, prior to exploring theories relating to each in subsequent sections.

2.5.2 Analysis of Performance Gap

2.5.2.1 Approaches to Evaluating Performance Gaps

A performance gap analysis is a process used to evaluate the extent to which current performance measures up to the desired performance, which can be evaluated using any means that the researcher defines. This method of analysis provides a basis to identify and evaluate the missing or suboptimal performance and strategies that are faced by an organization/institution, or an industry as a whole; which is then used to recommend steps and measures to aid said organization/industry in attaining their long-term objectives and goals (Chenet et al., 1999).

In contrast to a risk evaluation/assessment, a performance gap analysis is conducted by taking a look at historical figures and findings, evaluating the extent to which a particular issue has been examined in relevant literary studies, later evaluating the extent to which actual performance in real-life application measures up to the required performance; estimated depending on the extent that research places emphasis on a given variable or theory (Menezes et al., 2012).

Two primary approaches can be undertaken to conduct a basic performance gap analysis, which are:

1. Concrete Analyses: Evaluates the performance gap on the basis of data obtained from real-life case studies and application models
2. Conceptual Analyses: Evaluates and estimates the performance gap on the basis of hypothesized data obtained from examinations of hypothetical case scenarios.

2.5.2.2 Performance Gap in Contemporary Literature

A very interesting observation, attributed to Rashid (2013), is the notice provided on the opening page of CHD's Database (Ripple) on the date of the author's viewing:

> **NOTICE**: Design, cultural, operational, and technological strategies found on this site have been used in some situations. Because there are always unique factors at work for every facility there can be no guarantee that any given strategy will produce the same results in other situations. These strategies will need to be further investigated to help us fully understand their impact.
>
> ***Ripple Database Website***, ***Centre for Health Design***
>
> http://ripple.healthdesign.org/about

It is for fears like these that the performance gap in EBD and healthcare applications remains unbridged in current practice, for implementing such change is often methodical, exhausting, and not to mention, very costly. To realize, after implementing a design solution/treatment, that a better alternative exists, or that evidence points in the opposite direction, would prove very detrimental for the providers; who try to avoid such a scenario at all costs.

According to Coleman et al. (2018), performance assessment and evaluation has typically been approached by engineers to minimize the detrimental impact on those buildings at large, and the comfort/well-being of the building's occupants next. While performance assessment and implementation of decision-making processes are often portrayed to be simple, cost-effective solutions there for the taking, in reality, the process can be quite different.

For instance, sustainable environmental design is an approach primarily developed reduce resource consumption and often focuses on potential energy savings; presenting itself such that someone unfamiliar with the topic could not possibly realize that whatever economic savings may result from the implementation of sustainable solutions may not be recovered for a long period after initial implementation (Bartlett, 2014). Furthermore, significant evidence exists suggesting that buildings do not perform as well upon their implementation, as they were presumed to perform on paper.

2.5.2.3 Concluding Remarks

This section explored the links between theory and application in healthcare environmental design. Based on the gaps identified throughout the literature review process, the researcher evaluated both theoretical knowledge gaps pertaining to certain areas and fields in contemporary theory, as well as the current state of implementation of theoretical findings in practice, based on the observations of theorists and researchers alike.

2.6 A Critical Analysis of Patient Needs

2.6.1 Identifying Patient Needs

As numerous authors point out, the concept of a need differs greatly from one context to another, and there is not one single universally accepted definition of the construct (Fitzgerald, 1977; Armstrong, 1982; Doyal &Gough, 1984). Even in discussions taking place in the same field of research, different authors often identify different needs as relevant for the purposes of their study, and there is hardly ever any consistent application of one definition of need in different studies (Armstrong, 1982; Doyal & Gough, 1984).

Therefore, this section identifies the different types of need that are relevant for the purposes of this study, defining them in line with their application in the study's conceptual framework. Based on the researcher's review of the literature, four primary patient needs can be identified, each of which will be discussed in depth below:

1. Care Needs
2. Social Needs

3. Safety Needs
4. Comfort Needs

2.6.2 Care Needs

First and foremost, a patient's first need is healthcare, as that is the primary reason for which an individual is typically hospitalized. This need is typically examined on the level of individuals, as someone walking through the door of a healthcare facility may or may not reflect the wider health needs of the local community (Eccles et al., 1998).

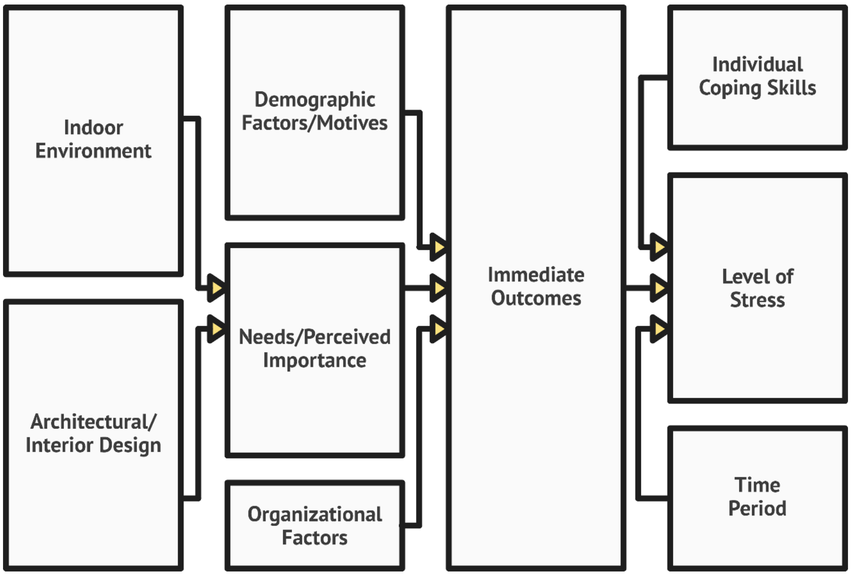
In a discussion centred around patient needs in general, the physiological and care needs of patients are the most natural need to infer, as patients who are hospitalized are almost certain to have some deficiency in the quality of their health/condition; one which were they were indeed hospitalized for (Kieft et al., 2014).

However, in the context of this study, the term care extends even further beyond to things that make up the care 'experience' of inpatients.

Stress and anxiety levels are among the most critical factors affecting patients perceptions of the care that they receive. Rashid & Zimring (2008) sought to examine the exact mechanism though which environmental design and practice impacted patients' stress. An adaptation of the authors' framework, shown inFigure 6, outlines the interactions between the built environment and patient stress, through multiple other factors that included patients' needs, outcomes, and demographics, along with some other organizational factors.

Figure 6
Framework, Physical Environment & Factors Leading to Stress

Source: Adapted from Rashid & Zimring (2008)



2.6.3 Social Needs

Among the most important but frequently left out needs includes the social aspect of patient's needs, which involves both communication with family members, among other parties such as healthcare staff. Having access to an outdoor space has also been determined to influence the degree to which patients interact and communicate with each (Asadi-Laari et al., 2004; McGuire et al., 2005).

Social and emotional support from family members and friends, including informational and evaluative support from those family members, has been strongly linked to increasing patient comfort levels (Jo & Kim, 2003).

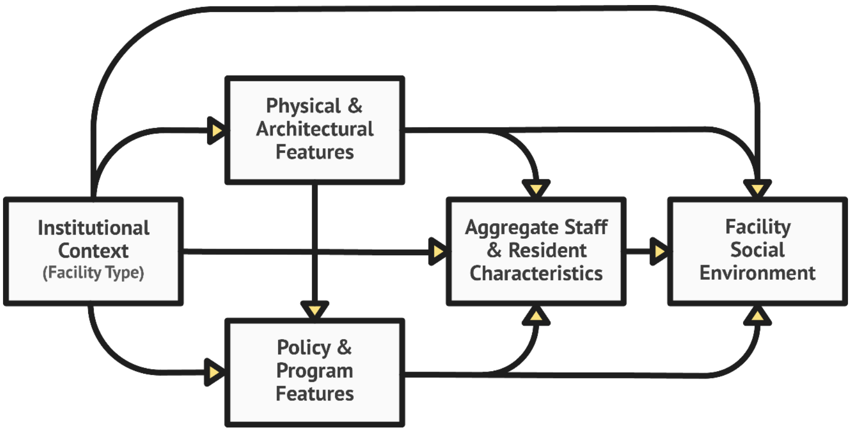
In some cases, research has shown the effect of social communication on an extreme scale. For instance, Ridd et al. (2009) report that the lack of social networks and support in post-myocardial infarction (heart attack) patients can have drastic effects on the premature mortality rates of this group.

Moos (1974; 1979; 2012) published various research studies on the environmental components that facilitate the creation of a social environment, or what the author dubbed, the "personality" of the space (Moos, 2012, pp. 76). The author developed a conceptual framework, modelling the determinants of social environments in healthcare, shown in Figure 7.

Figure 7

Determinants of Social Environments in Healthcare Environments

Source: Adapted from Moos (2012)



The conceptual framework developed by Moos (2012) suggests that the type of healthcare facility in question can largely and directly determine the social environment within that facility, emphasizing the role that physical and architectural environmental components must play in influencing the social climate of patients. The author differentiates between residential care facilities and hospital-based facilities stating that the greater space capacity of residential care facilities enables patients to host more visitors for longer durations, which facilitates cohesion, social bonding, and provides emotional support (Moos, 2012).

For the purposes of this study, a patient's information needs will be considered a substituent component of their social needs; since information is typically acquired through communication with healthcare professionals. The degree to which a patient is informed about their health is often used as a measure of social support, rather than being classified as a need in its own right (Turner, 1983; House &Kahn, 1985; Cohen, 1988; Mookadam & Arthur, 2004).

Cutili (2010) identifies three primary sources from which patients usually seek health information:

1. Healthcare Professionals: By far the most reliable source of medical information—general or specific to the patient's condition.
2. Family & Friends: Members with relevant experience in the past may provide some useful insights in general cases, but for more specific conditions, the information provided by family and friends could actually prove detrimental.

3. Internet & Media (Social Media & Other Outlets): Is generally not very reliable as a source of information. It may well be extremely difficult for those using this resource to locate reliable sources of information.

Unless the environment is directly responsible for delivering information to patients, classifying information needs as a standalone category would be redundant for the purposes of this study, as environmental factors can only contribute to patients' information needs by facilitating their contact with healthcare professionals; or family/friends as a secondary source.

As such, if information needs were to be classified as a standalone category, they will not be inclusive of any more results than is already incorporated into the social needs of patients; and may place unwarranted emphasis on the social environment of healthcare facilities, as aspects of the social environment are now identified to contribute to two patient needs, instead of the one need they actually contribute to: that which is the patient's social need.

2.6.4 Safety Needs

Among the biggest indicators of hospital safety is the number of falls that occur within, and without a patient's room. Falls and other types of injury often comprise the biggest issues in most healthcare settings. While most authors discuss the issue in terms of elderly patients, and patients using narcotics, the issue is very relevant to patients of all demographic groups (Abraham, 2011).

Abraham (2011) identifies some of the most common risk factors in healthcare settings. These factors are identified in terms of their correlation to staff involvement, and the degree to which staff-related factors and elements affect perceived patient safety.

Figure 8

Patient Risk Factors & Staff Involvement Grid

	Uninvolved Staff	Involved Staff
Safe Environment	*Family Involved in Care* *Closer to Nursing Station* *Bed in Lower Position* *Hip-Padding Available* *Bed Alarms Available* *Double-Side Treaded Socks* *Adequate Night Lighting* *Three Side Rails Up*	*Scheduled Toilet Assistance* *Sitter on Patient Bedside* *Amenities within Reach* *Call Button within Reach* *Hourly Comfort Rounding* *Clutter Free Environment* *Individualized Care Plan* *Nurse Assessment at Bedside*
Unsafe Environment	*Ambulating w/o Assistance* *Bed in Higher Position* *Wet and Cluttered Floor* *Bed without Brakes* *Unstable Furnishing* *Lack of Supervision* *Unanswered Call Lights*	*Patient Confusion* *Patient Anxiety/Agitation* *Patient on Narcotics/Meds* *Bedside Tubes Installed* *Bedside Catheters Installed* *Bedside Telemetry* *Patient Wandering*

According to Najafpour et al. (2018), factors that are typically controlled for in studies relating to patient falls include:

- Patient Age (Reported by the Patients)
- Patient Medication History (Reported by the Patients or Healthcare Staff)
- Risk Levels of Falls (Estimated by the Researcher or Healthcare Staff)
- History of Falls (Reported by the Healthcare Staff)
- Health Status (Reported by the Patient or Estimated by the Researcher)

Risk factors for patient falls are often described as one of two primary categories:

1. Intrinsic Risk Factors: These include patient-related factors and measures, including age, weight, past fall rates, and gender (Schaffer et al., 2012).
2. Extrinsic Risk Factors: These include the external conditions affecting the variable in question, which may or may not include physical environmental factors, staff communication, medication, and delays in treatment.

Beyond falls, several other adverse events can be identified relating to patient safety; among the most frequently cited of which is the rate of medical errors (procedural/prescription) .

In classifying risks and hazards to patient safety in healthcare contexts, Battles & Lilfoord (2015) identify human error/failure as a critical component affecting patient safety. The authors define human error in this context as active failures committed by staff members that lead to deviations from the intended results, and manifest in terms of risk that has either led to harm or can potentially lead to harm.

The nature of the environment in question can have an impact on reducing staff errors. For instance, Bion (2008) states that complex acute care environments are much more likely to have opportunities for staff error and require more monitoring and detection efforts to reduce the likelihood these errors occurring.

2.6.5 Comfort Needs

Wensley et al. (2017) conclude the findings of their integrative review in a framework examining how different stakeholders contribute to the realization of a patient's comfort needs. The framework places patient needs at the centre of the healthcare process, placing patients at the centre of the framework, as is evident in Figure 9.

Figure 9

Comfort Always Matters (CALM) Framework

Source(s): Adapted from Wensley et al. (2017)

The framework begins with the patient in the middle, which serves to demonstrate how this model emphasizes patient-centred healthcare.Patient are often the most directly influential agent in realizing their own comfort needs, which is necessary, given the fact that most healthcare settings are viewed as inherently stressful in nature These behaviours include patients using strategies to comfort themselves, such as positive distractions/thinking (Angstrom-Brannstrom & Norberg, 2014; Tutton & Seers, 2004), and becominginformed about their health condition (Morse, 1983; Kolcaba, 1992).

Moving outwards to the next layer, family presence and involvement is the second factor directly contributing to patient comfort. Many theoretical sources (Gropper, 1992; Tutton & Seers, 2003; Lowe & Cuteliffe, 2005) identify family involvement as the second direct actor substantially promoting patients' physical and mental comfort. Just through being alongside patients during their time of duress, family can provide sufficient comfort on their own (Borzou et al., 2014; Kennedy, 1991; Morse et al., 1995), an effect that is even more apparent with younger patients (children and adolescents) (Angstrom-Brannstrom et al., 2008; Carnevale & Gaudreault, 2013; Angstrom-Brannstrom & Norberg, 2014).

The presence of family members has been shown to have significant impacts on the comfort levels reported by patients (Hamilton, 1989; Arruda et al., 1992; Wilby, 2005). The very presence of family members or friends can have a number of impacts on patients, largely due to the fact that patients associate family/friends with a sense of belongingness (Yosefi et al., 2009; Cameron, 1993).

In the successive layer of the framework, staff are considered, who are recognized to contribute in more ways than any other stakeholder to the needs of patients, through five primary means:

1. Engagement and Commitment (Bowers et al., 2001)
2. Perceived and Actual Competence (Jones, 2013)
3. Information and Participation (Williams & Irurita, 2005)
4. Management of Patient Symptoms (Tutton & Seers, 2004; Angstrom-Brannstrom & Norberg, 2014)
5. Holistic Care and Assistance (Kolcaba, 1992; Collins et al., 1994)Practice based on Orlando's Nursing can help staff members (nurses in particular) achieve more successful patient outcomes, the most notable of which is reducing patient falls (Potter & Bockenhauer, 2000).

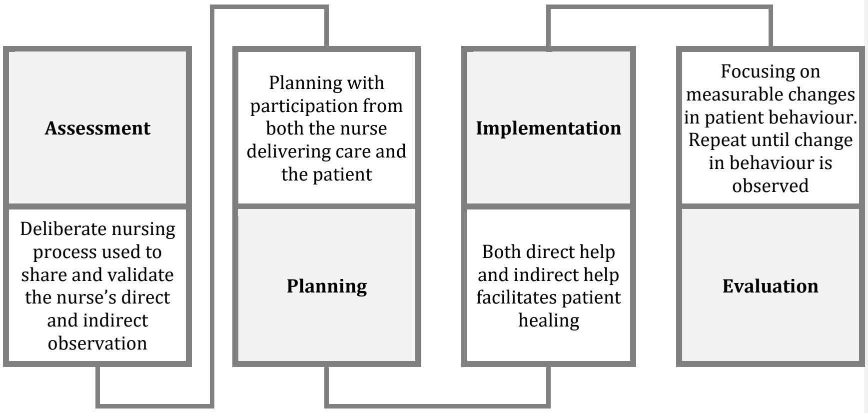
According to Abraham (2011), Orlando's Nursing Process Theory stands in complementary relationship with one of the primary missions of healthcare: maintaining patient safety. This is evident in the framework established by Orlando (1990), depicted in Figure 10, which summarizes the nursing situation as are comprising three primary elements:

1. The patient's behaviour
2. The nurse's reaction to this behaviour
3. The nurse's subsequent actions to alleviate any resulting distress

Figure 10

Orlando's Nursing Process Theory

Source: Adapted from Orlando (1990)



According to this framework, the nurse must evaluate the patient following the action to determine whether the nurse's action was effective in relieving distress (***Assessment Phase***). Per the findings observed in the assessment phase, a plan is evaluated constituting roles to be played by both the nurse and the patients (***Planning Phase***), which is then implemented on direct and indirect bases (***Implementation Phase***) If the patient shows positive outcomes, the goal is reached; if not, the process starts off from the beginning (***Evaluation Phase***) (Orlando, 1990). This theory, therefore, demonstrates the importance of nursing staff's role in mitigating the risks of patient falls (Abraham, 2011).

2.6.6 Concluding Remarks

This section explored the most identified and cited patient needs in studies relating to this research, which culminated in the identification of four primary patient needs: Care, Social, Safety, and Comfort Needs. These constructs will form a basis for the development of the conceptual framework of the study, and will help structure the remainder of the thesis; as the findings for both the systematic review and the primary research will be presented in terms of the factors relating to each need identified above.

2.7 A Critical Analysis of Patient Outcomes

2.7.1 Identifying Patient Outcomes

As established in earlier sections of this theoretical review, a patient's outcome is quite different from a patient's needs, and the two constructs are therefore differentiated on that basis in the conceptual framework of this study.Overall, three primary patient outcomes in total were identified to be of relevance to this study, and they encompass both physiological and psychological aspects of patient healing. These outcomes are presented below:

1. Functional Status
2. General Well-Being
3. Satisfaction with Care

2.7.2 Functional Status

According to Bierman (2001), functional status is among the most commonly used measures of patient outcomes, used to measure an individual's ability to resume their daily activities upon release from a healthcare facility. In his 2001 editorial, Bierman referred to Functional Status as the sixth vital sign, in reference to a commonly used group of bodily vital signs (Body Temperature, Blood Pressure, Heart Rate, Respiratory Rate, and Pain[9]) (Lorenz et al., 2009).While many alternatives have been proposed as a sixth vital sign, such as ecstasy(Belleli & Trabuchi, 2008), many authors support Bierman's proposition of using functional status as the sixth vital sign (Brekke et al., 2019; Chester & Rudolph, 2011; Richardson et al., 2012)

Commented [A19]: [37] Changed delirium to ecstasy? Not sure that's what you intended by the comment

This showcases the importance that some authors place on this outcome as a measure of patient healing, as the other five vital signs are among the most significant indicators of health, and are often considered chronic conditions that may lead to serious ailment or even death (Calkins et al., 1991; IOM, 2001; Lorenz et al., 2009).

According to Nicosia et al. (2019) and Spar et al. (2017), there are several methods and approaches researchers could take to evaluating the functional status of a patient. Some of the approaches used constitute bodily measures that provide more objective means to assessing functional status (such as repeat interval measurements of blood pressure and heart rate), while other approaches constitute more subjective and self-reported measures

[9]The fifth vital sign is somewhat contested in the literature, but the broad consensus points to the use of pain as the fifth bodily vital sign (Lorenz et al., 2009),

by either the patient or the physician (such as the use of self-reported questionnaire assessments) (Curtin et al., 1999; Litwin et al., 2012).

Identifying these methods of assessing functional status is relevant to the study as it helps outline the methodological approach to be taken by the researcher in evaluating functional status for the groups participating in the study.

2.7.3 Satisfaction with Care

The patient's experience is another major indicator of the quality of healthcare services; with many predictors and evaluative measures used by different authors to estimate patient satisfaction (Quintana et al., 2006; Ozaltin, 2009). Of all the measures used to quantify patients' satisfaction with the quality of care provided, questionnaires and surveys are among the most commonly used, which is natural, given that satisfaction is a subjective measure based on criteria determined by the patient (Aiken et al., 2018; Engel et al., 2010).

Jenkinson et al. (2002) explored patients' experience in healthcare settings, developing determinants of patient satisfaction based on 3,592 questionnaires distributed to patients at five hospitals in Scotland. Aside from the influence of demographic characteristics such as age and gender, several other determinants were identified by the authors, including:

- **Physical Comfort**: Ensuring that patients are physically comfortable[10] throughout their stay, which includes a commonly examined indicator in the literature: physical pain, commonly linked to patient satisfaction (Germossa et al., 2019; Otani et al., 2015; Tawil et al., 2018).
- **Emotional Support**: Studies like Sharma & Kamra (2013), Larson et al. (1993), and Imam et al. (2007) all indicate a strong degree of correlation between the level of emotional support received by inpatients, and their overall satisfaction with the quality of care provided. Emotional support does not only constitute the presence of family members, as nurses and other staff members are often seen to play a major role in facilitating patient support (Wensley et al., 2017).
- **Respect for Patient Preferences**: Finally, respect for the cultural and personal preferences of inpatients, such as meeting reasonable personal requests and

[10] Physical comfort, in this context, is not related to emotional comfort (psychological considerations and effects). Rather it relates more to sensations such as Pain or discomfort as a resulting of maintaining the same position for prolonged durations.

acquiring items based on cultural and religious background (e.g. praying mat for Muslim patients) have also been shown to play a major role in determining patient satisfaction (Phaswana-Mafuya et al., 2011; Docey et al., 2008).

Another study by Aiken et al. (2018) similarly explored the factors influencing patients' satisfaction with care, identifying poor working environments and the role of healthcare staff as a very accurate measure of patient satisfaction.

While the studies outlined above did not solely examine environmental components of healthcare settings, all of the above outlined factors could be tied to the healthcare environment in one way or another. Even aspects that are seemingly unrelated, such as the emotional support of family members, can accordingly be tied to environmental factors that influence those family members to visit more often, leading to an increased level of emotional support (Williams et al., 2018).

2.7.4 General Well-Being

Finally, general well-being is the broadest of the examined patient outcomes, encompassing aspects of both the physiological and psychological healing of patients. While general well-being and HRQOL are often correlated in the literature, some authors have presented concerns about using the two terms to indicate the same meaning.

While HRQL may significantly differ from general health, or QOL for that matter, Wilson & Cleary (1995) state that the concepts of HRQL and general well-being, are often used synonymously in this field of research. This similarity is also confirmed by Codinhoto et al. (2009).

The early work of Ulrich (1984) was one of the first studies conducted exploring the impacts of the physical environment on patient healing, and the measures used by Ulrich (evaluating patient satisfaction via the nurses evaluations and comments in a retrospective study) are strongly indicative of using a holistic measure of general well-being, such as HRQL. Furthermore, since this study, many authors have adopted general well-being as an umbrella measure encompassing both physiological and psychological aspects of healing, advocating for its use in future research (Anthony & Hudson-Bar, 2004; Couture et al., 2018; Lambert et al., 1997; Linton et al., 2016; Salsman et al., 2013).

As a result, this study will use the term *general well-being* to encapsulate the entire aspects of mental and physical wellness, which will be defined in terms of the users' perceptions of their current and past health, their symptoms and physiological health (to assess physical well-being), and their stress/anxiety levels (to assess mental well-being).

Subjective (self-reported) measures of general well-being are common throughout the literature, as both patients and providers are often informed enough on patient-related factors to posit a valid opinion on the HRQOL / general well-being of patients (Linton et al., 2016;; Sandvik et al., 2009).

2.7.5 Concluding Remarks

This section explored the most identified patient outcomes in studies relating to this research, which culminated in the identification of three primary measures of patient outcomes: Functional Status, General Well-Being, and Satisfaction with Care. These outcomes were selected among lists of many others for three main reasons:

- First and foremost, the outcomes capture the patients' psychological and physiological outcomes to a sufficient extent, without delving into too much detail possibly unrelated to the impact of healthcare environments.
- Second, they comprisepatient outcomes which could be measured via both self-reported and absolute empirical observations, such that either could be used depending on whether the sampled hospital population allowed for the collection of the latter.
- Finally, the measures were found to most closely related to environmental impacts, in contrast to other outcomes which may relate more or wholly to aspects pertaining to patients and their conditions.

2.8 A Critical Analysis of Environmental Design

2.8.1 Identifying Design Dimensions

In terms of the categorical dimensions identified by researchers for use in research, these are often identified in correlation to the objectives of the study. However, as with all theory, there is some foundational basis for establishing a generic set of dimensions that encompass a wide array of subsets and moving forth from there.

For the purposes of this study, a total of three primary environmental design dimensions were identified by the researcher, which include:

1. Spatial Design (e.g. Hutton & Richardson, 1995; Fottler et al., 2000)

2. Ambient Design (e.g. Dalke et al., 2004; Hutton & Richardson, 1995; Fottler et al., 2000; Ulrich, 1991;)

3. Functional[11] Design (e.g. Sommer, 1969; Day, 2017; Anthony & Watkins, 2007).

Many authors often identified at least two of the three design dimensions discussed below, such as Hutton & Richardson (1995) and Fottler et al. (2000), both of whom adopted environmental dimensions of ambient condition and spatial conditions. The particulars of each design aspect are outlined in the sections below, along with a detailed examination of what aspects and components each constitutes, and how it can be differentiated from other dimensions of design.

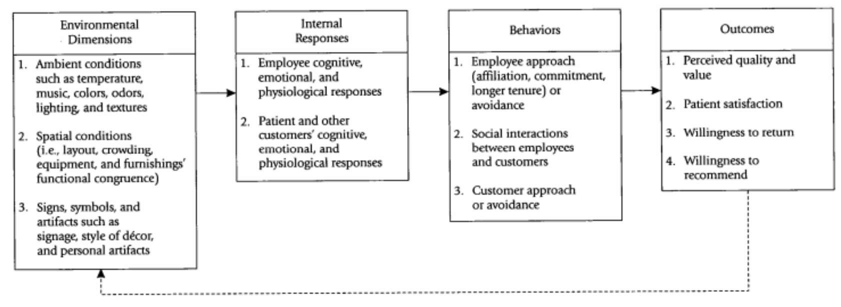
2.8.2 Spatial Design

Numerous spatial design considerations are often pointed out in the literature, each one of which is often relevant to the realization of multiple needs at once. For instance, Taylor & Card (2018) recommend that the outcomes of studies conducted in SORs (Single Occupancy Rooms) be considered in the context of unit configuration (the type of room), room layout decisions, and toilet location relative to the wall.

Figure 11

Customer and Employee Responses to Environmental Influences

Source: Adapted from Hutton & Richardson (1995); Fottler et al. (2000)



[11] Functional Design was sometimes referred to in the literature as behavioural design, which according to definitions of authors such as Sommers (1969), relates to the aspects of the environment that yield a differences in the behaviour and attitudes of the user toward the environment. This point makes behavioural design a very closely related topic to functional design, as the primary use of functional design is to facilitate easy interactions between patients and their environment (Day, 2017).

An early study by Hutton & Richardson (1995), whose ideas were later expanded on in the work of Fottler et al. (2000) examined the use of furniture and other key objects as a way to influence patient perceptions of interior space, via the effective use of space division. For instance, Holahan (1972) has demonstrated that reorienting seating patterns centred around a table, instead of being oriented shoulder-to-shoulder, can facilitate effective communication between a patient and their visitors, and enhances patient satisfaction in the quality of care provided.

The use of furniture and objects can influence patient perceptions of their environment, by effectively dividing up interior space. Reducing the cluttering of furniture and equipment in patient rooms can have an effect on patient's overall psychological comfort levels (Satterfield, 2010). Reducing clutter can also have implications for patient safety, since the presence of obstacles/clutter in the way between bed and bathroom is often associated with falls and other patient injuries (Huisman et al., 2012;

Matching a patient with the right-sized bed is one of the most important factors affecting patient recovery, along with helping maintain the safety and effectiveness of staff members, which indirectly affects patients' outcomes (Wiggerman et al., 2017). According to Smith et al. (2017) hospital beds have also been associated with patient outcomes like satisfaction with care, and overall experience.

The emphasis placed on hospital beds stems from the fact that the bed is the piece of equipment with which the patient has the most contact over the course of their stay, which makes it central to most aspects of their in-hospital experience (Wiggerman et al.,2017).

Patients, particularly those who have recently undergone surgery, need to turn in-bed to their side to get out of bed, which makes it a requirement for bed sizes in hospitals to meet the bare standard that allows them to comfortably do so (Zafiropoulos et al., 2004). If patients are not provided this bare minimum space required to turn in-bed to their side, patients will have to flex at their hips to get out of bed, which could cause abdominal pain, aside from the discomfort of staying in same position for hours on-end (VanGilder et al., 2017).

A study by Fragala et al. (2012) also correlate narrow hospital beds with an increased likelihood of physical injury, since patients, in their attempt to turn to their side, may roll past the edge of the bed and fall, which is especially evident in long-term care scenarios.

Clutter was defined in several papers as keeping floors and walkways clear of objects (Bell et al., 2008; Gowdy & Godfrey, 2003; Krauss et al., 2008). Similarly, Healey (1994) defines clutter as any item/component in the room/ward that remains unused for an extended period of time.

While a reference may have been generic to suggest a clutter-free environment (Gutierrez & Smith, 2008), other definitions of clutter were centred around clutter with regard to specific areas/components within the room. Clutter was also identified by many other independent authors including Fonda et al. (2006), Dykes et al. (2009) and Tzeng & Yin (2008).

Other aesthetic design choices for hospitals include factors that can be used to help guide users around a healthcare facility. Dalke et al. (2004) identify the two following aesthetic categories to be considered as part of an integrated design scheme for a hospital for helping orient the facility's users:

1. **Navigation:Successful negotiation of the building, from start to end, either by orienting users, or enabling wayfinding.**
   a. Orientation: Provision of a sense of direction, or point of reference
   b. Wayfinding: Information that helps guide the route planning process
2. **Signage: Elements providing information to users, classified based on purpose into Coding and Zoning-related signage.**
   a. Coding: Provision of a visual system to simply decision-making
   b. Zoning: Dividing space to broad areas based on function

2.8.3 Ambient Design

The ambient environment/design is identified in a number of literary sources (Carayon et al., 2007; Karwowsli, 2012; Wilson & Corlett, 2005), and is generally thought to constitute factors that surround patients, but in a *mellow* sort of way. What this means is that these components typically do not directly reference physical aspects of the environment, like spatial design; rather, they are usually resulting features or effects of these physical components within the environment. Such factors include thermal, air, noise, and lighting considerations, all of which are sensory factors commonly identified in systematic reviews, including Ulrich et al. (2008), Hadi et al. (2019), Malkin et al. (2012), Calkins et al. (2012), and are thought to contribute to facilitating the fulfilment of the majority of patient needs.

According to Knackstedt & Haney (1995), good interior design can only come about by accounting for the diverse set of needs and realities of people using the space. In the context of healthcare, interior design can account for many relevant patient needs. Bjorngaard (2010) summarizes the most important of those needs as follows:

1. Enhancing a patient's sensory (acoustic/visual) comfort and privacy
2. Creating contrast between objects to create instantly recognizable patterns, which can influence patient safety
3. Wayshowing by creating specific directions of movement within environments for patients to follow

Table 4
Evaluating Interior Design & Ambient Components

Source: Adapted from Pile (1995)

		Perceptions of		
Group	**Colours**	**Time**	**Size**	**Volume**
Warm Colours	Red Pink Orange Yellow	Overestimated	Longer Larger	Smaller
Cool Colours	Blue Green Violet Cyan	Underestimated	Shorter Smaller	Larger

Colour can be applied in a number of different ways in healthcare facilities, to match their impact on patient perceptions of the above-mentioned variables (Time, Size, & Volume). For instance, they can be applied to pathways and floors to delineate them (Wineman,1979), to emergency signage to elicit an emotional response (AHA,1979), and to a room's walls to curtail anxiety, decrease claustrophobia, and provide a sense of privacy (Bjorngaard, 2010).

Similarly, the use of patterns has also been shown in some cases to elicit stimulating or relaxing reactions. For instance, the result of Rodemann's (1999) survey indicate that certain pattern types, such as graphic mini-prints or natural textures, are often perceived to have positive effects in healthcare environments. However, research has yet to demonstrate this effect in terms of observable, measurable outcomes in patients.

It should be noted that distinguishing between effects owing to either spatial or ambient design could in some cases be difficult, as the underlying physical components within the facility can often be categorized under either, with the only differing variable being the way through which the physical component is believed to affect patients (Bhatt et al., 2009).

As stated earlier, the nature of the materials used in healthcare facilities can also be used to tend to patient needs, in terms of safety, by enhancing patient comprehension of visual cues (Miller & Schlitt, 1985); in terms of comfort, by reducing surface reflectance and glare (Brandi & Geissmar-Brandi,2001), and to facilitate wayshowing by establishing contrast between different patterns (Bjorngaard,2010).

According to Barnhart et al. (1998), whose study analysed commonly reported attributes of ideal settings/environments, the term "clean" is among the top three most consistently identified attributes, along with "colourful", and "happy". As such, studies like the one conducted by Barnhart and his colleagues demonstrate the shifting trend in customer perceptions to healthcare being a service much like any another; something that was not even remotely considered in earlier research.

Materials, such as carpeting, can be applied to flooring to reduce noise levels (CISCA, 2016), which can impact the comfort of both patients (Johnson & Thornhill, 2006) and staff members (Blomkvist et al., 2005).

Commented [A20]: [41] Changed the position of this paragraph as it relates more to cleanliness

Lighting is among the most critical components of environmental design in general, and in healthcare facilitiesin particular (CIBSE, 2002). An adequate level of lighting is not only required for the performance of visual tasks, but it can even transform the appearance of a physical space (Michel, 1996; Dalke et al., 2004).

Lighting is usually differentiated on the basis of its source; i.e. whether it is natural daylight (sunlight), or electrical light. Both sources of light are equally important in their impact on patients. As such, literary sources using the term *lighting* typically in reference to indoor lighting, with substitutes such as *daylight* and *outdoor light* used in reference to natural light coming from the sun.

Lighting design typically covers a number of different issues. Summarized by Loe & Rowlands (1994) as follows:

1. **Task Illumination**

   Being able to see to move around in a safe manner, or conduct visual tasks and activities

2. **Lighting Appearance**

   Providing a good quality visual environment that is comfortable for the senses

3. **Architectural**

Integrating the lighting type with the existing design of the hospital; both physical elements, and daylight—where it may be available

4. **Energy Efficiency**

Including specifications for particular types of lighting which are most appropriate for different settings

5. **Lighting Maintenance & Costs**

Not just the costs associated with the capital and installation, but also include other running costs of the lighting used.

Commented [A21]: [42] Yes, they have less to do with other components of ambient design, but this is how they are classified in most literary examinations of both qualities, so I added them to this part

Finally, the thermal conditions within which the patient is situated is among the most commonly examined components in the literature (Huisman et al., 2012, Malkin et al., 2012; Ulrich et al., 2003; Ulrich et al., 2008). Thermal environment is often most closely attributed to the indoor/air quality of a facility, often leading to thermal and indoor/air quality being categorized as the same construct (e.g. Huisman, 2012). The U.S. EPA (Environmental Protection Agency) defines Indoor Air Quality as the air quality within and around the proximity of a building structure, which is responsible for directly influencing the health and comfort of building occupants (EPA, n.d.)

2.8.4 Functional Design

Functional design, in the context of this study, is not to be confused with another use of the term to the division of healthcare staff members into specific functional departments, such as the financial, nursing or pharmacy departments (Sekhar, 2008).

The construct of functional design, as explored in the context of this study, is among the most primary forms of design in architecture and environmental studies, and dates back as early as 2000 years ago, in the treatise by Virtuvius. Virtuvius outlined three primary design utilities, the first of which was function, or the intended use and interaction with the physical environment, followed by ambient and spatial design (Omrania, 2018).

Commented [A22]: [43] Added these two

According to Hughes (1995), design for function requires a dynamic process be undertaken by the facility decision-makers, as to ensure the use of up-to-date technologies and methods to ensure that the users in question are taken into consideration with regard to the features with which they are offered.

Several layers exist encompassing the functional design of a facility, which include the following key points:

- Maintaining focus of the user function
- Maintaining focus on the integrity of the technical and structural components of the facility
- Considering sustainability, and the impact of functional design on the natural environment
- Considering the economic side and ensuring optimal functionality levels for the budgets invested.

2.8.5 Concluding Remarks

This section explored the different dimensions of environmental design in healthcare settings, whereby each dimension was characterized by certain features and intervention purposes. The aim of classifying design interventions into these three groups is to explore whether each set of design interventions (classified into a single dimension) can be identified to have a more significant impact on a particular patient need. This impact will be evaluated in the systematic review section of this study (See Chapter 3).

2.9 Chapter Summary

2.9.1 Concluding Remarks

To conclude the conceptual component of the literature review, the following subsections briefly summarize the most important factors identified by critically evaluating contemporary theories and extracting useful data applicable to this research. All of the factors/constructs outlined in the sections below will be used in developing the base model for the conceptual framework of the study, presented at the end of the next chapter.

The chapter began with a summary differentiating between users and stakeholders in healthcare facilities in order to determine the most appropriate group to target in conducting the research. The chapter then proceeded with an in-depth evaluation of relevant concepts used throughout the thesis, including: “needs”, “outcomes”, “evidence-based design”, “environmental design”, and many others.

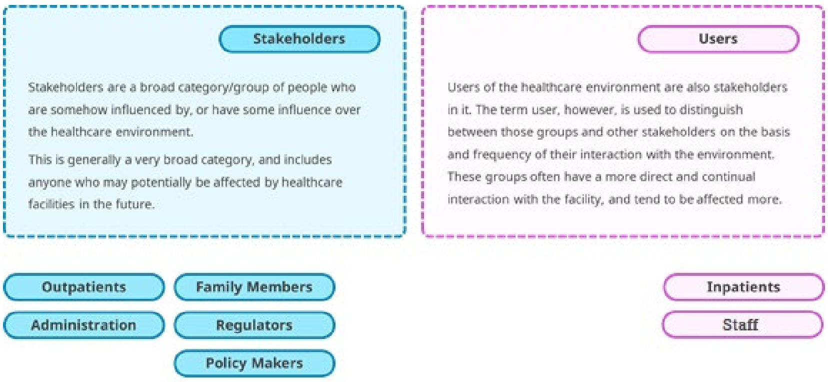
Commented [A23]: Added further elaboration in conclusion to conceptual review

2.9.2 Summary of Agents in Healthcare Environments

A summary of the key distinguishing features and traits between stakeholders and users is presented in Figure 12. Examples of both stakeholders and users are provided in the diagram, and the two users whose needs are explored in the study are identified to be hospital inpatients, and healthcare staff/personnel.

Figure 12

Summary of Differences between Stakeholders & Users

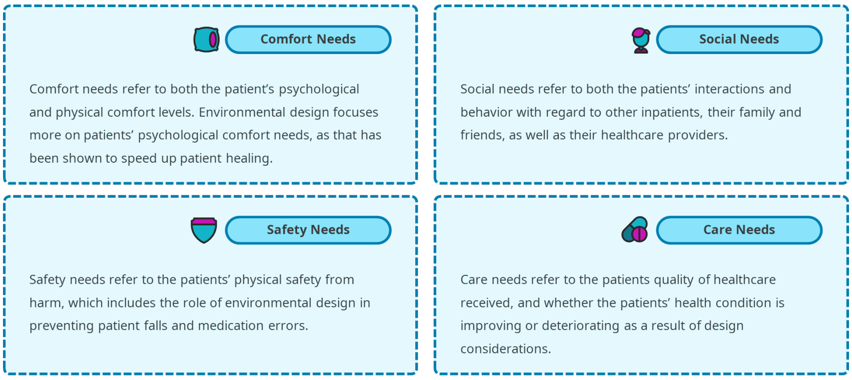


2.9.3 Summary of Patient Needs

The four patient needs identified in this review as relevant to the study are summarized in Figure 13. The four patient needs presented in the diagram will make up the primary needs to which the impacts of healthcare environments will be linked.

Figure 13

Summary of Patient Needs

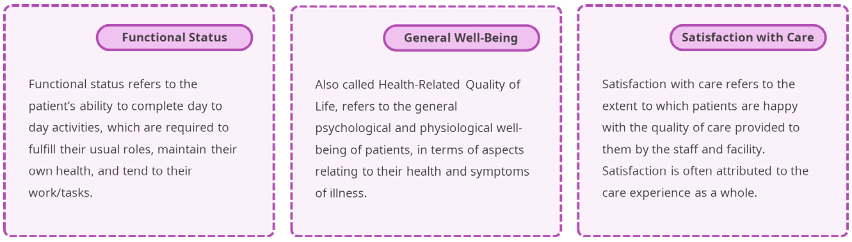


2.9.4 Summary of Patient Outcomes

The three patient outcomes identified in this review as relevant to the study are summarized in Figure 14. The three outcome measures presented in the diagram will make up the criteria and questions through which the impact of healthcare environments will be observed to impact patients' outcomes.

Figure 14

Summary of Patient Outcomes



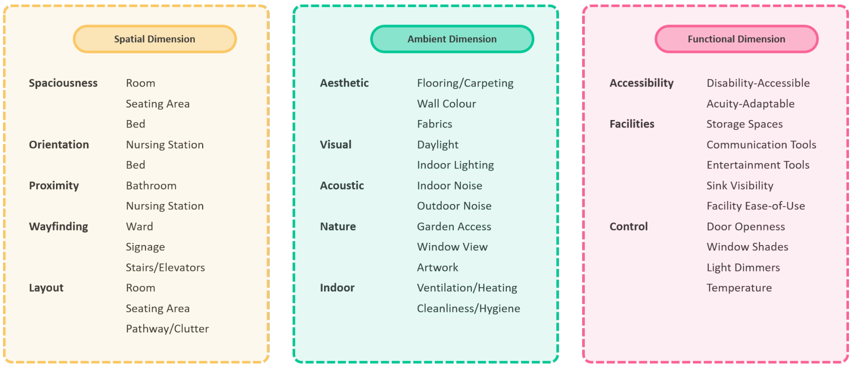
2.9.5 Summary of Environmental Design Dimensions

Presented in Figure 15is a summary of the three dimensions of design identified in the conceptual component of the literature review, along with subclassifications of each; along with some commonly associated design objects examined in the literature.

While the review identified all three of these dimensions as recurring and contextually valid, it is not always easy to classify a design intervention to fit within one of those groupings, as some overlap may occur. As such, a principal component analysis will be conducted to ensure the conceptual validity

Figure 15

Summary of Environmental Design Dimensions & Categories



These dimensions and sub-classified components were evaluated based on the findings of the conceptual part of the literature review. Listed in Section 3.3.1are descriptions of each of the design dimensions and categories, as well as some of the foundational studies (theoretical and empirical) upon which each of the categories is included. A more thorough examination of each of these factors, along with the extent to which each of these factors impacts patients in real healthcare environments is yet to be evaluated in the systematic review.

3 Systematic Review

Chapter Overview

Chapter 3 provides a systematic review of literary sources examining the correlation between healthcare environmental design componentsand the resulting impact of these components on different facility users; most notably: patients. The chapter begins by outlining the methodology used to search, screen, and evaluate evidence in the literature, and culminates in an in-depth evaluation of the role of each identified design component in realizing patient needs. The chapter concludes with a conceptual framework to be used in the development of the research instruments, based on the most significant relationships identified in the literature.

3.1 Introduction to Systematic Review

A substantial amount of literary research has been conducted, aimed at examining how the built environment contributes to patient healing and outcomes; though it remains contested whether this literature is substantial enough as to constitute a knowledge base for EBD.

An evaluation by Stankos & Schwarz (2007) indicates that it still far too early in the literary lifetime of EBD to refer to the field as a complete knowledge base; as is evident by the fact that there are too few reliable findings spread across too wide a field of study. This view is reiterated by McCollough (2009), in her book ***Evidence-Based Design for Healthcare Facilities***, where she states that EBD cannot be described as a discipline of its own yet, and that it is improbable that it will be considered one anytime soon, given the current rate of progress in practical application of the identified design features.

Neither Stankos & Schwarz (2007) and McCollough (2009) make a claim to the fault lying in EBD or any of its core principles, but rather, the authors mostly attribute how little evidence there actually is to the continuing application gap in the field, and difficultly of implementing reform in real-life settings, given how costly, time-consuming, and risky such reform could be [See Section 2.5.1.2d].

Such a view of EBD is not without merit, as it is also supported by the substantial amount of the conflicting evidence that can found in EBD literature, and the extent to which researcher biases could compromise the quality of individual studies' findings (Kumar, 2012). This serves to show how little is currently known as to the overall impact of environmental interventions on different facility users.

In the absence of systematic efforts to organize the available knowledge in the field of EBD, it has little value for applications in practical healthcare (Rashid, 2013). Theoretical reviews, such as the one presented in the previous chapter, are often considered ill-advised sources of recommendation in practice, although some sources may be much more credible than others (Ballad & Rybkowski, 2007). As such, incorporated elements established and verified via a systematic review of the literature enables a much stronger claim for application and financial investment in practice.

3.2 Review Method

3.2.1 Synopsis of Review Methodology

This systematic review is primarily based on the methodology developed in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2019). It should be noted that while this study cites several chapters of the handbook in reference to the review strategy and methods, the researcher makes no claim to this being a Cochrane Review. Cochrane reviews typically follow a very highly structured formatting pattern, a strict set of procedures, and a thorough peer-review process. Therefore, given the time constraints of a PhD thesis, conducting a full Cochrane review in preparation of one section would not be plausible.

However, with that being said, the overarching principles set to guide the review are very similar (in some cases identical) to those used by Cochrane reviews, especially with regard to the assessments of quality of evidence and risk of bias [See Sections3.2.5.4 and 3.2.5.7].

Section 3.1 aims to provide a comprehensive overview of the different methods used by the researcher to conduct the systematic review, detailing the process from the identification of the review questions, to the tools developed to perform the data extraction and synthesis processes.

3.2.2 Review Questions

3.2.2.1 Scope of Review Questions

Since a systematic review is often conducted as a standalone work of research, the first step to conducting a systematic review is to identify the research questions the review aims to explore (Higgins et al.,2011). Determining the scope of the review question is dependent on many factors, including the potential generalizability of the factors, the availability of resources, and the primary aim of the systematic review.

O'Connor et al. (2011) points out several advantages and disadvantages to setting broad vs. narrow review question, which are shown in Table 5.

Table 5
Systematic Review, Review Questions, Broad vs. Narrow

Source(s): Adapted from O'Connor et al. (2011)

	Question Scope	
	Broad	**Narrow**
Advantages	Provides a comprehensive summary of the evidence on a topic	Is more manageable for the review team to conduct
	Enables the review team to assess the generalizability of the findings	Is easier for other readers to understand and browse through
Disadvantages	Search, collection, and analysis may require additional resources	Presents a possibility of sparse and ungeneralizable evidence
	Risk of heterogeneity may be more difficult for review team to interpret	The scope may be chosen by the research to produce desired results

Bearing in mind the considerations listed in Table 5, the questions identified for this systematic review cover a broader scope, since generalizability and a wider (more complete) scope results is essential to the development of a comprehensive conceptual framework.

This review aims to answer one question, which can be further broken down into 4 sub questions, which are presented in the two sections below.

3.2.2.2 Review Question

The primary question identified for this review are:

1. *What can past research tell us about the relationship between environmental design and patient healing?*

3.2.2.3 Review Sub-Questions

Furthermore, this question can be divided into the following sub-questions:

1. *Which components of environmental design influence the likelihood of patient needs/outcomes being satisfied?*

2. *Which components of environmental design influence the satisfaction of needs/outcomes of other healthcare stakeholders? Can these stakeholder needs, in turn, influence the needs and outcomes of patients?*

3. *How much scientifically credible evidence supports the relationships between each environmental design component and the satisfaction of patient needs/outcomes?*

4. *Are there any significant intercorrelations between multiple environmental design components and a single need/outcome? What can be done to resolve any such conflicting intercorrelations?*

3.2.3 Search Strategy

3.2.3.1 Overview of Search Strategy

To ensure that a significant portion of the vast literary base was covered by the researcher, a consistent search strategy was developed, comprising database searches to obtain (presumably) high-quality papers from peer-reviewed journals, as well as grey-literature web searches, to account for publication bias (See Section 3.2.3.3).

3.2.3.2 Database Searches

An extensive search of relevant literature was conducted using the EBSCOhost research platform, which allowed the researcher to conduct simultaneous searches of multiple databases. Several other relevant databases and repositories (e.g. *Cochrane Database*; *HERD Knowledge Repository*) were identified in the theoretical review process and were included along with the primary EBSCO search. The final list of searched databases/repositories is shown inTable 6.

Table 6

Systematic Review, Search Strategy, List of Searched Databases

Database	
Publisher	**Name**

Database	
Publisher	**Name**
APA	PsycArticles
	PsycINFO
BMJ	BMJ Journals
Cochrane	Cochrane Database
EBSCO	Academic Search Elite
	Art & Architecture Complete
	CINAHL
	Psychology &Behavioural Sciences Complete
Elsevier	ScienceDirect
Emerald	Emerald Insight
HERD	HERD Knowledge Repository
NCBI	MEDLINE

The first round of searches included any study that alluded to healthcare environment design/layout in relation to patient needs/outcomes. These searches yielded a total of **576,091** studies. However, a significant portion of those results were irrelevant, since *SmartText searching*—an advanced algorithm yielding additional results, was used. Many journal articles were also cross posted across multiple databases.

A second round of searches was conducted to narrow down irrelevant results. Combinations of terms related to environmental design, healthcare stakeholders, and key functions/variableswere applied using Boolean operators (e.g. OR; AND; NOR; etc…), depending on whether the search space needed narrowing or broadening. For instance, when searching the literature for the impacts of design on infections, disjunctive operator 'OR' was used to pair 'Hospital-Acquired Infections' and 'Nosocomial Infections', since both terms are synonymous. This round of searches yielded a total of **8,206** results.

To reduce the number of articles to a more manageable level, yields from different databases were cross-examined to eliminate duplicate results, and were screened online to determine whether they met the exclusion/inclusion criteria.

3.2.3.3 Grey Literature Searches

Song et al.(2010) define publication bias as a type of bias that occurs in academic publications, in which the outcomes/findings of the research paper influences publishers' decisions on whether or not to publish the study. In the majority of cases, significantly positive results are almost three times as likely to get published in comparison to null results (Dickersin et al., 1987).

In reviewing 'grey-literature', the researcher aims to identify and include unpublished research studies to supplement the studies found in database searches. According to McDonagh et al.(2013), using grey literature sources can help assess and reduce biases in a systematic review or meta-analysis, since the presence of grey literature in the first place may suggest evidence of publication bias.

This bias, in particular, becomes very relevant in conducting systematic reviews, since studies will null results may be of the same standard as studies with significant results in terms of the design and quality of research conducted, with the only differentiating factor being the nature of the conclusions reached (Easterbrook et al., 1991).

The search strategy is consistent for both database and grey-literature sources, albeit, with a somewhat more evaluative approach undertaken by the researcher for the latter.This is due to the fact that over-reliance on large amounts of grey literature sources may also produce a high risk of bias; in that those literature sources may be unpublished due to methodological/practical flaws in the studies, rather than the nature of the produced results. Therefore, analysing whether to include a grey literature source required that enough information be present about the methodological design of the paper, and entailed a more critical approach be taken by the researcher (McDonagh et al., 2013).

3.2.4 Screening & Eligibility

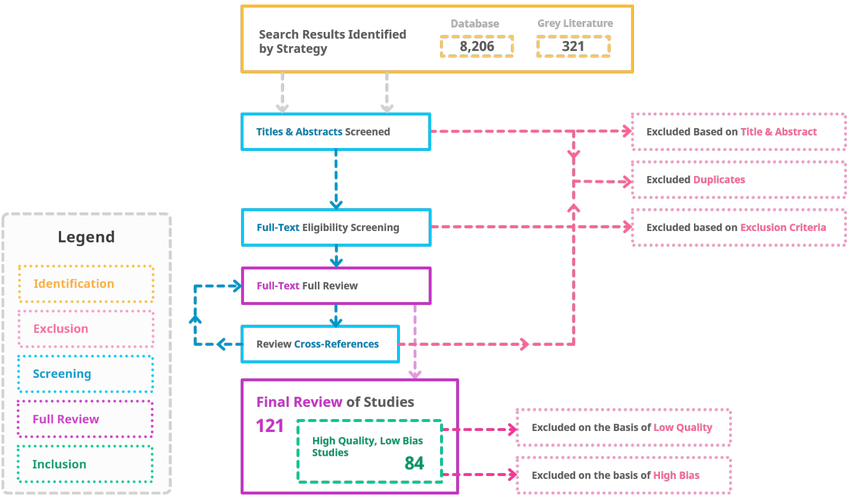
3.2.4.1 Screening Process

Outlined in Figure 16is the strategy and screening process undertaken by the researcher in conducting this study. The framework itself demonstrates a flow chart of the different stages undertaken while conducting the systematic review.

Figure 16

Systematic Review, Screening & Eligibility, Flowchart of Screening Phases

Source(s): Adapted based on the PRISMA Flowchart presented in Moher et al.(2009)



The flow chart diagram above shows the search strategy and screening process used to obtain the final list of included articles. The longest phase throughout this process was the full-text eligibility screening, based on the inclusion and exclusion criteria established in the following section. While the following step, comprising a full-text comprehensive review, technically required a much higher average review time per paper, the number of articles making it to this stage is significantly lower than the screening process.

A total of 8,206 articles were identified from databases, and 321 articles were identified from grey literature sources. Of these articles, upon the exclusion of the items highlighted in red inFigure 15, a final list of 121 articles were reviewed in full by the researcher, and were assigned quality and bias rankings in Section 3.2.5. Upon excluding studies that were of low quality/high risk of bias, a total of 84 articles finally provided a comprehensive list of the impacts of environmental design components on the needs and outcomes of hospital inpatients.

3.2.4.2 Eligibility Process

The search results obtained via database and grey literature searches were evaluated to ensure that the predetermined inclusion and exclusion criteria were met for each source. These inclusion and exclusion criteria were derived based on considerations provided in Chapter 5 (O'Connor et al.,

2011) of the Cochrane Handbook (Higgins et al., 2011), regarding participants, interventions, outcomes, and study types.

The inclusion and exclusion criteria are listed in Table 7:

Table 7

Systematic Review, Screening & Eligibility — Inclusion & Exclusion Criteria

		Criteria	
Basis	**No.**	**Inclusion**	**Exclusion**
Relevance	1	The study's aim is relevant to the identified research question(s)	The study's aim is unrelated to the identified research question(s)
Homogeneity	2	The study's findings are generalizable across a random population of patients	The study's findings are not generalizable across a random population of patients
	3	The study's scope does not extend to populations or settings beyond the aims or scope of this research	The study's scope extends to populations or settings beyond the aims or scope of this research
Soundness	4	The study uses sound methods to derive the results, either empirically, or using solid scientific evidence	The study is methodologically flawed,and does not derive the results using appropriate means
	5	The study draws upon past research in design and analysis	The study draws upon little or no past research
Integrity	6	The study directly answers the proposed research questions, and does not selectively report findings	The study does not directly answer the proposed research questions, or selectively reports findings
	7	The study does not show partiality due to conflicts of interest or research funding	The study shows some partiality due to conflicts of interest or research funding
Availability	8	The study is originally written in English, and is not translated	The study is not originally written in English, and/or is translated
	9	The study's full text is available for review by the researcher	The study's full text is unavailable for review by the researcher

According to McDonagh et al. (2013), the operational criteria guiding the selection of research studies to include in systematic reviews; namely, the inclusion and exclusion criteria, can significantly influence the final results of the systematic review, which makes it very important to eliminate bias from those criteria in particular. Therefore, the rationale behind criteria selection is presented below, along with any additional considerations made in the process:

3.1.1.1a Inclusion & Exclusion Criteria

The inclusion/exclusion criteria of this study, which were used to screen the literary sources obtained on the basis of several key elements; are listed below in order; along with the rationale used to justify their establishment.

1. **Criterion 1: Relevance of Topic & Question**

While the initial screening process used certain keywords to identify as many relevant articles as possible, these keywords are not enough to ensure that the relationship examined in the study is in line with the goals of this research paper, and the use of broad keywords can often generate a wide variety of articles that may be wholly unrelated to the relationship sought (Bramer et al., 2018).

As a result, careful examination of each title and abstract is required to ensure the validity and relevance of the results analysed, for which the first criterion is drawn. Irrelevant articles include papers examining aspects such as medical treatment/wound healing, or papers centred on the needs/outcomes of other facility users like staff or family members, with little or no mention of patient needs.

2. **Criteria 2 – 3: Relevance (Homogeneity) of Populations**

Ensuring the representativeness of the populations studied by the reviewed articles is another important factor when it comes to setting inclusion and exclusion criteria. Chapter 5 (O'Connor et al., 2011) of theCochrane Handbook (Higgins et al., 2019) points out that when conducting a systematic review, researchers must discuss how articles with participants belonging to different subsets of target populations are handled in the review, regardless of whether a corresponding inclusion/exclusion criterion is developed.

Restricting the population of a research study to a particular demographic or group can introduce elements that drastically alter the results of the study (Ioannidis, 2010). Different subsets/groups of patients can and often show drastically different results from the population as a whole. For instance, Hansson et al.(1995) demonstrate that different subgroups of psychiatric patients have varying levels of intensity when it comes to their needs, depending on the nature of the mental illness present.

Factoring in these considerations, the second criterion is drawn, since the aim of this paper is to examine the needs of hospital inpatients in general, and not the needs of a particular group or demographic of patients.

The third criterion excludes studies by their scope, in which any studies taking place in a different healthcare facility type (such as nursing homes or special clinics) will be excluded from the analysis, for the same reasons mentioned above.

3. Criteria 4 – 5: Methodological Soundness

The fourth and fifth criteria are drawn to ensure the validity of the methodological approach and analytical methods used to obtain the results. The primary focus of these criteria is to ensure that only research that meets a certain standard is used to derive the results of the systematic review. This systematic review targeted RCTs (Randomized Control Trials[12]), observatory (cohort) research, and case/time series, all of which are analysed differently (See Section 3.2.5.2). While RCTs are generally thought to present the highest evidence in terms of unfiltered research, not including cohort studies may disregard some important outcomes that cannot be assessed using RCTs, especially when a large number of such outcomes is present (McDonagh et al., 2013).

However, the results for each study type are evaluated and discussed separately, since utilizing one method of quality assessment for all study types will most often result in disproportionate weighting and biased results (Higgins et al., 2019).

Criterion 4 is drawn to ensure that only empirical or scientifically backed studies are included in the review. An emphasis is placed on empirical findings, however, for two reasons:

1. The majority of credible sources on the topic obtain their results through empirical findings (Huisman, 2012).
2. Empirical findings are best suited for the analysis of cause and effect relationships and differentiating between correlation and causation in variable analyses (Heitink, 1999).

Criterion 5 is drawn to ensure that the study is conducted based on credible existing literature, as to reduce the likelihood of personal biases, judgement errors, and subjective analysis. Ensuring that the study is grounded in solid literary basis is essential to reducing the likelihood of error in the analysis.

4. Criteria 6 – 7: Integrity & Impartiality

The sixth and seventh criteria are drawn to ensure the integrity and quality of the studies analysed, and to reduce bias, be that publication bias, or bias due to conflicts of interest, or funding concerns.

Criterion 6 is objectively easier to measure than Criterion 7, due to the fact that conflicts of interest or funding concerns may not be readily legible to the reviewer, or not even mentioned at all; although the possibility of that can be drastically reduced by obtaining studies only published via reliable, peer-reviewed journals and databases.

[12] Randomized control trials refer to a systematic and organized research method where two similar groups are allocated on a random basis and are given different treatments/interventions, to which the differences between the observed effects are then evaluated (Kabisch et al., 2011).

5. **Criteria 8 – 9: Availability for Review**

Finally, the eighth and ninth criteria are drawn to ensure that the researcher is able to conduct a thorough analysis of any study included in the systematic review, in order to assess its design, analytical methods, and to address all of the aforementioned criteria.

While there is no clear indication that studies published in other languages are of inferior quality to those published in English, Morrison et al.(2009) demonstrate that there is no evidence of systematic bias resulting from the implementation of language restrictions in systematic reviews. Therefore, the time, effort, and cost constraints associated with translating non-English articles make it infeasible to do so.

3.2.4.2a Sample Included & Excluded Titles

Presented in the Table 8is a list of some articles that were excluded on the basis of their titles, along with the basis for their exclusion, which are based on the inclusion and exclusion criteria outlined in the above chapter.

Table 8

Sample of Included & Excluded Titles

No	*Citation*	Title	Basis for Exclusion
1	***Federman et al. (2000)***	Relationship between climate and psychiatric inpatient length of stay in Veterans Health Administration Hospitals	Special Group: Psychiatric Patients.
2	***Kennedy et al. (2001)***	Reduced lighting does not improve medical outcomes in very low birth weight infants	Medical Condition: Demographic: Low-Birth Infant
3	***Leather et al. (1998)***	Windows in the workplace: Sunlight, view, and occupational stress	Setting Scope: General Work setting
4	***Leppamaki et al. (2003)***	Timed bright-light exposure and complaints related to shift work among women	Demographic: Female Patients
5	***Lovell et al. (1995)***	Effect of bright light treatment on agitated behaviour in institutionalized elderly subjects	Demographic: Elderly Patients

3.2.5 Data Extraction & Synthesis

3.2.5.1 Extraction Process

After all search results have been screened for the inclusion/exclusion criteria, quantitative data are extracted to be synthesized. According to Munn et al.(2014), not only does data extraction involve the outcomes of a study, but it also includes extracting the methods used to obtain those findings, and an assessment of the validity/reliability of those methods.

A data extraction form was developed from the Cochrane Collaboration's Data Collection Forms (EPOC, 2013), and were adapted to include variables relevant to EBD research, per EPOC's (Effective Practice and Organisation of Care) recommendations. The adapted forms are divided into multiple sections, beginning with a general section which was used to collect data that are consistent across all study designs (e.g. Reference Data), and multiple subsequent sections, tailored depending on whether the research was experimental, non-experimental, or synthetic in nature.

3.2.5.2 Synthesis Process

As stated before in the methods section of the systematic review, Chapter 8 of the Cochrane Handbook (Higgins et al., 2011) points out a noteworthy distinction to be made between the terms *bias* and *quality*. The authors' reasoning for this distinction is that while a study may be performed to the highest tier of methodological standards, a substantial risk of bias may still be present— inherent to the nature of the variable being examined. While such studies cannot be deemed to be of 'low quality', classifying them as 'high-quality' while ignoring potential biases would also be inappropriate.

In accordance to the definitions provided by the handbook, the term 'Bias' will be used to a potential risk of systematic error in results, leading to overestimations or underestimations of the examined impact. On the other hand, 'quality' will be used in reference to the extent to which the researcher is confident that any given effect approximately represents the true value of any given outcome. More information of the quality and bias assessments is provided in the subsequent assessment sections.

3.2.5.3 Research Designs

3.2.5.3a Taxonomy of Research Designs

Table 9 outlines the differences between research designs in the field of EBD and related studies, which will be used to formulate the basis for the quality assessment domains and criteria, shown in Section 3.2.5.7.

Table 9
Systematic Review, Taxonomy of Research Designs

Source(s): Adapted from Drummond & Murphy-Reyes (2018) &Sousa et al. (2007)

Study Design			
Category	**Nature**	**Type**	**Example**
Non-Experimental	Observational	Descriptive	Cross-Sectional Cohort
			Comparative Cohort
	Exploratory	Correlational	Correlational Cohort
Experimental	Predictive	Quasi-Experimental	Non-Equivalent Control Group

Study Design			
Category	Nature	Type	Example
			Interrupted Time-Series
		(True) Experimental	Randomized Control Trial
			Cross-Over (Between-Groups)

Experimental research designs refer to studies in which an intervention took place, and two groups (with and without the intervention) are analysed to quantitatively assess the impact. Whether the groups were randomized is the point of differentiation between (True) Experimental designs, and Quasi-Experimental Designs. Experimental designs are generally thought to represent a higher tier of evidence than descriptive/correlational designs (Drummond & Murphy-Reyes, 2018).

Furthermore, these classifications are important to identify in selecting the design of the study, as they will factor into the considerations made in Section 4.2.

3.2.5.3b Appropriateness of Research Designs

In spite of the fact that qualitative research is often viewed as a subjective method; inferior to experimental designs and other quantitative sources of evidence, it is far too often “bashed” by authors, even in cases where qualitative research has plenty more to contribute than experimental and other observatory designs (Sackett & Wennberg, 1997).

Sackett & Wennberg (1997) argue for the use of non-experimental approaches to research in EBD, proposing that both experimental and non-experimental designs fare better in certain regards, and that far too much attention and emphasis have been placed on experimental designs in the literature.

This fact has culminated in models where non-experimental designs are typically disregarded in systematic reviews of the literature, on the basis of the fact that they are considered lower quality designs [See Section 3.2.3], and an association that non-experimental designs typically significantly increase the risk of bias in research.

However, while this may have some basis in truth, an RCT, for instance, will not be able to determine how experimental treatments will fare in general use, nor can they identify aspects such as rare side effects directly pertinent to the design intervention and measured outcome. This may be due to biases relating to the RCT design, insufficient sample size, or the measurement method used to evaluate the outcome. (Sackett & Wennberg, 1997).

The focus on assessing only claims obtained via experimental designs is something that is more often considered for the sake of translating knowledge into practice, rather than being something used to determine the validity of a study's methodological approach (Ballard & Rybkowski, 2007).

That is not to say that non-experimental designs are equally comparable to experimental designs, as this is refuted by too many credible models to be true (Leatherdale, 2019; Thompson & Panacek, 2007); as was previously established in Section 3.2.3. It only serves to establish that non-experimental designs (if designed appropriately to account for bias) are frequently neglected, yet important designs that have much to contribute to the field of EBD.

According to Ballard & Rybkowski(2007), selecting a sound methodology in the field of EBD is primarily dependent on what the test aims to accomplish, and the nature of the variables considered. Making the assertion that RCTs are the best source of knowledge for every single topic of discussion would be ill-considered. The authors point to the case of assessing the impact of the built environment on managerial and administrative outcomes, for instance, stating that such topics preferably require the use of qualitative data—which would make it a better source for findings in this case than an RCT.

3.2.5.4 Bias Assessment & Criteria

3.2.5.5 Bias Assessment in Experimental Research Designs

3.2.5.5a Evaluating Bias in Experimental Research Design

Rashid (2013) also argues for the consideration of qualitative research studies in systematic reviews of the literature, identifying many seminal studies in comparable fields that are based on qualitative sources of evidence, and stating that qualitative research can be "*as valuable as, and sometimes even more valuable for generating knowledge of human society and culture*."

Sackett & Wennberg (1997) take a very similar stance to that of Rashid (2013), who states that favouring only knowledge of the experimental kind for discussions of EBD results in a kind of analysis that will fail to identify factors guaranteed to be relevant to the discussion, simply due to the fact that there is no way to directly measure such a using experimental designs.

In the Cochrane Handbook, Higgins et al. (2011) outline four primary grades of evidence for recommendations relevant to healthcare environmental design. The quality ratings are provided in terms of a range ranking from A, high, to D, low.

Two tools were developed by Cochrane to assess the risks of experimental studies, depending on whether a study's population was randomized or not. These tools include the ROBINS-I (Risk of Bias in Non-Randomized Studies — of Interventions), used to assess risk of bias in 'cohort-type'/quasi-experimental research, and the ROB (Risk of Bias) 2 Tool, used to assess risk of bias in experimental research. Both tools identify several criteria for bias, which are attributed to methodological or systematic flaws in the studies.

3.2.5.5b Bias Domains in Experimental Research

Table 10 outlines the bias domains in different experimental research designs, which were identified from the Cochrane Review Handbook (Higgins et al., 2011).

Table 10

Systematic Review, Bias Assessment, Bias Domains in Experimental Research

Source(s): Adapted from Higgins et al. (2011)

Bias		
Domain	**Source**	**Description**
Selection	Random Sequence Generation	Systematic differences between the baseline characteristics of the compared groups, prevented by ensuring that participants are selected based on a (truly) random process.
	Allocation Concealment	Systematic differences between the baseline characteristics of the compared groups, prevented by taking steps to prevent participants from having foreknowledge of allocation
Performance	Participant & Personnel Blinding	Systematic differences between groups in care provided, or exposure to any other factors aside from the intervention, prevented by fully blinding participants and personnel to the intervention
Detection	Outcome Assessment Blinding	Systematic differences between groups as to how the outcomes of a study are determined, reduced by blinding the outcome assessors to prevent them from having foreknowledge of intervention
Attrition	Incomplete Outcome Data	Systematic differences between groups in withdrawals from a study, which results in incomplete outcome data, and may compromise the quality of the results obtained
Reporting	Selective Reporting	Systematic differences between reported and unreported findings, where non-significant differences are much less likely to be reported than significant differences
Other Bias	Other Sources	Any important concerns of bias that are not addressed above

However, as these criteria outlined above involve the assessment by a human researcher; and the rules for determining them are not clear cut, they may entail some subjectivity in evaluation, which is discussed in further detail in the limitations section (Section 0).

3.2.5.5c Bias Criteria for Experimental Research Designs

Table 11 outlines the criteria for bias assessment in experimental research designs, with assessments being ranked as either low risk or high risk studies, as well another assessment of unclear risk when not enough data is present to perform an assessment.

Table 11

Systematic Review, Bias Assessment — Bias Criteria for Experimental Research

Source(s): Adapted from Bilotta et al. (2014)

Bias		**Assessment**	
Domain	**Source**	**Rating**	**Criteria Examples**
Selection	Random Sequence Generation	Low Risk	Referring to a random number table
			Using a computer random number generator
			Coin-Tossing; Throwing Dice; Drawing Lots
		High Risk	Sequence generated by odd/even date of birth
			Allocation by judgement of the investigator
			Allocation based on availability of intervention
		Unclear Risk	Insufficient information to permit assessment
	Allocation Concealment	Low Risk	Central allocation and randomisation
			Sequentially numbered treatment objects
		High Risk	Using alternation or rotation
			Using participants' date of birth
			Using any explicitly unconcealed procedure
		Unclear Risk	Insufficient information to permit assessment
Performance	Participant & Personnel Blinding	Low Risk	No blinding, and outcome is not influenced
			Blinding of participants, and is likely unbroken*
		High Risk	No blinding, and outcome is likely influenced
			Blinding of participants, but may be broken*
		Unclear Risk	Insufficient information to permit assessment
			Study did not address this outcome
Detection	Outcome Assessment Blinding	Low Risk	No blinding, and assessment is not influenced
			Blinding of assessors, and is likely unbroken
		High Risk	No blinding, and outcome is likely influenced
			Blinding of assessors, but may be broken
		Unclear Risk	Insufficient information to permit assessment
			Study did not address this outcome
Attrition	Incomplete Outcome Data	Low Risk	No missing data on the outcomes of a study
			Reasons for missing data is unrelated to outcome
			Missing data have been imputed appropriately
		High Risk	Reasons for missing data is related to outcome
			Potentially inappropriate imputation of data
		Unclear Risk	Insufficient information to permit assessment
			Study did not address this outcome
Reporting	Selective Reporting	Low Risk	Outcomes are specified and fully reported
			Outcomes not specified, but fully reported

Bias		Assessment	
Domain	**Source**	**Rating**	**Criteria Examples**
		High Risk	One or more specified outcomes are unreported
			One or more unjustified outcomes reported
			Study fails to include an expected key outcome
		Unclear Risk	Insufficient information to permit assessment
Other	Other Sources		Criteria are circumstantial to the nature of bias

*
Broken/Unbroken refers to whether the participants (and researchers, in the case of double-blinded studies) remained blinded for the full duration of the study, and the treatment/control groups were not revealed to anyone, potentially compromising the quality of the findings.

3.2.5.6 Bias Assessment in Non-Experimental Research Designs

3.2.5.6a Evaluating Bias in Non-Experimental Research Designs

While some biases (such as reporting bias) are common to both experimental and non-experimental research, other biases (such as selection bias due to allocation concealment) are inherent to intervention studies. As a result, the risk assessment criteria shown in the tables above would not be applicable to observational studies (Reeves et al., 2011), as such studies typically do not involve any intervention.

Excluding non-experimental research would also result in a conceptual framework that fails to provide a comprehensive outlook of all the design factors influencing patients. As a major systematic review by Ulrich et al. (2008) points out, relatively few randomized control trials exist linking specific design features to patient outcomes. This is arguably due to the fact that most interventions in healthcare alter several environmental factors simultaneously, which would make it difficult to isolate any of those factors as the primary independent variable causing the impact.

As a result, a different approach had to be undertaken to account for risks of bias in non-experimental (observatory) research. A tool was developed based on the Newcastle Ottawa Scale (Wells et al., 2012), which is the tool recommended in *Chapter 13* (Reeves et al., 2011) of Cochrane Handbook (Higgins et al., 2011) for assessing risk of bias in non-experimental research.

3.2.5.6b Bias Domains in Non-Experimental Research Designs

The Newcastle Ottawa Scale offers two comparable assessment tools for cohort and case-control studies, which share some common domains and criteria with the domains identified in Section 3.2.5.5b.

Aside from Selection, the domains of comparability, exposure, and outcomes are identified for non-experimental research designs. According to the definitions provided by Higgins et al. (2011) and Wells et al. (2012), these domains encompass the following:

- **Comparability:** Examines whether the groups compared to each other using non-experimental means were comparable in nature. Testing non-comparable groups would make grounds for the invalidity of the study whole.
- **Exposure:** Examines whether the groups compared actually differ in terms of their exposure to different measures, making it reasonable to expect different outcomes for the two groups.
- **Outcomes:** Examines whether the outcomes defined to reach a conclusion are appropriate in the context of the study conducted.

3.2.5.6c Bias Criteria for Non-Experimental Research Designs

Table 12 demonstrates the bias criteria used to screen non-experimental research designs, based on the Newcastle Ottawa Tool (Wells et al., 2012), which sets out different criteria for case-control studies and cohort studies.

Table 12

Systematic Review, Bias Assessment — Bias Criteria for Non-ExperimentalResearch

Source(s): Adapted from Wells et al. (2012)

	Bias	
Study Design	Domain	Criteria
Case-Control	Selection	Adequacy of Case Definition
		Representativeness of Cases
		Selection of Controls
		Definition of Controls
	Comparability	Comparability of Cases & Controls
	Exposure	Ascertainment of Exposure
		Similarity of Method for Cases & Controls
		Non-Response Rates (Dropouts)
Cohort (General)	Selection	Representativeness of Exposed Cohort
		Selection of the Non-Exposed Cohort
		Ascertainment of Exposure
		Demonstration that Outcome was Added Later
	Comparability	Comparability of Cohorts on Basis of Design
	Outcome	Assessment of Outcomes

	Bias	
Study Design	Domain	Criteria
		Follow-Up &Timescale of Outcomes
		Adequacy of Follow-Up of Cohorts

3.2.5.7 Quality Assessment & Criteria

3.2.5.7a Quality Rankings of Research Designs

Many scales are often used by different publishers and authors to attempt and objectively establish a standard of quality assessment that is not subject to personal biases and misappropriations. One such scale is the Cochrane Handbook's Grading of Recommendations scale (Table 13).

Table 13
Cochrane Handbook Grading of Recommendations Assessment

Source: Adapted from Cochrane Handbook (Higgins et al., 2011; 2019)

Evidence		**Description**	
Grade	***Quality***	**Future Research Implications**	**Source**
A	***High***	Further research unlikely to change confidence in estimate of the effect	Several Consistent High-Quality Cases
			Special cases of large multicentre trials
B	***Moderate***	Further research likely to have somewhat significant impact confidence estimate	A single high-quality research study
			Several studies with some limitations
C	***Low***	Future research is very likely to have a critical impact on confidence in estimate	One study with severe limitations
			Several studies with severe limitations
D	***Very Low***	Any estimate of an effect is quite uncertain, and requires interpretation	Expert opinion and personal experience
			No direct research evidence indicators
			One study with very severe limitations
			Several studies with very severe limitations

In synthesizing the results of a systematic review, explicit consideration must be made *a priori* as to how the concept of 'best evidence' will be handled. Even after all of the selected papers have met all of the required eligibility criteria, the level/quality of evidence is heavily dependent on the availability of evidence in the literature and is also dependent on whether any gaps exist in credible literary sources like systematic reviews and RCTs (McDonagh et al., 2013).

Therefore, reporting relatively lower-strength evidence sources should only be done in the case where there is no clear consensus in the evidence provided by higher-quality evidence sources, and establish explicit rules for utilizing lower-strength evidence (Norris et al., 2012).

Plenty of institutional and individual quality assessment categories for research have been developed over the years, none of which could be said to fit all review types and academic topics, since their tools naturally differ in design, depending on the nature of the topic in question.

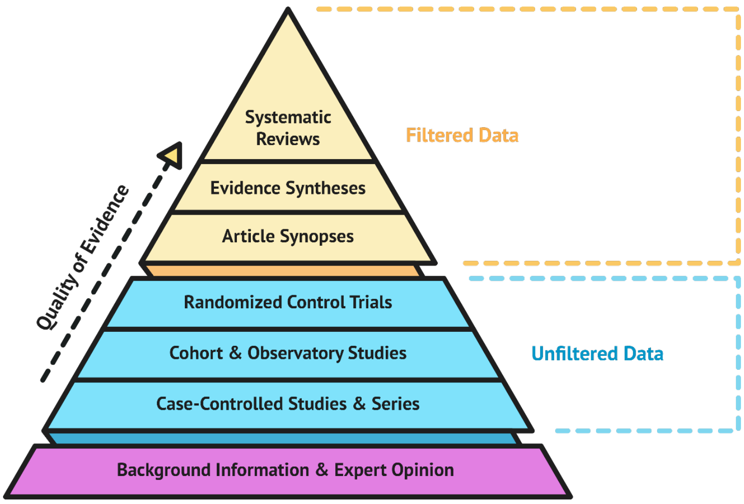
3.2.5.7b EBM's Level of Evidence Pyramid

Among the most notable quality assessment frameworks in healthcare literature is EBM's Level of Evidence Pyramid, which outlines how studies of different types rank in terms of the quality of evidence they present. While the model has been criticized for over-generalizing study types (Guyatt et al., 2008, Murad et al., 2018), it still serves as an excellent framework for quality assessment, especially when the framework's users are aware of its limitations (Sackett, 2000). The framework, shown in Figure 17classifies research studies into a hierarchal structure based on the nature/type of research conducted, which reflects upon the quality of evidence provided.

Figure 17

Systematic Review, Quality Assessment, EBM Pyramid of Evidence

Source(s): Adapted from Sackett (2000)



A commonly used classification method is to assign quantitative studies into one of three categories, based on research design (Table 9). This type of classification is usually done to assess the quality of studies performed in healthcare settings (Sousa et al., 2007).

These rankings can then be used to formulate levels upon which to evaluate the quality of evidence for each study, which are shown in Table 14.

Table 14

Levels of Evidence in Healthcare Environmental Design

Source: Adapted from Voigt et al.(2018)

Level	Design	Category	Criteria
Level I	Synthetic Research	Review Systematic	Multiple RCTs
			Non-Randomized
		Review Meta-Analysis	True Experimental
			Quasi Experimental
		Review Meta Syntheses	Qualitative
Level II	Experimental Research	Study True-Experimental	Randomized
		Study Quasi-Experimental	Non-Randomized
Level III	Observational Research	Descriptive Approach	Correlational
			Qualitative
		Review Systematic	Correlational
			Qualitative
		Study True-Experimental	Inconsistent Study
		Study Quasi-Experimental	Inconsistent Study
Level IV	Documented Sources	Professional Standards	Peer-Reviewed
		Professional Guidelines	Supporting Research
Level V	Expert Opinion	Expert Recommendation	Opinion of Known Experts
		Documented Cases	Old Case Studies, Reports, and Series
Level VI	Conflicted Opinion	Consultant Recommendations	High risk of Bias
		Manufacturer Recommendations	High risk of Bias

The classification system shown above, developed by Voigt et al.(2018), identifies and classifies studies in terms of six levels in total, establishing criteria to be used in determining the level at which a study should be ranked, which are somewhat related to the criteria for bias assessment, outlined in 3.2.5.5c and 3.2.5.6c.

3.2.5.7c GRADE Quality Assessment

The principles developed by the GRADE(Grading of Recommendations Assessment, Development and Evaluation) Working Group were used to grade the quality of evidence of the studies included in this review.

Aside from being the tool recommended by the tool recommended in Chapter 12 (Schunemann et al., 2011) of the Cochrane Handbook (Higgins et al., 2011), using this tool for quality assessment is also recommended by the BMJ (British Medical Journal), who state that the tool is officially endorsed by more than 100 organizations worldwide (BMJ, n.d.).
GRADE is used to assess the quality of evidence of a research study on a certainty level from (1-Very Low to 4-High) (Table 15), in terms of how closely the estimated effect is expected to represent the effect in reality (BMJ, n.d.; Schunemann et al., 2011).

Table 15
Systematic Review, Quality Assessment, GRADE Certainty Ratings

Source(s): Adapted from BMJ (n.d.) &Bilotta et al. (2014)

		Considerations	
Rating	**Indication**	**Study Design**	**Adjustment***
Very Low	The true effect is expected to markedly differ from the estimated effect	Experimental Study	TripleDowngraded
		Observational Study	Once Downgraded
		Case Study/Series	None
Low	The true effect may be different from the estimated effect	Experimental Study	TwiceDowngraded
		Observational Study	None
Moderate	The true effect is probably close to the estimated effect	Experimental Study	OnceDowngraded
		Observational Study	OnceUpgraded
High	The true effect is represented well by the estimated effect	Experimental Study	None
		Observational Study	DoubleUpgraded

*
None: No adjustment made
Once Upgraded: **e.g. Very Low to Low**
Double Upgraded: **e.g. Very Low to Moderate**
Once Downgraded: **e.g. High to Moderate**
Double Downgraded: **e.g. High to Low**
Triple Downgraded: **e.g. High to Very Low**

Furthermore, one of the limitations of rating studies based on the criteria of study design is that it may lead to some generalization, since not all RCTs are conducted to the same standards. As a result, Chapter 5 (Schunemann et al., 2011) of the Cochrane Handbook (Higgins et al., 2011) lists some factors to be considered that may result in the downgrading or upgrading of a study's GRADE rating.

For instance, some factors decreasing the quality rating of studies include:

1. Considerable limitations in the design and implementation of the study
2. Indirectness of the evidence-provided, and unreported major concerns
3. Unexplained heterogeneity of populations, and inconsistent results
4. Imprecise results; a wide confidence-interval
5. High probability of publication bias

On the other hand, some factors increasing the quality rating of studies include:

1. Study has a large magnitude of effects (that are explained)
2. There is evidence of the dose-response gradient
3. Plausible confounding would serve to reduce an effect demonstrated in the study, or would suggest a spurious effect where none is identified

As a result of these considerations, while most observational studies should receive low ratings, some observational studies will receive Moderate (or even High Ratings), if said study yields large-enough effects, with no identifiable methodological issues or biases. Similarly, experimental research may be downgraded (per the criteria presented in Table 15) for unreported methodological procedures, or major research biases.

3.2.5.8 Additional Considerations in Quality Assessment

Table 16 identifies some of the most important criteria to examine in experimental and non-experimental studies conducted for evidence-based field, which include the factors of intervention time, ascertainment exposure, ascertaining outcomes, and control for confounding (Voigt et al., 2018). It should be noted that these factors closely relate to the bias domains discussed earlier, which are shown in 3.2.5.5b and 3.2.5.6b.

Table 16

Healthcare Environmental Design Simple Quality Assessment

Source: Adapted from Voigt et al. (2018)

	Quality Assessment		
Category	**High**	**Moderate**	**Low**
Intervention Time	Prospective	Prospective	Prospective or Retrospective
Ascertainment Exposure	Acute Exposure (1 Year)	Within 3 Years of Inventions	After 3 Years of Interventions
Ascertaining Outcomes	Long term follow-up(5 Yr.)	Long term follow-up & Blinding	Short-term follow up, & no blinding
Control for Confounding	Randomized/Adjusted	Adjustment for one	Confounding not

	Quality Assessment		
Category	High	Moderate	Low
	for 3 confounding variables	confounding variable	accounted for

3.3 Findings& Discussion

3.3.1 Summary of Environmental Design Components

Table 17 presents an overview of the design components identified in the literature, each of which will be examined in the Sections 3.3.2 to 3.3.5 in correlation to mediating factors relating to one of the four patient needs established in Section 2.6.

Table 17

Summary of Environmental Design Components & Authors

Dimension		Component	*Supporting Studies*
Spatial Design	*1*	*Room Spaciousness*	*Ulrich et al. (2008); Huisman et al. (2012); Iyendo et al. (2016)*
	2	*Bed Spaciousness*	*Wiggerman et al. (2017);Zafiropoulos et al. (2004); Smith et al. (2017); VanGilder et al. (2017)*
	3	*Seating Area Spaciousness*	*Ohde et al. (2012); Tzeng & Yin (2008); Mosley et al. (1998); Krauss et al. (2008); Guiterrez & Smith (2008)*
	4	*Orientation of Door*	*Huisman et al. (2012); Chaudhury et al. (2005); Taylor & Card (2018)*
	5	*Orientation of Nursing Station*	*Morgan et al. (1985); Wolf et al. (2013); Gutierrez & Smith (2008)*
	6	*Proximity of Bed to Bathroom*	*Morgan et al. (1985); Wong et al. (1981); Ulrich et al. (2008)*
	7	*Proximity of Bed to Nursing Station*	*Morgan et al. (1985); Wolf et al. (2013); Gutierrez & Smith (2008)*
	8	*Wayfinding (Signage Use)*	*Schaffer et al. (2012); Taylor & Hignett (2016)*
	9	*Wayfinding (Stairs & Elevators)*	*Calkins et al. (2012); Ulrich et al. (2008); Morse (1993); Paiva et al. (2010)*
	10	*Standardized Layout*	*Vassallo et al. (2000); Huisman et al. (2012); Ulrich (1991); Barnhart (1998); Buchanan et al. (1991)*
	11	*Tabular Arrangement of Seating*	*Holahan (1972); Huisman et al. (2012)*
	12	*Pathway Cluttering*	*Calkins et al. (2012); Ulrich (1991); Ulrich et al. (2008)*

Dimension	Component		Supporting Studies
Ambient Design	***13***	*Carpeted Flooring*	*Calkins et al. (2012); Cheek et al. (1971); Donald et al. (2000); Healey (1994); Warren & Hanger (2013); Skoutelis et al. (2004); Noskin et al. (2000)*
	14	*Wall Colour*	*Dalke et al. (2004); Zraati (2013); Ulrich et al. (2008); Schweitzer et al. (2004); Iyendo et al. (2016)*
	15	*Fabric Quality*	*Fijan & Turk (2012); Hota (2004); Fijan (2005); Wensley et al. (2017)*
	16	*Daylight Intensity*	*Bell et al. (2008); Booker & Roseman (1995); Pati et al. (2012); Buchanan et al. (1991); Beachemin & Hays (1996; 1998); Frankenhaeuser (1980); Walch et al. (2005); Ulrich et al. (2008); Huisman et al. (2012); Malkin et al. (2012); Pati et al. (2012); Hadi et al. (2019)*
	17	*Indoor Lighting*	*Calkins et al. (2012); Healey (1994); Wolf et al. (2013); Vieira et al. (2011); Bell et al. (2008); Choi et al. (2012); Ulrich et al. (2008); Huisman et al. (2012); Malkin et al. (2012); Pati et al. (2012); Hadi et al. (2019)*
	18	*Garden Access / Nature View*	*Park & Mattson (2007); Satterfield (2010); Ulrich et al. (2008); Huisman et al. (2012); Malkin et al. (2012)*
	19	*Window View*	*Verderber (1986); Huisman et al. (2012); Ulrich (1974); Schweitzer et al. (2004); Ulrich et al. (2008); Ulrich et al. (2004); Ulrich (1991); Ulrich (1992)*
	20	*Artwork (Natural Scenery)*	*Kline (2009); Nanda et al. (2011); Nanda et al. (2012); Ulrich et al. (1993); Ulrich & Gilpin (2003); Ulrich et al. (2003)*
	21	*Ventilation & Heating*	*Smedbold et al. (2002); Arlet et al. (1989); Panagopoulou et al. (2012); Malkin et al. (2012); Schweitzer et al. (2004)*
	22	*Cleanliness & hygiene*	*Aygun et al. (2002); Boyce et al. (2007); Jonas et al. (2004); Malkin et al. (2012); Ulrich et al. (2008); Schweitzer et al. (2004)*
	23	*Indoor Noise*	*Barlas et al. (2001); Karro et al. (2005); Mlinker & Pierce (1997); Blomkvist et al. (2005); Bavo et al. (1995); Toph (2000); Ulrich (1991); Laursen et al. (2014); Malkin et al. (2012); Schweitzer et al. (2004); Iyendo et al. (2016)*
	24	*Outdoor Noise*	*Barlas et al. (2001); Karro et al. (2005); Mlinker & Pierce (1997); Blomkvist et al. (2005); Bavo et al. (1995); Toph (2000); Ulrich (1991); Laursen et al. (2014); Malkin et al. (2012); Schweitzer et al. (2004); Iyendo et al. (2016)*

Dimension	Component		Supporting Studies
Functional Design	25	Disability Accessible	Quan et al. (2011); Ulrich et al. (2008); Kaehne et al. (2019); O'Halloran et al. (2012); Steinfeld & Danford (1999)
	26	Acuity Adaptable	Brown & Gallant (2006); Huisman et al. (2012); Kwan (2011); Hendrich et al. (2004); Schweitzer et al. (2004)
	27	Storage Spaces	Quan et al. (2012); Ulrich et al. (2008); Douglas & Douglas (2004)
	28	Communication Tools	Chandra et al. (2018); Clever et al. (2008); Wensley et al. (2017); O'Halloran et al. (2012)
	29	Entertainment Tools	Ulrich (1991); Ivendo et al. (2016); Kiecolt-Glaser et al. (1998)
	30	Visibility/Location of Sink	Ulrich et al. (2008); Marjadi & McLaws (2010)
	31	Ease of Use	Lopez et al. (2010); Ulrich et al. (2008); Schweitzer et al. (2004)
	32	Control over Open Door	Huisman et al. (2012); Chaudhury et al. (2005); Taylor & Card (2018); Barnhart (1998); Prochansky et al. (25); Ulrich (1992)
	33	Control over Window Shades	Huisman et al. (2012); Barnhart (1998); Prochansky et al. (25); Ulrich (1992)
	34	Control over Light Dimmers	Huisman et al. (2012); Barnhart (1998); Prochansky et al. (25); Ulrich (1992)
	35	Control over Temperature	Huisman et al. (2012); Barnhart (1998) Prochansky et al. (25); Ulrich (1992); Schweitzer et al. (2004)

3.3.2 Impact of Design on Patient Safety Needs

3.3.2.1 Relevant Studies & Findings

As stated earlier in the theoretical review section of this report, patient falls constitute the number one adverse event contributing to risks that threaten patient safety. As such, this topic will be explored first in the discussion on factors influencing patient falls.

Calkins et al. (2012) identifies many environmental factors to contribute to patient falls, including lighting levels, flooring materials, and cluttering in both the internal and external environments. According to the authors, the risk of patient falls is an intermodal function; meaning that it is dependent on a whole number of factors. As such, controlling for potential sources of bias in assessments of patient falls is a must, as the raw unfiltered results could potentially be misleading, leading the researcher to draw misinformed conclusions.

Morganet al. (1985) &Wong et al. (1981) found that most falls take place within the patients' rooms, as opposed to corridors and other external spaces. Of the falls investigated by Morgan and colleagues, 29% took place within the patients' private bathrooms, with most of those falls taking place in close proximity to the toilets. An emphasis is especially placed on the bathroom in contributing to patient safety, as a study by Alcee (2000) also found that 30% of all falls were related to the bathroom in one way or another.

With respect to environmental risk factors, two studies (Calkins et al., 2012; Wolf et al., 2013) found rooms with direct visibility or close proximity from nurse stations were correlated to higher rates of falls, but the authors of both studies indicated the higher rates may have been a result of the highest risk patients being placed in those rooms.

Cheek et al. (1971) identified a conflict between staff members and administration regarding the installation of carpeting in healthcare settings. While the administrative members generally thought of the installation of carpets as a success, most staff harboured negative attitudes towards this intervention. The authors also identify the use of carpeting to have a significant impact on patient safety by reducing patient falls.

In an experiment conducted to assess the impact of unit types on patient falls, authors found the nuclear layouts[13]in two units (where 85% of patient beds were visible from either one or two nursing stations) contributed to a significantly lower number of falls than on a unit with visibility of only 20% of the patient beds (Vassallo et al., 2000).Optimizing unit layout often pertained to visibility, but the layout may have also affected nurses' and other caregivers' cognitive load, contributing to risk factors for patient safety.

For instance, Lopez et al. (2010) referenced functional adjacencies, noting that when the location of functions such as medication preparation and charting precluded ongoing surveillance of patients, workarounds occurred. The authors suggested that design strategies should relocate indirect care tasks closer in physical proximity to the bedside.

While most studies did not offer details about locations of nursing stations or primary activities, one study established satellite nursing stations outside patient rooms saw a significant reduction in patient falls as a result of an increased likelihood that patients were to ask for assistance from nearby staff (Gutierrez & Smith, 2008).

Several studies of varying methods and design quality appraisal referenced the importance of family presence in a falls-prevention program. Family presence interventions included education and awareness

[13] Ward layouts with branched hallways, contrary to longitudinal hallways (See Vassallo et al., 2000).

but also entailed family staying with the patient (Gutierrez & Smith, 2008; Krauss et al., 2008; Mosley et al., 1998), and assisting where possible (Ohde et al., 2012; Tzeng & Yin, 2008).

This finding implies the need for space for family to stay 24/7, a feature often included in more recent patient room designs. One study noted that families were a difficult aspect to control as participation was voluntary (Tzeng & Yin, 2008). Another study found that while relatives should be involved, family members had little to add in a conversation about falls, raising a concern that they do not perceive fall prevention as their role (Vieira et al., 2011).

This misaligned expectation highlights the need for a proactive and active partnership, referenced by Wolf et al. (2013), and family engagement that extends beyond mere physical presence. Half of the studies referencing family presence reported statistically significant positive results as part of the overall study.

Visual Cues are typically used to address communication breakdowns and were incorporated in 10 of the included studies, most in the midrange of quality appraisal and half of which reported statistically significant outcome results.

One study (Schaffer et al., 2012) did not specify the location of visual cues, such as signage, while most of the rest specified that signage was located in the external environment immediately outside the patient's room. Hallway signage was often part of a set of visual cues that also included signage inside the room and/or coloured patient wrist identification bracelets used to visually alert staff (and family) to a patient's fall risk. This finding is also supported by the results of another systematic review tailored to patient falls (Taylor & Hignett, 2016).

The most examined comparison in terms of flooring materials was between carpeting and vinyl (Donald et al., 2000; Healey, 1994; Warren & Hanger, 2013), and the results were often inconsistent throughout, and did not show statistically significant results in the comparative analyses.

In Healey's (1994) retrospective study, an analysis of 4 years of accident forms indicated that there were no more falls on vinyl than there were on carpeting, though the incidence of injury resulting from falls appeared to be lower on carpeted floors than they were on vinyl.

Multiple studies of varying appraised quality included lighting as part of their bundled solution, but the intervention descriptions were not always specific. Several studies referenced the need for some form of lighting at night, whether continuous or motion activated (Fonda et al., 2006; Gowdy & Godfrey, 2003; Mosley et al., 1998; Tzeng & Yin, 2008).

One study specified that patient areas should never be completely dark, and that low-level lighting was safer than changes from light to dark (Healey, 1994). Others referenced the location of lighting. In one study, lights were both under the bed frame and 2 feet above the floor close to the bathroom (Wolf et al., 2013), and in another study, night lights were in the bathroom (Vieira et al., 2011).

One staff-focused study highlighted the need for adequate lighting in all work areas, whether interior or exterior (Bell et al., 2008). Although several studies incorporating lighting strategies had statistically significant results, one study investigating how the nature of the built environment correlates to falls (Calkins et al., 2012) found no significant relationship between falls and lighting, night lights, or the control that patients had over the light.

A study by Booker & Roseman (1995) investigated seasonal patterns in medical errors in Alaska, with the rationale that summer seasons received significantly more daylight than winter seasons. The study found that 58% of prescription errors took place during the first quarter of the year, and that medical errors were approximately twice as likely to occur in December, in comparison to September.

Among the primary concerns for patients commonly identified for patients is being subjected to medical and prescription errors by healthcare staff members. Many environmental factors contribute to errors in prescribing and taking medication. The most frequently identified factor contributing to prescription errors is lighting, coming from both indoor and outdoor sources. Several studies in this review identified lighting as a critical component to medical errors in general (Pati et al., 2012).

Indoor lighting is also thought to significantly impact the rate of prescription errors in healthcare settings. In a study by Buchanan et al. (1991), three illumination levels were compared to evaluate this relationship. The highest illumination level was found to significantly reduce prescription errors from a rate of 3.8% to 2.6%.

Standardization is another important component in addressing the extent to which prescription errors occur. Two studies by Ulrich et al. (1991) and Barnhart et al. (1998) found that wards with standardized layout distributions[14] significantly decreased staff errors.

Reducing infection is often a matter of reducing contamination of contact surfaces, as contaminants can be carried from one patient to another via the contaminated gloves of healthcare staff members (Aygun et al., 2002; Boyce et al., 1997).

Infection also appears to be correlated to the room's occupancy, as MORs (Multi-Occupancy Rooms) typically contain more contact surfaces for transmission (e.g. bedside rails, handle, curtains, etc…), and more patients near one another (Jonas et al., 2004).

[14]Standardized room layout in the wards; as well as standardized furnishing layouts in the rooms

While higher microorganism counts are typically reported on carpeted flooring in comparison to vinyl or rubber surfaces, no studies reported statistically significant differences in infection levels between such groups (Skoutelis et al., 2004; Noskin et al., 2000).

3.3.2.2 Visual Representation of Findings Related to Safety Needs

Figure 18summarizes the list of design components identified in Table 17 in Section 3.3.2.1, denoting which of those components influences patient safety via the four mediating factors: (1) Wayfinding/Accessibility, (2) Fall/Fall-Related Injury, (3) Medical/Prescription Error, (4) Contamination/Infection.

Figure 18

Visual Representation of Factors Influencing Patient Safety Needs, Network Diagram

*Dashed Link: Potentially Biased Finding

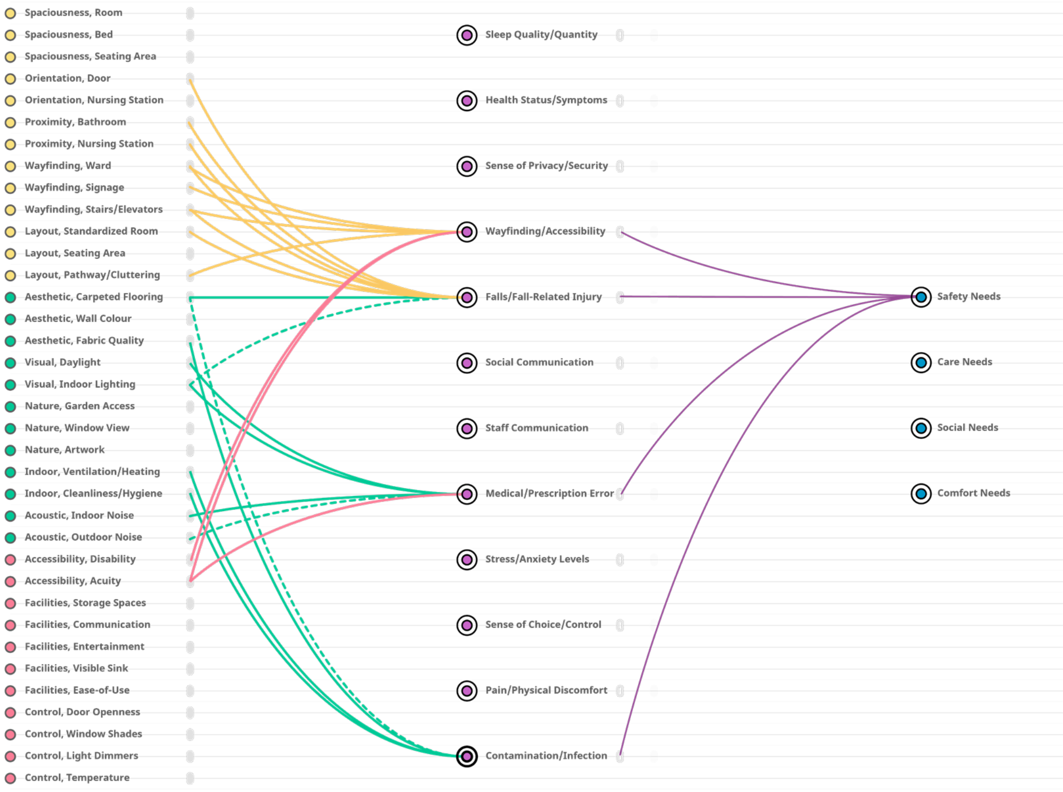


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Figure 18 Legend

Color	*Dimension of Design*
	Spatial Dimension
	Ambient Dimension
	Functional Dimension

3.3.3 Impact of Design on Patient Comfort Needs

3.3.3.1 Relevant Studies & Findings

Thermal and indoor quality (encompasses heating/ventilation, air quality, and cleanliness) are essential qualities to enhancing patients' overall comfort, facilitating the creation of a healing environment (Smedbold et al., 2002; Arlet et al. 1989; Panagopoulou et al., 2002).

Providing patients with control over environmental components within the room appears to be another essential factor to satisfying their comfort needs. The issue appears to be related to the satisfaction of a patient's sense of lack of control, which Ulrich (1991) identifies as one of the primary sources of patient stress and anxiety.

Huisman et al. (2012) summarize patient control in reference to the bed, room temperature, indoor lighting, outdoor lighting, sound/music, and entertainment tools.

Single-bed rooms are the leading cause that influence a patient's sense of privacy, as is indicated by studies such as Firestone et al. (1980), who examined the issue among residents of MORs (4 patients per room). The findings presented by the authors indicate a strong connection between room occupancy type and patients' sense of privacy, their ability to communicate and interact in social encounters with visitors.

Regarding the inclusion of artwork in the room (print or electronic), many considerations are often made to ensure that this artwork is appropriate for use in healthcare settings. Several sources were identified linking artwork to reduced stress and anxiety (Kline, 2009; Nanda et al., 2011; Nanda et al., 2012; Ulrich et al., 1993, Ulrich & Gilpin, 2003, Ulrich et al., 2003), and the following considerations were commonly-used as to what constituted appropriate artwork:

- Natural Themes
- No Abstract/Ambiguous Themes
- No Shocking/Gore Themes
- Culturally Appropriate Themes
- In Direct Line of Sight
- Unimpaired Visibility (from Glare/High Illuminance)
- Visually Comforting Colours

Ulrich & Giplin (2004) examined the use of artwork incorporating natural elements and landscape scenery on patients' pain and stress levels. The authors concluded that the use of artwork has much potential to reduce stress and pain levels, especially if placed in direct view of the patients. On the other hand, abstract art and other ambiguous images that require interpretation were mostly perceived as negative by patients; causing cognitive distress in patients.

Verderber (1986) identified that the most preferred window views among both patients and staff members were those of plants and other natural scenery, the surrounding neighbourhood in general, and other people outside performing day-to-day activities—for contextual clues as to what is happening outside the facility.

As Huisman et al. (2012) also points out in their review of the literature, the term view was not always used in the context of views from the windowpane. One such example is distraction therapy, which was often used as a form of visual stimulation to keep patients from focusing on their current health condition and painful procedures, and also often came in the form of a window view for patients.

Beachemin & Hays (1996; 1998) examined the exposure of hospital inpatients to daylight by comparing between two groups of patients, one located in a sunny room, and the other in dimly lit rooms. Consistent results between both genders were found indicating higher mortality rates in groups located facing away from the sunny side.

Choi et al. (2012) found a significant inverse relationship between indoor lighting intensity and exposure, and the patient's duration of stay. This relationship was especially identified for prolonged exposure to outdoor lighting in the morning, as compared to exposure in the afternoon or evening.

Regarding noise levels, as perceived by patients, the study's results are very much in line with those in the literature, indicating a strong impact from level of perceived noise on patients' sensory comfort, patient satisfaction, and stress and anxiety levels. Furthermore, as many researchers point out (Barlas et al., 2001; Karro et al., 2005; Mlinker & Pierce, 1997), the primary source of noise in healthcare facilities appears to come mainly from inside the ward; more particularly, from the ward and adjacent rooms, as well as the equipment inside the patient's room.

The acoustic environment can contribute to a great extent on patient comfort levels(Blomkvist et al., 2005), while other studies identified a strong correlation between noise levels and patients' healing processes (Bayo et al., 1995), as well as the patients' general stress and anxiety levels (Toph, 2000).

Meyers-Levy & Zhu (2007) also state that there is reason to believe that higher vs. lower ceiling heights may activate regions of the brain associated with the notions of freedom and confinement, respectively. Similar propositions are also made by Moore et al. (1979) and Kraft (1987).

What this suggests is that the results are not always dichotomous in nature (i.e. entirely positive, or entirely negative), and that such dichotomous relationships should not be sought in the first place, since they encourage researchers to stick to one (possibly flawed) association or interpretation, thus, limiting their ability to critically evaluate other factors.

Some studies have shown that the use of indoor plants in healthcare facilities can help alleviate a patient's stress and anxiety, and improve their psychological comfort (Park & Mattson, 2007; Satterfield, 2010).

Many studies cite acoustic quality as one of the most important factors in healthcare environmental design, emphasizing its contribution to the largest number of healing factors. Ulrich (1991) was among the first to advocate this claim, stating that healthcare environments can directly promote patient wellness—if designed to eliminate what the author identified to be environmental stressors.

Finally, the impact of the healthcare environment overarches the conceptual framework, serving as the outermost layer, since it is responsible for influencing all stakeholders combined (Wensley et al., 2017).

A summary of the discussed interactions of stakeholder's on patients' comfort needs, based on the work of Wensley et al. (2017), is shown in Table 18.

Table 18

A Summary of Stakeholder Influences on Patients' Comfort Needs

Source(s): Wensley et al. (2017)

Stakeholder	Influence	Description
Patient	**Self-Comforting**	Patient uses several different strategies to boost emotions associated with comfort
	Culturally Connected	Patient gains comfort by familiarizing themselves with the environment, increasing their sense of belonging
	Spiritually Connected	Some patients may gain comfort by re-establishing their relationship to a higher power or deity
Family	**Presence/Involvement**	Having family and relatives involved can substantially promote patient emotional and physical comfort levels. Family can also tend to the patients' physical comfort and well-being by tending to their needs
Staff	**Engagement/Commitment**	Patients tend to feel more comfortable when they see staff members engaged and committed to their duties
	Perceived/Actual Competence	Patients' perceptions of staff members' clinical competency can help them develop a sense of safety and comfort
	Information/Participation	Providing patients with information on their health condition can help increase psychological comfort
	Symptom Management	Relates more to tending to patients' physical discomfort sources and symptoms; most

Stakeholder	Influence	Description
		notably: to pain levels
	Holistic Care/Assistance	Holistic care involves interventions that mitigate emotional & physical impacts of hospitalization on patients

3.3.3.2 Visual Representation of FindingsRelated to Comfort Needs

Figure 19summarizes the list of design components identified in Table 17 in Section 3.3.2.1, denoting which of those components influences patient comfort via the three identified mediating factors: (1) providing patients with a sense of privacy, (2) providing patients with a sense of control, (3) reducing pain and discomfort.

Figure 19

Visual Representation of Factors Influencing Patient Comfort Needs, Network Diagram

*Dashed Link: Potentially Biased Finding

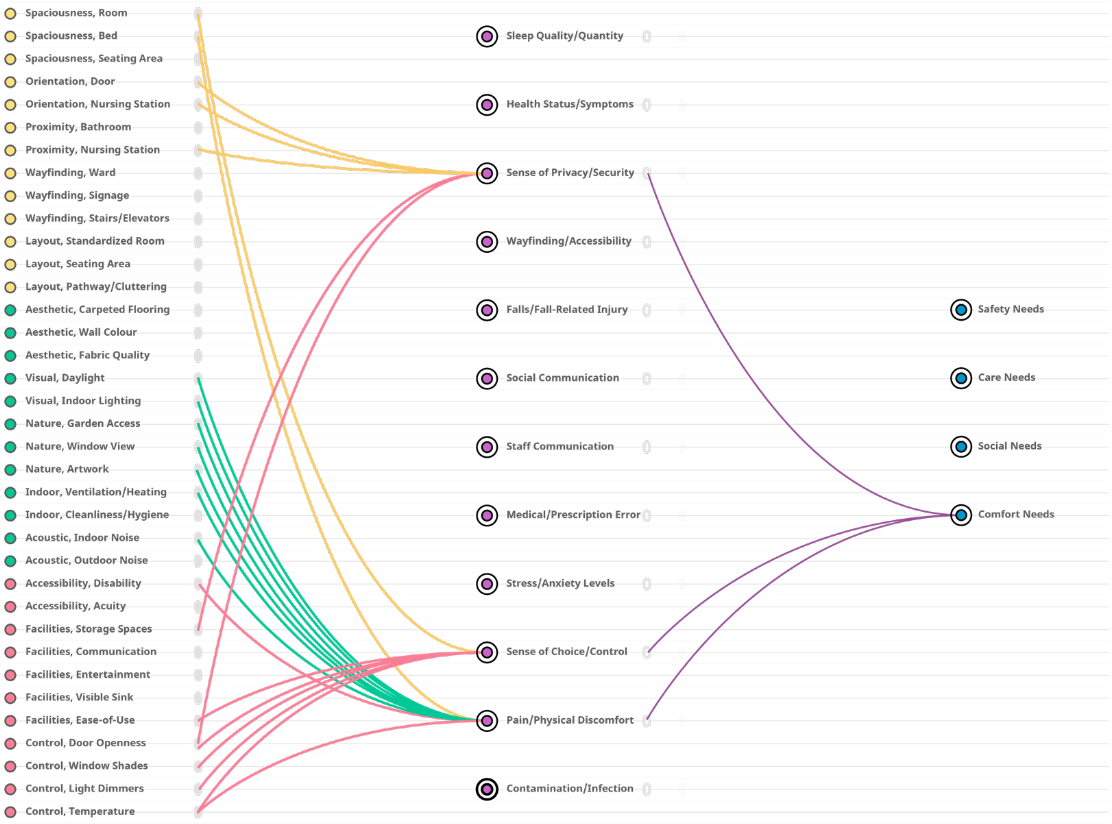

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Figure 19 Legend

Color	*Dimension of Design*
●	***Spatial Dimension***
●	***Ambient Dimension***
●	***Functional Dimension***

3.3.4 Impact of Design on Patient Social Needs

3.3.4.1 Relevant Studies & Findings

Staff members' communication behaviours can potentially affect patient satisfaction, and may also results in positive outcomes, such as adhering to medication, having less symptoms, and having generally higher HRQOL measures (Chandra et al., 2018; Clever et al., 2008).

There is also plenty of evidence demonstrating the impacts of welcoming/social hospital staff members on the physical and psychological comfort levels reported by patients, which in turn, impacts patient satisfaction (Angstrom-Brannstrom & Norberg, 2014; Arruda et al., 1992).

A study by Holahan (1972) identified a very strong relationship between the seating patterns and layout within private patient rooms, and the amount of social interaction and communication in which the patients had participated in. Social interaction appeared to be suppressed by aligning seats along a wall, in contrast to arranging them around a table next to the patients.

There is almost always a trade-off in choosing to implement a design intervention, even in cases where both research studies and systematic reviews both indicate major positive outcomes. Most notably, such is the case for SORs (Single-Occupancy Rooms) (Chaudhury et al., 2005; Taylor & Card, 2018), wherein some subjective considerations must be made to assess the extent of one impacted factor to a counteracting factor (e.g. Privacy vs Companionship, Social Interaction vs, Infection Control).

Many of these trade-offs comes as a result of the presence of family members in patient rooms, as these family members can contribute a great deal to the safety and care needs of patients, aside from their contributions to the patients' social and information needs.

Furthermore, staff members were also identified as a major stakeholder with regard to fulfilling patients' social needs, which is a matter that mostly came down to whether the patients had direct means of contact to communicate with the staff members, and whether aspects such as ambient noise and other factors allowed for that to be done.

3.3.4.2 Visual Representation of FindingsRelated to Social Needs

Figure 20 summarizes the list of design components identified in Table 17 in Section 3.3.2.1, denoting which of those components influences patients' social interactions and needs, as mediated through the following two mediating factors: (1) social communication (communicating with family and friends), (2) staff communication (communicating with caregivers and obtaining self-care information).

Figure 20

Visual Representation of Factors Influencing Patient Social Needs, Network Diagram

*Dashed Link: Potentially Biased Finding

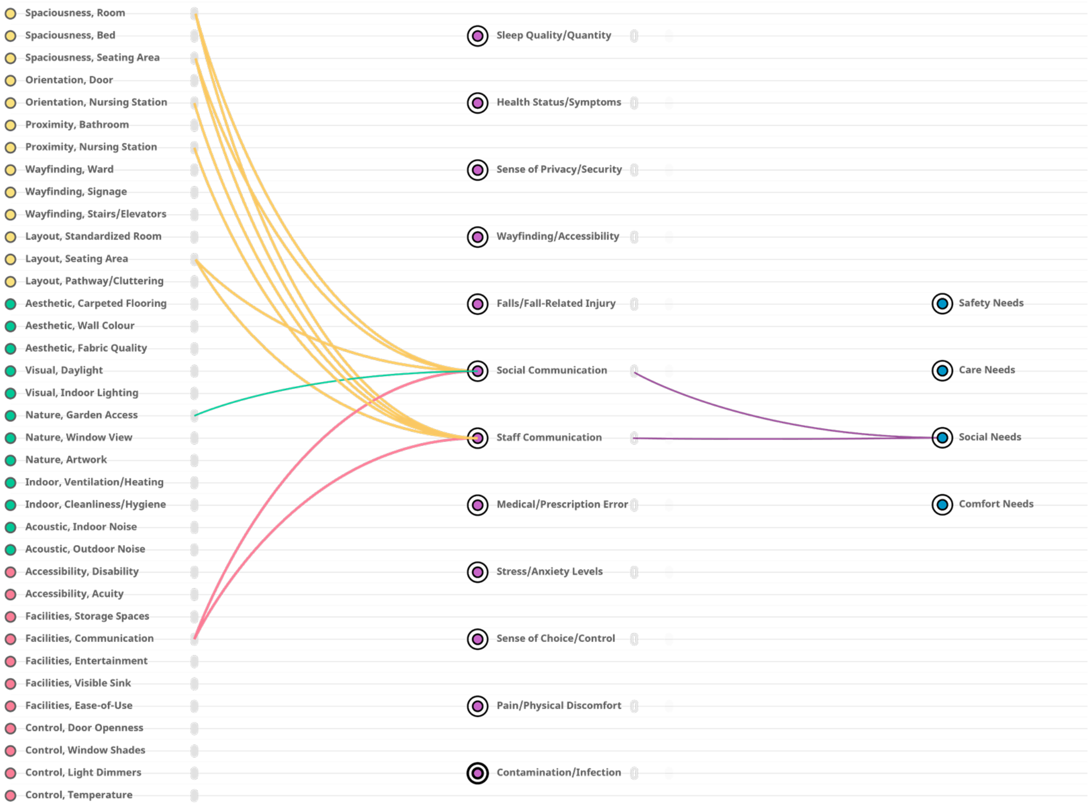

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Figure 20 Legend

Color	*Dimension of Design*
● (yellow)	*Spatial Dimension*
● (turquoise)	*Ambient Dimension*
● (pink)	*Functional Dimension*

3.3.5 Impact of Design on Patient Care Needs

3.3.5.1 Relevant Studies & Findings

Reducing stress and anxiety is arguably the most frequently identified items in evidence-based design, and there is evidence to support that the majority of patients experience considerable stress over the course of their hospitalization, frequently accompanied by increased anxiety, delirium, higher blood pressure, and higher intake/doses of medication (pain medication in particular) (Wilson, 1972, Ulrich, 1991).

According to Ulrich (1991), there are two major sources of stress for patients:

1. Illnesses that result in physical constraints/restraints, involve uncertainty, or involve painful surgical procedures
2. Physical/social environments, which may be noisy, cluttered, invade privacy, and do not allow for visitors

These stressors, recognized by Ulrich (1991) and many other authors (Iyendo et al., 2016; Williams & Irurita, 2005; 2008), refer to stimuli in the environment which increase stress, and are usually the by-product of sensory (visual, acoustic, and olfactory) cues in the environment.

Kiecolt-Glaser et al. (1998) demonstrate that reducing stress in healthcare environments can speed up patients' recovery times as outpatients, reduce narcotic/analgesic use, reduce anxiety and depression, and even reduce patients' mortality and morbidity rates.

Stress and anxiety levels do not just have psychological manifestations, but can also be linked to physiological manifestations such as changes in bodily systems and levels (e.g. blood pressure, muscle tension, stress hormones, etc…), which can enforce a positive feedback loop, leading to even more stress (Frankenhaeuser, 1980).Such physiological and psychological manifestations are often used as measurements in EBD to correlate an environmental intervention with the reduction of stress and anxiety.

The most frequently identified function mediating the link between the built environment and patient needs/outcomes appears to be the stress and anxiety levels faced by patients. Figure 20 indicates that stress and anxiety has been linked to result from at least 11 components (as was identified by the researchers, wherein there could be more hidden impacts not yet identified or evaluated). Furthermore, this is not including the other functions that are very strongly linked to stress and anxiety levels and could potentially be described as a subfunction to this function.

For instance, research indicates that patients' loss of control or choice (perceived or actual) can result in significantly higher stress and anxiety rates among patients. As such, the list of components affecting stress and anxiety levels (Figure 20) could potentially be expanded to include much more than just 11 components of design, depending on how restrictive the researcher is with regard to evaluating and describing this function; and whether the results of one finding pertaining to one examined relationship could be used across different functions in the model developed by the researcher.

3.3.5.2 Visual Representation of FindingsRelated to Care Needs

Figure 22 summarizes the list of design components identified in Table 17 in Section 3.3.2.1, denoting which of those components influences patient care needs, manifesting in their health status and as reflected by their functional status upon their leave. The mediating factors affecting this need include: (1) improving patients' sleep quality and quantity, (2) improving patients' health status and symptoms, (3) reducing stress and anxiety levels.

Figure 21

Visual Summary of Design Factors Affecting Patient Needs

*Dashed Link: Potentially Biased Finding

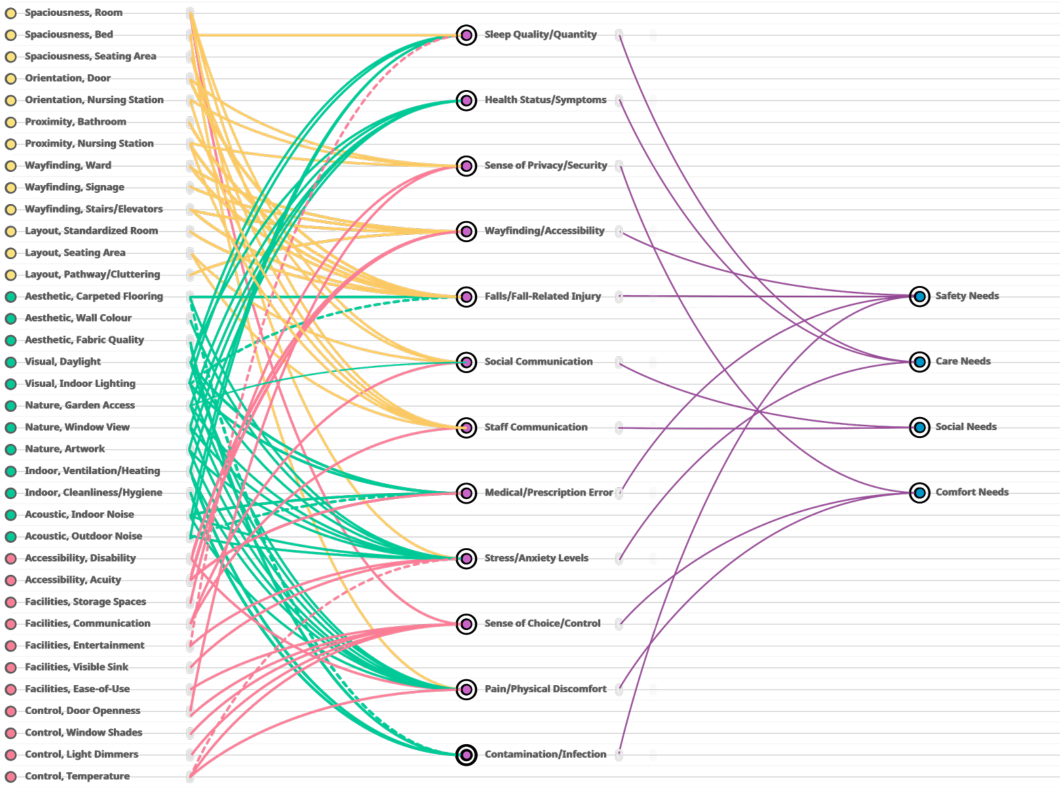

Figure 22 Legend

Color	*Dimension of Design*
●	*Spatial Dimension*
●	*Ambient Dimension*
●	*Functional Dimension*

Figure 22

Visual Representation of Factors Influencing Patient Care Needs, Network Diagram

*Dashed Link: Potentially Biased Finding

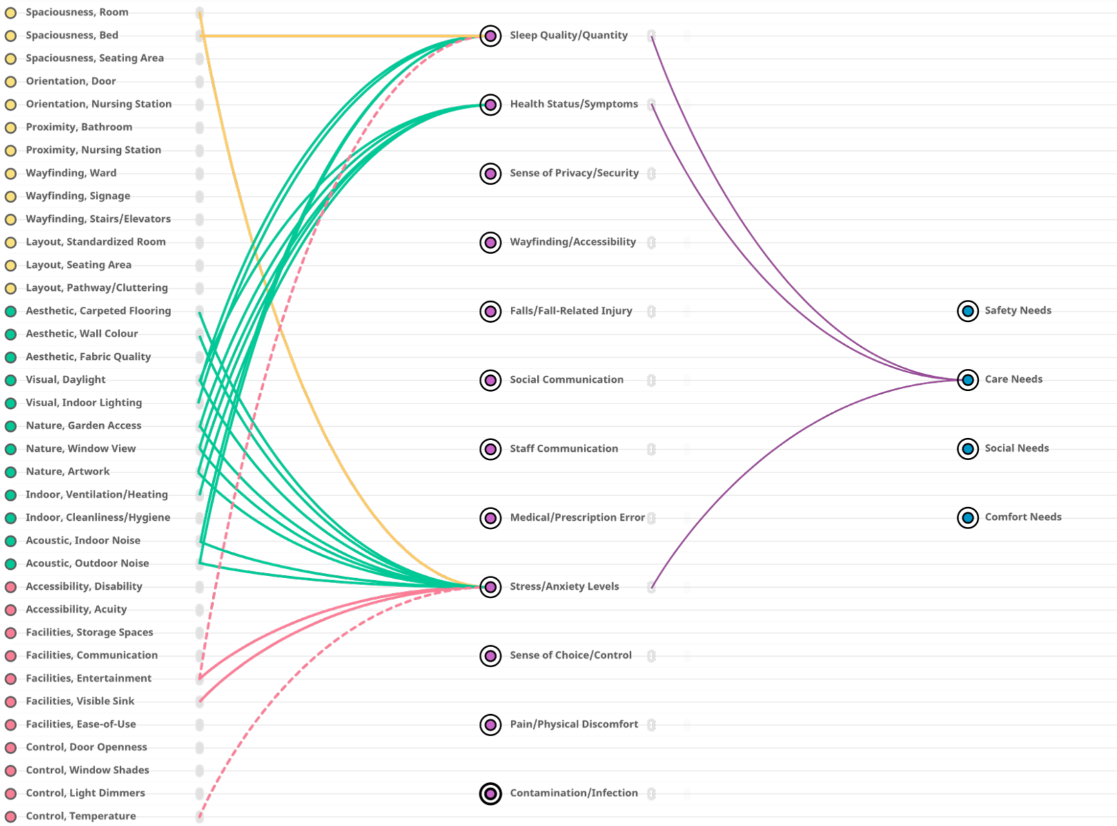

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Figure 22 Legend

Color	*Dimension of Design*
●	***Spatial Dimension***
●	***Ambient Dimension***
●	***Functional Dimension***

3.4 Summary of Systematic Review Findings

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Figure 21 and able 19 present a summary of all findings presented in the above sections, outlining the different relationships identified between each design component and mediating function, as well as the link between those functions and the four primary patient needs.

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able 19 presents the final list of findings in terms of the impact of different design components of the mediating functions examined in the literature review section of this report. Potentially biased results are differentiated and highlighted in red, and asterisks are used to indicate relationships with mostly uncontested findings in the literature.

A single asterisk (*) was used to indicate statistically significant findings ($p<0.05$), and two asterisks were used to indicate studies that demonstrate an even stronger effect, at a significance level of ($p<0.01$)[15]

Results from able 19 and those also presented in the completed network diagram (Figure 22), will be used to construct the questionnaires and conduct the analysis of this study. These factors will then be compared against the study's empirical findings to assess the extent of difference between the two.

[15] While the majority of studies comprised of quantitative and empirical findings that allowed for their classification in the matrix in Table 19, some of the qualitative findings that were conducted using sound measures based on the quality

able 19

Summary of the Systematic Review, Matrix of Design Functions vs. Design Components

Component/Feature	Larger Room	Larger Bed	Larger Seating Area	Bed to Door	Nursing Station to Bed	Bed to Bathroom	Nursing Station to Bed	Ward Layout	Signage Availability	Stairs/Elevators Location	Room Standardization	Tabular Seating Area	Cluttered Pathway	Carpeted Flooring	Cool/Blue Wall Colour	Fabric Quality/Materials	Daylight Exposure	Indoor Lighting Ambience	Access to Garden	View from Window	Appropriate Artwork	Ventilation/Heating	Cleanliness/Hygiene	Indoor Noise Quality	Outdoor Noise Quality	Disability-Accessible Room	Acuity-Adaptable Room	Sufficient Storage Facilities	Communication Tools	Entertainment Tools	Sink Visibility	Facility Ease-of-Use	Door Openness	Window Shades	Light Dimmers	Temperature
#	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Category	Spaciousne			Orientatio		Proximity		Wayfindin			Layout			Aesthetic			Visual		Nature			Indoor		Acoustic		Accessibilit		Facilities					Control			
Sleep Quality/Quantity																	**	*						**	*					*						
Health Status/Symptoms																	**		*	**	*	*														
Sense of Privacy/Security				*	**		**																					**					*			
Wayfinding/Accessibility								**	**	*	*		**													*	**									
Falls/Fall-Related Injury					**	**	**	*		*	*			*				*																		
Social Communication	**		**									**																	*							
Staff Communication	**		**									**																	*							
Medical Errors																	**	**						**	*		*									
Stress/Anxiety Levels	*													**	*		**		**	**	**			**	**					**	*					*
Sense of Choice/Control	**																															*	*	**	**	**
Pain/Physical Discomfort		**															**	**	*	*	**	**		**		*										**
Contamination/Infection														**		*						**	**													

3.5 Excluded Findings & Observation

3.5.1 Overview of Excluded Findings

This section explores findings that were not included in the final results of the systematic review, but that are nonetheless noteworthy to mention—including the results of environmental design studies conducted in Jordan in particular, which were few in number, and did not meet the criteria for inclusion in the review.

The section also outlines some of the researcher's personal observations while conducting the systematic review—including the high level of similarity in results conducted by the CHD (Centre of Healthcare Design[16]), and some general observations and commonalities found across the articles reviewed.

3.5.2 General Observations

Most existing studies tend to be very specific and linear in investigating one attribute of the built environment in relation to one specific health outcome. For instance, Walch et al. (2005) used an RCT design to examine the impact of exposure to daylight on the post-operative analgesic medication use of two patient groups; hospitalized in identical rooms but located in different wings of the same hospital. Such a setting is the perfect natural experiment, as it naturally controls for the effect of most intervening variables (since the rooms are identical), while changing a single aspect of the built environment: the amount of daylight a patient receives.

This is an important consideration for the methodological design of EBD studies, as it is usually extremely challenging to intervene in setting a single design element in healthcare settings, given the delicate state of the majority of patients. There is also the fact that researchers must often account for the placebo effect[17] in such experimental designs;

[16]See **https://www.healthdesign.org/**; the CHD is an institution dedicated to collecting information on the impacts of healthcare environments on patients and their healing.

[17]An effect where patients who believe themselves to be receiving the positive intervention show signs of improvement as a result of holding such beliefs, rather than owing to the impacts of this intervention. For instance, a patient who is informed that he/she will be getting healthier as a result of being placed in front of a sunny window may show signs of better health, which are wholly unrelated to being placed in front of the window; but rather, are related to the well-documented relationship between mental attitude and health improvement (which only takes place to a limited extent) (Rehn & Schuster, 2017).

typically by hiding the intervention from any and all involved participants (Rehn& Schuster, , 2017).

Another critical consideration to make is that numerous factors not related to the built environment interact with design elements, making it even more difficult to ascertain which of these elements is causing the observed change in outcome measures. Such factors may include things like in-patient management, healthcare providers' skills and experience, as well as many demographic and socioeconomic factors pertinent to the patient.

3.5.3 Similarities in Agency-Backed Research

There appears to be a high degree of similarity in systematic review sources published by the same agencies and institutions; most notably, in sources accredited to the CHD, from which a significant portion of the largest reviews, such as Ulrich et al. (2008), Quan et al. (2011), Laursen et al. (2014), and many others, originate.

However, it is not apparent whether this similarity is a direct result of some sort of bias (such as publication bias), or whether it is naturally occurring phenomena, given that many of those reviews are conducted by the same authors, using similar search strategies and inclusion criteria.

Nonetheless, the majority of the sources from which systematic reviews were obtained—and the CHD in particular, remain some of the most credible in terms of research conducted on the healthcare built environment, and the research articles reviewed—whether empirical or synthetic in nature, were all critically evaluated and deemed to be of sound methodological quality; taking into account many considerations to limit bias and error. As such, such similarities were not considered to be indicative of any criteria that are grounds for exclusion; as such sources also include some major figures and seminal studies in healthcare environmental design research, including authors such as Roger Ulrich and many others—all of whom are well-renowned by peers for the quality and soundness of their methods/work.

3.5.4 Studies Conducted in Jordan

Although the term *Jordan* was used in several instances along with other keywords in searches of the databases, only a few articles could be identified as relevant to the study, none of which were included in the final results of the systematic review, as they did not fulfil one (or several) of the inclusion/exclusion criteria established in the methods section.

These articles were nonetheless worthwhile to examine without inclusion, as they may contribute to point out some considerations for the researcher to make in conducting the study, given that there is a lack of research studies situated in Jordan.

Furthermore, systematic review conducted by Taylor et al. (2018) indicates that some bias may occur that is a specific to the country being reviewed, although it was not clear whether said bias was a reporting bias, a cultural/contextual difference, or some unidentified factor.

One article (AlZoubi & Al-Rqaibat, 2014) examined the impact of hospital daylight quality in the paediatric (children) ward at KAUH (King Abdullah University Hospital)—one of the few teaching hospitals in Jordan, and the largest medical structure in the northern region of the country. The study considered various variables connected to differences in daylight environment (using different measures for daylight & luminance). The study found that the average daylight at KAUH was significantly higher the recommended range by 20%, 39%, and 45%, for the months of March, June, and December, respectively; and showed significant differences at ($p<0.01$).

Although the authors did correlate daylight in general to staff performance, general health, and productivity, no empirical assessment was made to analyse any of those factors in their study, so these claims were excluded as well. However, some findings presented by the authors do indicate that reflectance and glare coming off of surfaces in the room was at much higher levels than guideline recommended averages by CIBSE (Chartered Institution of Building Services Engineers). While these guidelines are insufficient on their own to establish a link between lighting and patient needs/outcomes in Jordanian hospitals in particular, their recommendations are nonetheless important to mention, as they could be indicative of a potential issue in the Jordanian healthcare system as a whole.

Another study by Muhsein et al. (2017) examined how the implementation of an electronic safety program at the ICU in Al-Istishari Hospital [a hospital included as part of this study's sample, see Section 4.4.2.2a] affected patients' safety needs. The electronic safety program in question refers to the HSE (Health Service Executive) Change Module, a project management lifecycle model intended to implement change to the hospital's technological safety-related infrastructure (Barry et al., 2018).

While Muhsein and his colleagues imply that the findings are generally positive, using descriptive statistics to indicate somewhat more positive responses by the sample, no sufficient/sound analytical measure was performed to back up the claim, nor was there any other such supporting evidence. Therefore, the study was also excluded from the review.

3.6 Design Components & User Needs/Outcomes

3.6.1 Intercorrelations in Design Impact

While the particular aim of this study is to examine the built environment in correlation to patient needs and outcomes, other forces at play within the environment—which may or may not be indirectly correlated to the environment, are of major importance to this study. Such forces include the stakeholders/users of a healthcare facility, along with factors such as the patient's health and condition, income and treatment method.

Due to the overlap occurring between environmental design and these forces, it could be extremely difficult (if not impossible) to isolate the primary causal agents for a change in the variables representing patient needs/outcomes.

To elaborate further, while patient falls are related to so many aspects of the built environment, it also remains true that the presence of family members in the room could potentially reduce or prevent patient falls as well. Advancing this line of thought even further, family presence in the room may or may not be correlated to the built environment, including aspects such as the room's size and furnishing orientation and arrangements (Huisman et al., 2012).

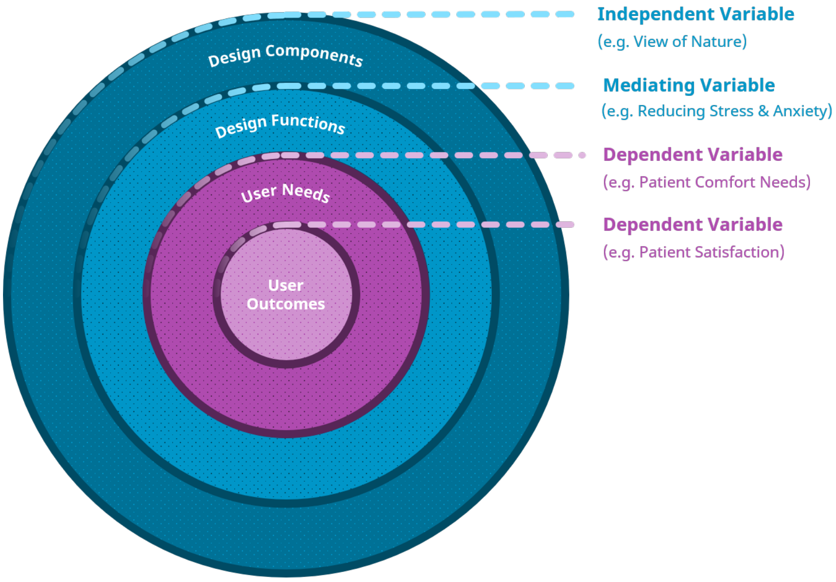
Accounting for all possible intercorrelations between environmental design variables may well be impossible to do, in part due to how often researchers identify conflicting relationships between design variables, and in greater part due to how little is currently explored and understood in the field of healthcare environmental design.

Bearing in mind the above intercorrelations, it was important to model a conceptual framework that could be used in such a way for a single design component to have multiple varying degrees of impact on different patient needs and outcomes. As such, the conceptual framework for this study is comprised of four concentric circles, as is shown in Figure 23. The outermost two circles constituted design components (e.g. Indoor Lighting), and design functions (e.g. Reducing Stress & Anxiety). The innermost two circles constituted user needs (e.g. Care Needs) and user outcomes (e.g. Satisfaction with Care).

The conceptual framework can thus be applied, offering a logical visual representation of the ideas examined within these theoretical frameworks, and demonstrating the various relationships between the study's key factors, variables, and constructs. Unlike a theoretical framework, a conceptual framework is often grounded in both theoretical and empirical works of authors and is useful in helping a researcher directly formulate an expected relationship between two or more of the study's variables (Rocco & Plakhotnik, 2009).

Figure 23

Research Conceptual Framework



The primary attribute of the framework shown above is that the two outermost circles are able to revolve around the circles inside them. Therefore, a single design component, (e.g. indoor lighting) could serve multiple functions (e.g. reducing stress & anxiety levels, reducing the likelihood of medical/prescription errors); which in turn, affect two different needs (e.g. safety needs, care needs), both of which contribute to a single patient outcome (e.g. functional status).

The example mentioned above is but a presumed effect, based on the findings of the systematic review, however, the real effect cannot be truly confirmed until evaluated via empirical means.

The model includes three main types/categories of variables:

1. **Independent Variables (Design Components):** Assumed to result in an impact on the dependent variables and is altered/tested on the basis of this assumption/hypothesis.

2. **Mediating Variables (Design Functions):** Assumed to explain the how/why of an observed relationship between the dependent and independent variables.
3. **Dependent Variables (Patient Needs & Patient Outcomes):** Assumed to be impacted as a result of variations in independent variables and is measured/evaluated on the basis of this assumption/hypothesis.

Figure 24 shows the outermost three layers of the study's conceptual framework, with variables plugged in, based on the key findings of the systematic review. Patient outcomes were excluded from this model, as the results collected using the systematic review on patient outcomes were inconsistent throughout, and there were not enough data to incorporate these results into the study's framework.

Each of the numbered items shown in the framework above correspond to a single design component of the built environment in the hospital, which either has one or more impacts on the needs and outcomes of the different users of the facility. Furthermore, these items are color-coded to indicate the design dimension to which they belong, as is shown in the legend above.

Figure 24

Research Conceptual Framework, Systematic Review Results, Colour-Coded (Dimension)

Yellow: Spatial Design, Green: Ambient Design, Red: Functional Design, Grey: Design Function, Blue: User Need

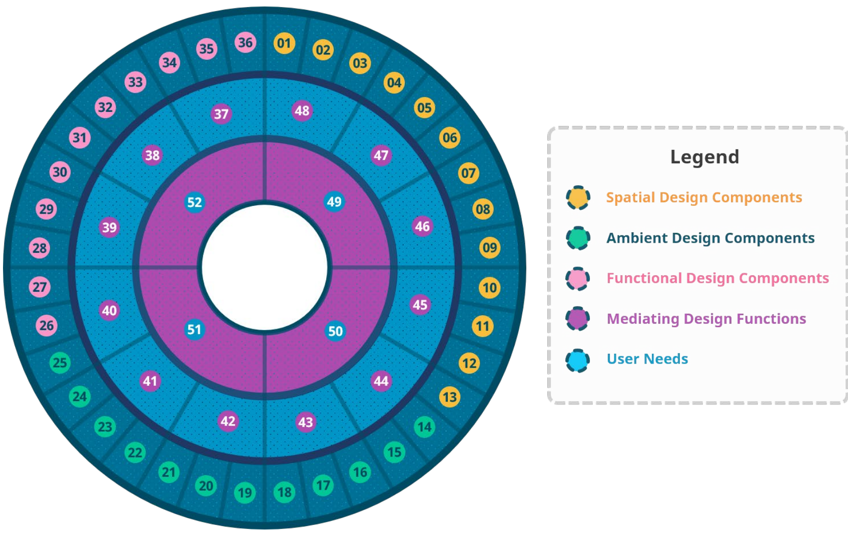


Figure 24 is categorized on the basis of similar characteristics, which were identified in the conceptual review sections; a summary of which is provided in Section 2.9.5.

3.6.1.1 Spatial Dimension

The spatial dimension is categorized on the basis of the **physical** and **measurable** qualities/characteristics of the physical environment, which include the following:

1. **Spaciousness**: Refers to the physical dimensions and size of an area/object, in terms of height, width and length.

e.g. *(1) Size of the room, (2) seating area, and the (3) patient's bed.*

2. **Orientation:** Describes the direction of two components of the built environment, relative to each other.

e.g. *(4) Nursing Station oriented towards bed, (5) Bed oriented towards the door*

3. **Proximity:** Describes the distance between two components of the built environment, relative to each other.

e.g. *(6) Proximity of Bed to Bathroom, (7) Proximity of Room to Nursing Station*

4. **Wayfinding**: Refers to the patient's ability to easily locate facilities and navigate through the environment.

e.g. *(8) General Accessibility of Ward, (9) Use of Guiding Signage, the (10) location of stairs and elevators*

5. **Layout:** Refers to the physical arrangement and layout of components of the built environment.

e.g. *(11) Standardization of Patient Rooms, (12) Seating Area Arrangement Around Table, (13) Cluttering of Room/Pathway*

3.6.1.2 Ambient Dimension

The ambient dimension is categorized on the basis of the non-physical and measurable qualities/characteristics, as perceived in terms of bodily senses. These include:

1. **Aesthetic Quality:** Describes the general feel, beauty and finish of components within the environment.

e.g. *(14) Carpeted Flooring, (15) Wall Colour, (16) Furnishing Fabrics*

2. **Visual Quality:** Describes sensory experience of hospital inpatients in terms of sight, mainly constituting indoor and outdoor lighting.

e.g. *(17) Daylight, (18) Indoor Lighting*

3. **Acoustic Quality:** Describes sensory experience of hospital inpatients in terms of hearing, mainly constituting noise from internal and external sources.

e.g. *(19) Indoor Noise from Equipment/Neighbouring Rooms, (20) Outdoor Noise*

4. **Natural Elements:** Describes elements that relate to nature and water in particular, or scenery of those elements.

e.g. *(21) Access to Outdoor Garden, (22) View from Window, (23) Artwork (Appropriate)*

5. **Indoor/Air/Thermal Quality:** Refers to the general quality of the indoor air and ventilation/heating within the room.

e.g. *(24) Ventilation & Heating (HVAC), (25) Cleanliness & Hygiene*

3.6.1.3 Functional Dimension

The functional dimension is categorized based on features/usefulness/purposefulness of design components, and includes:

1. **Accessibility:** Refers to functions of room design that facilitate the user experience for certain groups of users.

e.g. *(26) Disability Accessible (27) Acuity-Adaptable Rooms*

2. **Facilities/Amenities:** Include the availability and functionality of certain tools of the environment, which relate to the physical facilities/amenities within the room.

e.g. *(28) Storage Space Availability & Sufficiency, (29) Communciation Tools & Equipment, (30) Entertainment and Recreational Tools, (31) Visible Sinks for Handwashing, (32) General Ease-of-Use*

3. **Choice/Control:** Finally, this aspect relates to the degree of choice and control that users have on components within an environment, and the degree to which these components are alterable to begin with.

e.g. *(33) Control over Opening and Closing the Door, (34) Control over Window Shades, (35) Light Dimmer Controls, (36) Temperature Controls*

3.6.2 Overview of Limitations

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While the researcher tried as much as possible to account for the risk of bias in this review, it is not without limitations. These limitations mainly arose as a result of how large the domain for EBD is and how relatively new applications in it currently are. Subjectivity was another factor that played a part in the systematic review. Many important studies were included that did not clearly fit within the exclusion boundaries defined earlier; as they comprised critical works upon which later works were founded, which involved some subjectivity on the researcher's end in identifying such studies.

3.6.3 Inclusion/Exclusion Criteria Evaluation

Referring back to the second inclusion/exclusion criterion, which related to population selection and sampling, it should be noted that there are some exceptions to excluding studies based on population, since eliminating all studies whose populations consist of one type of patient cannot be reliably done without having negative implications on the results of the analysis (O'Connor et al., 2011).

For instance, Ulrich (1984) is widely regarded as a seminal landmark study in the field, and is often cited as a very credible source (Leger, 2003; Huisman, 2012). This is in spite of the fact that Ulrich's study sample constituted of only patients who have undergone cholecystectomy (a common type of gall-bladder surgery). However, the findings of Ulrich's study remain generalizable nonetheless, since this is a standardized procedure, not influenced by patient demographics, and there seems to be no logical correlation between patients having undergone a simple surgery, and the degree to which they will be influenced by natural settings. Such considerations are stipulated in Chapter 5 (O'Connor et al., 2011) of the Cochrane Handbook (Higgins et al., 2011), and will be taken into account where possible throughout the data synthesis.

However, as a result, assessing whether to include or exclude an article from the analysis may entail some subjectivity on the researcher's part. Countering this limitation would usually require that such assessment be done by two or more independent researchers, which is inapplicable in this case, due to time-constraints, and the general rule of thumb that theses must constitute individual work.

3.6.3.1 Quality & Bias Assessment

3.6.3.1a Subjectivity in Rating Quality of Evidence

While the GRADE tool is heavily endorsed by research bodies, it should also be noted that GRADE scale cannot be implemented objectively (mechanically), and subjective decisions must be made by the person performing the analysis. Therefore, while it is usually recommended that GRADE assessments be conducted by a minimum of two blinded reviewers (Bilotta et al., 2014), in this case it was not possible to include another researcher to perform the assessments, given that this review is conducted as part of a doctoral thesis, which must constitute the researcher's works alone.

3.6.3.1b Subjectivity in Determining Risk of Bias

The biggest factor hampering the risk assessment of experimental studies is incomplete reporting of how the study was conducted (Higgins et al., 2011). As a result, the risk of bias for many studies remains largely unevaluated and had to be reported as such in the results. This limitation was especially detrimental for studies with notable findings, as attributing these findings to a bias would increase/decrease their weighting in the study's conceptual framework. A changed weighting may or may not have a significant impact on the framework, depending on the findings reported by similar studies.

With regard to the assessment of reporting bias in experimental research, the researcher anticipates the majority of the studies assessed to fall under the category of Unclear Risk. According to Bilotta et al. (2014), while reporting bias is one of the most substantial biases affecting results in individual research, most studies do not offer sufficient evidence to permit assessment of this risk.

Finally, while Cochrane's considerations were taken into account in assessing risk of bias non-experimental research studies, the authors also note that non-randomized studies of poor methodological quality can significantly dominate the findings of other studies, and further state that no remediation can estimate or account for this effect (Reeves et al., 2011).

3.6.3.2 Scale and Scope of the Topic

One final limitation naturally results from the massive amount of literature available addressing the impacts of healthcare environments on the different users of those environments. As such, not all identified materials could possibly be reviewed over the timeframe allotted for this research.

Furthermore, some key studies may not have been identified as they may be published in other databases not included in the review. This limitation is inherent to conducting a systematic review of this scope and breadth, and no delimitations can be implemented to account for it.

3.7 Concluding Remarks

This systematic review was conducted to complement the theoretical review conducted in chapter 2 of the thesis, adopting a rigorous qualitative review process to identify the most relevant articles discussing the effects of design interventions in healthcare facilities, and their potential effects on patients' and staff members' satisfaction and well-being. The chapter details the process used to conduct the systematic review, concluding with a summary of the key findings obtained in conducting the review.

Commented [A31]: Elaborated more on the process and aims of the chapter in the conclusion

Considering the limitations discussed in Section 0, this research remains of great value to the field of literature, considering the performance gap identified in the conceptual review chapter (See Section 2.5.2), as there has been little research done compiling past literary findings, exploring the scope of the design factors influencing the needs of patients, and by extension, the quality of patient care in practical settings. Developing a comprehensive understanding of those design factors can aid in the development of a design management framework that addresses this performance gap, which serves as the primary reason for which the systematic review chapter is conducted in this thesis.

4 Methodology& Design

Chapter Overview

This chapter outlines the methodology adopted by the research in the development of this thesis, comprised of the study's approach and design, the instruments used for the collection of primary data, the study's population samples, data, statistical methods, and finally, the ethical considerations taken by the researcher to ensure the protection and privacy of all of the study's participants.

4.1 Synopsis of the Methodology

The methodology detailed is designed such that it enables reliable data collection and analysis in line with the primary aims of the study.As a result of the restrictions preventing the adoption of a true experimental approach (defined in Section 3.2.5.3) given the scope of this work, an observational approach was used to evaluate the impacts of different design components on patient needs and outcomes.

Patient and staff questionnaires were distributed to a final sample populations of 216 and 102 participants, respectively. These quantitative data sources, along with direct observations recorded by the researcher in non-standardized forms, were used for data collection. Data extraction and analysis were then performed using Microsoft Excel and IBM SPSS, extracting the data into digital format, which enabled the statistical analysis of the data.

An inductive approach is used to evaluate and interpret the study's findings, which is undertaken bearing in mind the results of the systematic review, in confirmation of the most evidence-backed claims made by the studies reviewed (See Section 233.2.5.2[18]). While the obtained findings may not be as sound as those obtained via true experimental designs, such an approach allows for the analysis of more relationships than would be possible using true experimental designs (See Section 3.2.5.2[19])

Principal Component Analysis (PCA) is conducted to evaluate the validity of the concepts (dimensions), and the groupings of the design interventions evaluated in the research (See Section 5.2). Non-parametric analysis of variance is conducted to obtain the findings, using Kruskal-Wallis tests, as the data used for the study do not meet the assumptions for parametric ANOVA testing.

4.2 Approach & Design

4.2.1 Defining the Research Approach

4.2.1.1 Deduction vs. Induction

Another key consideration to the research approach is with regard to how the study's data will be generated, i.e. whether the researcher will follow an inductive or deductive approach.

Soiferman (2010) differentiates between the two approaches, stating that induction refers to the act of moving from the specific to the general; while deduction refers to moving from the general to the specific. According to the author, research arguments making their claim on the basis of experience or observation are best evaluated using an inductive approach, while arguments making their claim on the basis of rules, regulations, or widely-accepted principles are best evaluated using a deductive approach.

As the two approaches are not necessarily mutually exclusive, this study adopts both inductive and deductive approaches to obtain the data, analyse them, and develop the study's final framework. An deductive approach was used to translate the findings of the

[18] Systematic review of the literature

[19] For explanations of the differences between

systematic review into a conceptual framework used for conducting the primary study, while an inductive approach was used to conduct the primary study and obtain empirical findings; which were later reapplied along with the results of the systematic review to develop, in part, the final framework of the study, deductively.

4.2.1.2 Correlation vs. Causation

The primary methodological challenge associated with multivariate studies of complex systems (such as the environment of a healthcare facility) is analysing the results such that evidence of causation, not mere correlation, is obtained. However, directly measuring causal relationships may be difficult in the healthcare setting. Not only because the significant number of variables that exist within the built environment cannot all be controlled for simultaneously, but also because it is unlikely that all of the relevant variables for any given intervention have been identified. Furthermore, while most design interventions are intended to alter a single design factor, they may end up altering several in the process if not properly designed.

However, bearing that in mind, causal links have been determined and supported by other types of evidence in cases where RCT designs may not be applicable. As Ulrich et al. (2008) argues, correlative research designs may still be useful in the context of the field as a whole, as emergent "reliable patterns of findings" would serve as a measure to validate correlative research designs. Furthermore, as Ulrich and his colleagues point out, such patterns often generate a very credible body knowledge that continually verifies and supports past findings at very high consistency levels. As for the stance of this research on their findings, the researcher views the quality of evidence supported in their work to be of paramount importance to the literary base at large; as it has contributed to many theorizations and empirical works moving forward.

4.2.2 Defining the Research Design

4.2.2.1 Outline of Research Design

The design of this study could be described as confirmatory in nature, as the scope of this work does not allow for experimental evaluation of the causal impacts arising from design interventions on patient needs and outcomes. Confirmatory research refers to studies conducting aiming to add further evidence supporting claims made by previous authors (Nilsen et al., 2020). As such designs are typically restricted to one or two design interventions in most cases, an interventional approach would have not been befitting for the aims of the study (Nilsen et al., 2020).

Instead, the study is observational in nature, drawing on empirical evidence and user-reported data to conduct a comprehensive analysis of the impacts of different design components on patient needs and outcomes. While the study relies primarily on quantitative data sources to obtain the results, qualitative feedback from the respondents, along with some qualitative observations made by the researcher were also used in support of quantitative data.

4.2.2.2 Restrictions to Adopting an Experimental Design

While an experimental design would have been preferable to an observatory design, as such designs provide a more reliable method of ensuring that the perceived effects truly arise from the design components they are attributed to, several restrictions make it difficult to conduct the study experimentally:

1. Hospitals' stipulation that the researcher must not directly intervene with the treatment of patients
2. Ethical concerns of examining factors which are thought to have negative impacts on patients' treatment and healing[20]
3. Experimental designs would not be truly effective unless a single factor could be examined, while everything else was controlled to the best of the researcher's ability(Dean et al., 1999).
4. Finally, given the scope and breadth of the components to be examined in the study, as well as the time and resource limitations of the researcher, it would not be logistically, practically, or ethically feasible to examine a sample population large enough for each component to have a representative sample of its own.

The observatory part of the study was presented in the form of qualitative findings observed throughout the researcher's interactions with the patients and staff members during the study. Observed findings were collected using the observation sheet discussed in Section 4.3.4.

[20] For instance, examining whether carpeting leads to higher rates of falls in an experimental manner would require that patients be randomly placed in rooms which could compromise their safety.

4.3 Instruments &Data

4.3.1 Overview of Data Collection Approach

This study uses a multimethod data collection approach, which involves the use of both direct systematic observations of different facility users, as well as the use of validated standardized questionnaires, distributed to both patients and staff members, both of which will be elaborated on further in the following section.

Using the findings obtained through the systematic review (See Chapter 3), two questionnaires were developed to assess the impacts of design components (identified to have significant findings on the basis of the data presented in able 19), assessing the impacts of design components directly on patients, and indirectly through staff members.

4.3.2 Patient Questionnaire

4.3.2.1 Development & Design

Many factors had to be considered with regard to the design of the patient questionnaire, to account for the nature of the research sample. One such important consideration is the fact that the majority of respondents to environmental surveys have little (if not zero) knowledge of interior design and its terminology, and the questionnaire was carefully formatted in simple manner to avoid confusion and patients misinterpreting the questions asked (Fowler, 1995; Friedow, 2012).

The researcher was especially careful not to probe the respondents for positive or negative opinions in informing the participants about the study, remaining as neutral as possible as to gain.

The variable of age was also reported on a numerical scale, rather than a categorical one, to allow for grouping and regrouping of patients to indicate different age ranges, which may be required for interpreting the mediating effect of demographic variables with regard to different relationships.

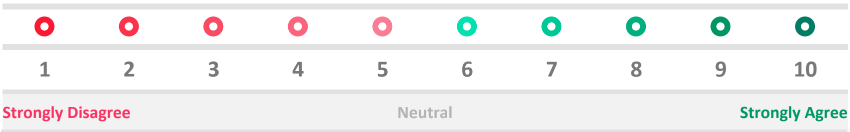
4.3.2.2 Structure & Sections

A copy of the questionnaire instrument can be found in Appendix B.3.

The questionnaire mainly consisted of65 questions structured in the form of a 10-point Likert-Scale (Figure 25), asking that patients to rank their level of agreement with statement linking different environmental design features to their perceived needs and outcomes.A 10-point scale was identified to more precise measurement results, given the patient sample size (Section 4.4.3) and statistical analysis method (non-parametric ANOVA; Section 4.5.3) (Krosnick, 2018; Dawes, 2008).

Figure 25

Patient Questionnaire, 10-Point Likert-Based Scale, SD (1) to SA (10)



Other types of questions included in this questionnaire comprise simple and easy-to-understand question types, including: (1) single-response multiple-choice, (2) multi-response Multiple Choice, and (3) Fill-in-the-Blanks.

The questionnaire included 5 sections in total. Following a fairly standard demographic/socioeconomic data section, the questionnaire was divided on the basis of the three primary dimensions of design identified in Section 2.6, and included one additional section asking patients to rank their perceptions of how their different needs are fulfilled and outcomes are achieved through environmental design.A copy of the questionnaire can be found in Appendix B: Supplements to Methodology.

4.3.3 Staff Questionnaire

4.3.3.1 Development & Design

The staff questionnaire was developed bearing in mind the same considerations as the patient questionnaire, with one minor alteration: the terms used throughout the questionnaire were a little more complex in nature, as to ensure that the participants fully understood what was being asked of them. Given the fact that the included staff members were all healthcare professionals presumed to have undergone lengthy training in the field, it is not unreasonable to assume that they should be familiar with constructs such as functional status and HRQOL.

One important consideration to make in the development of the staff questionnaire is that all sampled members were matched to patients that they oversaw. As such, staff members

Commented [A32]: [87] Mentioned number off questions

Commented [A33]: [73] Changed from accurate to precise

Commented [A34]: [72] Yes, it is provided by these articles

Commented [A35]: [75] Added link to questionnaire were able to provide some insight into patients' outcomes, which included their general well-being, functional status, and HRQOL.

The questions included in staff questionnaires were structurally very similar in nature to those in the patient questionnaire, with the only difference being the topic around which each question was centred. As the main focus of this study is on examining the needs and outcomes of patients, the questionnaire did not focus on the impact of the built environment on staff needs, but rather, it focused on examining the impact of the built environment on patient needs, mediated via staff outcomes.

However, the methods used to analyse and interpret the results of the staff questionnaire were somewhat different from those used for the patient questionnaire, based on the design of the questionnaire itself, as is explained in Section 4.5.3.3.

4.3.3.2 Structure & Sections

The first four sections of the staff questionnaire were similar to those of the patient questionnaire, while the final fifth section asked the respondents to evaluate their own outcomes, as well as those of the patients.

Evaluating patient outcomes using the evaluations of their primary care providers is not uncommon in the literature. For instance, Ulrich (1984) used nurses' comments and remarks on patient profiles to get a general sense of patients' well-being. In fact, the only difference between Ulrich's approach and the approach used in this study is with regard to the type of data collected (qualitative vs. quantitative), and the fact that Ulrich's design examined data retrospectively, as the study was of quasi-experimental design.

4.3.4 Direct Observation

4.3.4.1 Procedural Outline

A primary issue researchers face in studies involving direct observation is that people tend to change their behaviour when directly observed; either voluntarily or involuntarily. As a result, the observations conducted by the researcher was mostly focused on areas outside patient rooms; most frequently in general wards that had maximum view of as many patient rooms as possible, along with some other key areas identified to play a major role in the literature, such as centralized/decentralized nursing stations, stairs and elevators, public use bathrooms, and the waiting areas for inpatients' families.

To generalize observations into quantifiable and synthesizable forms of data, and to ensure the comparability of the results later on in the analysis, data collection forms were used to record all observations that the researcher made. The collection forms used were non-standardizable; a decision that was made to ensure that any previously unconsidered factors and variables could be individually identified and added to the list of observations.

While non-standardized forms allow the benefit of collecting additional circumstantial data and individual notes made while conducting the study, they also suffer from the inherent limitation making them inept for quantification (Śliwa, 2017), meaning that any such findings would have to be presented in the findings in a qualitative manner, as an observation by the researcher.

4.3.4.2 Observational Measures

The majority of the observed patient outcomes were either recorded when exiting a patient's room upon the completion of their questionnaire or took place during dedicated observation periods. The observation forms were also used to record any extra feedback that the patients provided as to variables missing from the questionnaire, and to notes on some patients' questionnaire responses.

Quantitative data, including measures of the patients' biological functions and bodily activity systems were not be provided by any of the hospitals, who cited that data privacy and security concerns prevented them from giving out such data, regardless of cause and privacy measures. As a result, the recorded observations were mostly qualitative in nature, but were nonetheless a key supplementary item that enabled the identification and validation of correlations between design features and patients/staff needs and outcomes.

In line with the ethical considerations of this study, the researcher ensured that no personally identifying information was recorded in any of the data collection forms, and handling/storage of physical copies followed the same treatment used for the study's questionnaires.

4.3.5 Validation & Reliability

According to Boynton & Greenhalgh (2004), while methods such as RCTs are typically subject to very strict reporting criteria, designed to minimize the risk of bias and invalidity, no such measure accounts for this risk in questionnaire research. As a result, it is important for researchers to validate the responses of previously untested questionnaires, in order to assess the degree to which questions are internally consistent throughout, and to identify any possibly conflicting or inappropriate questions.

Both validity and reliability are concepts used to evaluate the quality of a research instrument or measure. Where the two concepts differ is in terms of what each assesses, and how this assessment is made. The distinction between reliability and validity is outlined in Table 20.

Table 20

Research Quality Evaluation, Reliability vs. Validity

Source: Adapted from Middleton (2019)

	Reliability	Validity
Assessment	Assesses the extent to which results are reproducible when conducted in the same way as the original, and whether these results are consistent	Assesses the extent to which results measure what they claim they do, and how reliable a tool is in obtaining accurate measures
Method	Evaluates the consistency of generated results across time, by different observers, and throughout different sections of the test itself	Evaluates the degree to which the results conform to well-founded and established theories and measures of a similar concept
Correlation	While reliable measures may be consistent, nothing ensures their validity. Reproducibility alone does not make for a good instrument, and a validation tool is required	While valid measures are generally reliable, if tests produce accurate results, they should also be reproducible. However, reliability alone does not ensure validity, and assessment is required

Based on the criteria and descriptions outlined above, a reliability test serves to show whether results are reliably and consistently measured across similar populations, while validity serves to show whether the content of the tool is valid and well-founded.

As for the former, Cronbach's Alpha test(Cronbach, 1951) was used to compare the results, using an alpha score of ($\boldsymbol{\alpha \geq 0.7}$) as the baseline for which the individual items are deemed internally consistent with one another. While the value of 0.7 is somewhat contested in the literature, as it is something of an arbitrary selection, it is generally well regarded as a good baseline, and the higher the score, the more preferable the item is for inclusion in the study (Cortina, 1993).Among the most common reasons cited for the use of Cronbach's alpha test is the validation of the internal consistency of scales (Taber, 2017). It is important to heed Gardner's (1995) warning that researchers should not conflate internal consistency and unidimensionaland consider a high value of alpha as suggesting that the items in an instrument were all measuring the same thing, as this is not what a high value alpha indicates.

While Taber (2017) cites some concerns regarding the use of alpha in contemporary research, as the author notes the measure is commonly misunderstood by the researchers implemented it, the author indicates that it can be a very reliable measure of internal consistency, if justification is provided by the researchers as to the why the constructs defined to be validated are chosen. In the context of this study, the dimensions of design evaluated using Cronbach's alpha were based primarily on theoretical review of the literature, as many authors have clearly defined each of these individual dimensions as a valid area of design (Hutton & Richardson, 1995; Fottler et al., 2000; Dalke et al., 2004; Hutton & Richardson, 1995; Fottler et al., 2000; Ulrich, 1991; Sommer, 1969; Day, 2017; Anthony &Watkins, 2007); though a concern still remains that with regard to overlap in these design dimensions (See Section 2.8.1)

Bartlett's sphericitytest (Ul Hadi et al., 2016) was used to assess whether a factor analysis would be suitable for the purposes of the study. Values below a standard statistical significance level of 0.05 typically indicate the usefulness of a factor analysis with a specific dataset.Accordingly, based on the work of Jollife (2002), aPCA (Principal Component Analysis) was also conducted to assess factor loading of study's primary results. The PCA is typically used to establish the validity and internal consistency of the examined items and was used as such to evaluate these measures for this study's instruments.

Finally, both questionnaires and all other measures were run by consultants from academia to review the questions asked and provide feedback on which aspects of the questionnaire should be amended.The submitted questionnaire was approved in terms of the concepts and questions asked to the patients and staff members, with adjustments made to the instruments on the basis of the feedback provided by the academic consultants.

4.4 Populations & Sampling

4.4.1 Sampling Strategy

The term sampling refers to a component of the methodological process of a research study, where a subset of the study's population is selected by the researcher to make for a representative group of the population, for which claims could be generalizable to the population as a whole (Thompson, 2012).

Sampling can be divided into two primary types:

1. **Probabilistic Sampling**

   A probabilistic sampling method refers to sampling in which the study sample is randomly picked out from a population, where this final sample is expected to follow a normal statistical distribution (a bell-shaped curve) under normal circumstances.

2. **Non-Probabilistic Sampling**

   On the other hand, non-probabilistic sampling refers to a sampling method where the population is not selected at random, and the odds of a member being selected from any given group cannot be calculated.

Bearing in mind the nature of non-probabilistic sampling, the latter is not recommended for quantitative research, and is generally thought to be of inferior quality to probabilistic sampling in quantitative research studies (Forster, 2001).

For the purposes of this research, sampling was conducted over the course of two stages. In the first stage, a sample of hospitals was selected, which was followed by the second stages, in which a sample of patients and healthcare staff was selected from the sampled hospitals.The staff sample could not be evaluated for representativeness, as no reliable sources of data could be found consistently showing the total number of staff members within the sampled hospitals.

Commented [A36]: [86] Explicit mention of representativeness

4.4.2 Sample of Hospitals

4.4.2.1 Sampling Strategy for Hospitals

The sampling methods used for hospital selection constituted a non-probabilistic convenience sampling approach, as the researcher identified a target population of hospitals in Jordan, narrowed down the sample based on criteria outlined below, and approached all hospitals within reach; as it would be infeasible for a single researcher to sample hospitals from all across Jordan.

4.4.2.2 Healthcare Sector Overview

An analysis by AbuRuz et al. (2017) on nursing staff in 7 registered Jordanian hospitals indicates that there is a statistically significant difference in perceived evidence-based practice ($p<0.001$), attitudes ($p<0.001$), and knowledge ($p<0.001$) in staff working in private hospitals, in comparison to those working in public &Royal Medical Services (RMS) hospitals.

As a result, selecting a sample population constituting only private hospitals significantly increases the likelihood that staff members are familiar with EBD and its various subtopics, and are able to contribute to the discussion, even if such practices are not employed in their healthcare facilities (AbuRuz et al., 2017).

As a result, the sampling method through which the final hospital sample is selected is convenience sampling among privately run hospitals. This is due to the fact that the researcher was unable to find any resources indicating that any of the private hospitals in the study's accessible population utilized EBD (or any such similar environmental design approach) to address patient needs/outcomes.

Attempts were made to establish contact with HR personnel from the Ministry of Health to inquire about conducting research in public hospitals, to which the ministry were non-responsive. However, access to public and RMS hospitals is generally very restricted, in contrast to private hospitals in the region, who may be more open to initiatives and research undertakings, given the competitive service and image-based industry in which they operate.

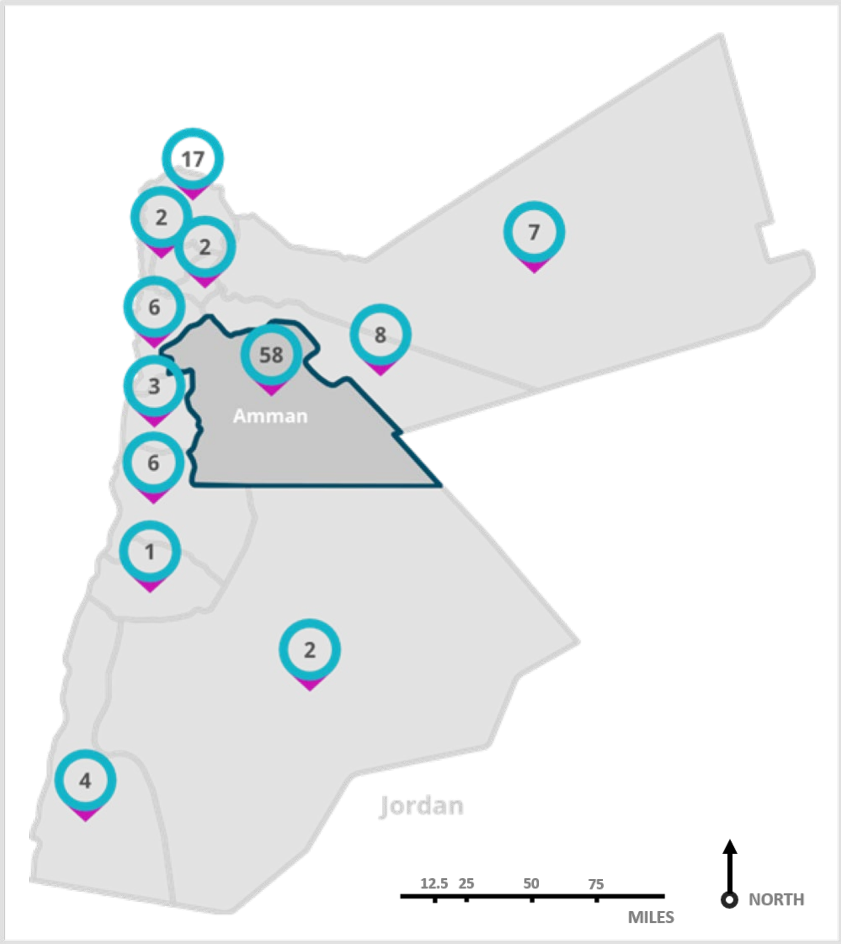
4.4.2.2a Accessible Population

Figure 26, shows that the accessible hospital population for this study constitutes Jordanian hospitals located in the capital city of Amman, as that is the researcher's area of residence, and is home to approximately half (49.15%, n=58/118) of all hospitals in the country.Of those 58 hospitals located in Amman, 44 private hospitals were the primary sample of interest for the researcher—reiterating what was stated in the previous section; as private hospitals generally provide better quality of service than their publicly-funded counterparts, especially in developing regions like Jordan (Alijanzadeh et al., 2016; AlKhattab &Aborumman, 2011). Furthermore, public hospitals are generally much more restrictive to provide access to their patients, even for a brief 10-minute questionnaire.

Figure 26

Map of Hospitals in Jordan, by Governorate

Source: Adapted from Data provided by DOS & ICF (2019)



All 44 accessible private hospitals were visited by the researcher, of which a final sample population of 6 hospitals granted the researcher access to collect data from patients and staff members.

The final list of included hospital is provided in Table 21, along with some descriptive data on each hospital, denoting the size and facilities available within each. These data, in accordance with the researcher's direct observations, will determine whether any of the facilities allow for the examination of the impact of individual design features on patients needs and outcomes[21], such as examining the particular impact of daylight on patients healing; while controlling for other variables. The final list of included hospitals, which totals 6 hospitals, as shown in Table 21. This sample cannot be used to sufficiently explore all of the design components identified to influence patients' needs in the systematic review (Section 3.3.1). This is mainly the result of the requirement of having comparable environments to conduct the analysis, as to ensure that the findings are not misrepresentative of an effect owed to another explanation.

Commented [A37]: [88] Made sure tables are numbered correctly

Table 21

Final List of Included Hospitals

Ref	Hospital Name	Year Est.	No. of Beds
H.1	**AbdulHadi Hospital**	**2002 (18 Yrs)**	**110**
H.2	**Gardens Hospital**	**2014 (6 Yrs)**	**165**
H.3	**Ibn Al-Haitham Hospital**	**1996 (24 Yrs)**	**230**
H.4	**Amman Surgical Hospital**	**1993 (27 Yrs)**	**100**
H.5	**Jordan Hospital**	**1993 (27 Yrs)**	**300**
H.6	**Al-Istishari Hospital**	**2004 (16 Yrs)**	**130**

Appendix B.1showsthe letters of permission signed by relevant administrative staff in the sampled hospitals. It should, however, be noted that the researcher encountered many difficulties throughout conducting the study with regard to obtaining persmissions and access to patient data.

4.4.3 Sample of Patient Participants

4.4.3.1 Sampling Strategy for Patients

Sampling for hospital inpatients was largely determined based on the agreements with the hospitals included in the investigations as discussed above. Patients were selected on randomized basis, with the stipulation that hospital management determined the sample

[21] Example:

e.g. 3 of the 6 hospitals included rooms located on different sides of the hospital, in which there was a noticeable difference in daylight received by patients at certain hours throughout the day. As such, it could be evaluated whether this difference in daylight received affected patient needs by comparing differences in self-reported items for the two groups, such as patients' stress and anxiety, and rates of prescription errors.

pool from which this randomized sample was to be selected. This requirement was to assure that any patients deemed to be in critical condition were not disturbed at any point throughout their treatment.

While there were some differences in terms of how lax the hospitals were in terms of eliminating and minimizing the available pool of patients from which the study's sample was identified, all hospitals showed some concern and caution not to disturb or interrupt the treatment of patients with acute conditions.

4.4.3.2 Sampling & Selection

4.4.3.2a Target Population

The target participant population of this study includes two primary groups of participants:

1. The first participant group consists of hospital inpatients who were admitted to private hospitals during the data collection phase of this study (See Section 4.5.1).
2. The second participant group consists of healthcare professionals working at the same hospitals from which the patient was sampled, as to allow for cross comparison between the perceptions of patient and staff groups.

Furthermore, with regard to patient recruitment, the study only identified patients who occupied SORs, not only for the multitude of health benefits associated with SORs, but primarily due to the fact that the increased number of confounding factors expected in Multi-Occupancy Rooms(MOR) would drastically decrease the researcher's ability to isolate design components for their impact on patients. In addition, controlling for the impacts of additional confounding factors would also limit the sample size, to extent where an analysis of individual design components may be not even be possible.

Furthermore, a systematic review by Taylor & Card (2018) revealed that 87% of the reviewed empirical studies were able to identify at least one advantage resulting from the room occupancy (SORs vs. MORs) on patient satisfaction and/or other patient outcome measures.

4.4.3.2b Accessible Population& Response Rate

In accordance with the target population identified in the section above, the accessible population of the study constituted patients who hospital administration assigned to participate in the study; if the patients so chose to do so. This was done to further ensure that no patients in critically ill condition had their treatment or healing interrupted by the study, and to ensure that special patient groups such as those patients with Alzheimer's disease or otherwise demented patients would not be included in the study's sample, as these patients would be unable to provide assured consent to partake in the study.

In accordance with the above, the initial sample population of patients who consented to participate in the study constituted 223 patients in all 6 hospitals. A sum of 7 questionnaires were excluded from the analysis, as the results were halted due to medical/non-medical interruptions (2.24%, n=5/223), or were later removed as the participants no longer wished to have their results published as part of the findings (0.89%, n=2/223).

As such, the final response rate for the patient population was 96.86% (n=216/223), who make up the final sample of patient respondents, and whose results are presented in findings and discussion (Chapter 5).

To evaluate the representativeness of the sample of the population of patients in Jordanian private hospitals, the number of total hospital beds was obtained for the private sector as a whole, based on information reported by the Jordanian MOH for the year 2019[22] which is outlined in Table 22.

Table 22

Number of Hospital Beds in Jordanian Private Hospitals

Source: MOH (2019)

Zone	Total Beds
Qweismah	**53**
Qasabat Amman	**2766**
Jama'a	**690**
Na'ur	**58**
Markah	**207**
	3774

Using the total number of hospital beds as a baseline for the number of patients in Jordanian private hospitals, and assuming a 100% occupancy rate to account for the most strenuous

[22]Obtained from the analytical tool provided by the MOH website on: **https://gis.moh.gov.jo/MOHHealthMap/Home.html#**

possible time for the medical system in Jordan, the sample population of private hospital patients at any given point is estimated to amount to 3,774 patients.

Using a standard sample size calculator, such as the one developed by RaoSoft[23], the following assumptions can be made to estimate the required sample size for a representative majority of the population:

- Margin of Error (Confidence Interval) of 10%
- Confidence Level of 95%
- Population size of 3,774
- Standard response distribution of 50%

Plugging in the above figures into the equation, the recommended sample size of patients amounts to 94 in total; which is less than half the sample of the study. As such, it could be stated that the sample may be considered representative of the target population as a whole, even under the worst possible strain faced by the system.

4.4.4 Sample of Staff Participants

4.4.4.1 Sampling Strategy for Staff

Finally, as for healthcare staff, their results were to be used in conjunction with those of the patients to support the findings. The primary criteria for sampling healthcare staff was to have at least a single staff member for each patient; as staff members were asked to evaluate two of the patients' outcomes: functional status, and general well-being. Taking into account that a single healthcare staff member could be responsible for multiple patients, it is expected that the staff sample will be much smaller than the patient sample.

4.4.4.2 Sampling and Selection

4.4.4.2a Target Population

Healthcare staff members were mainly selected on the basis of their clinical role, as sufficiently relevant responses required that staff members make direct contact with patient groups andinteract frequently with the environments examined in this study.

[23] Available at: **http://www.raosoft.com/samplesize.html**

As a result, the final staff sample constitutes (1) physicians, (2) nurses, (3) technicians, (4)therapists, and (5) medical assistants. Other professionals, including pharmacists, medical technologists, dietitians, and those working in non-clinical jobs, were excluded from the sample, either for not making enough direct contact with inpatient groups, or for not interacting with the patient environment on a frequent basis.

4.4.4.2b Accessible Population & Response Rate

Accessibility to the staff sample was only restricted by whether staff members were on duty or leave at the times of data collection. However, it was essential that every patient was matched with at least one of the direct care providers; as to obtain a minimum of one set of evaluative measures of said patients' outcomes—which are essential to the findings of the study.

The initial sample population of healthcare staff constituted 103 staff members in total, and only 0.97%(n=1/103) of the final responses were excluded, as the interviewed staff member was called on-duty halfway through the procedure.

Nonetheless, the nurses and physicians included as part of the final sample population of staff were appropriately matched with the respective patients, and thus, the criteria for including the results of the staff sample was deemed met by the researcher.

As such, the final response rate for the staff population was 99.02% (n=102/103), who make up the final sample of staff respondents, and whose results are presented in findings and discussion (Chapter 5).

Figure 27lists participants included in the study from each of the sampled hospitals.

Figure 27
Participants by Hospital, Patients & Staff Members

Hospital	Patients	Staff	Total
Al-Istishari Hospital	30	17	47
Jordan Hospital	72	39	111
Gardens Hospital	24	11	35
AbdulHadi General Hospital	20	9	29
Ibn Al-Haitham Hospital	48	18	66
Amman Surgical Hospital	22	8	30
Totals	**216**	**102**	**318**

4.5 Data&Methods

4.5.1 Data Collection & Handling

4.5.1.1 Participant Information Sheet

Participant information sheets were distributed to the study's patient and staff participants upon their consent provision, and the researcher thoroughly went over the information sheet to ensure that participants are sufficiently informed on key aspects of the research process, including:

- The background, aims, objectives, and methods of the study
- The approach the researcher will take to conducting the study
- How the participants can contribute to achieving the study's objectives, and what kinds of data they will be asked to contribute
- How the participants' data will be collected, extracted, and synthesized for use in the analysis
- The privacy and confidentiality considerations taken into account by the researcher while conducting the study
- What will happen to participants' data upon the submission of the study's final draft, and where they can obtain a copy of the final study report upon its completion

4.5.1.2 Questionnaire Data Collection

Upon distributing and explaining the participant information sheet to its intended recipients, questionnaire data collection commenced, with data from patients and staff members collected in written format, as requested by the hospital, as a precautionary measure to avoid the use of electronic devices in patient rooms, to avoid infringing on patient privacy and security. The paper sheets were stored in a portfolio placed in a bag carried at all times by the researcher, sorted by hospital and date of collection, in order to ease the retrieval process.

In the case of both patients and staff members, data collection involved the researcher reading the questions aloud to the participants, as to minimize the rate of invalid responses and unanswered questions and make the process more convenient for the participants.

It should be noted that another stipulation made by the hospitals, outlined in the letters of permission (attached in Appendix B.1), was that staff members at each hospital had to accompany the researcher while conducting the study. They did not in any way assist in the collection and transcription of the responses on the physical sheets to ensure that no persons with potentially conflicting interests could tamper with the study's primary data. Staff members, however, contributed in other meaningful ways by aiding the researcher in explaining the topic at hand, and providing their own personal feedback on certain matters relevant to the topic.

Upon completion of participant questionnaires, verbal and written consents were obtained from the respondents, in which they agreed to the inclusion of the responses they provided in the study's dataset, provided that none of the confidentiality and privacy stipulations are broken.

4.5.1.3 Observational Data Collection

As for observational data, it was, as stated earlier, collection used unstructured sheets, as to account for any variable or unmediated noteworthy observation. The only structured portion of these forms were the five key quantitative data measures, examined in Section 4.3.4.2. Similar to questionnaire data collection, all observational data were transcribed onto paper sheets by the researcher, and stored in a separate compartment in the portfolio, next to the filled questionnaires.

4.5.2 Data Extraction

Upon the completion of the data collection phase of this study, the data extraction process commenced to migrate data into processable digital format, which offered a more practical storage solution, and enabled automated data analysis using the methods outlined in the following chapter.

Data were manually entered into Microsoft Excel© spreadsheets by the researcher, and double checked upon completion to ensure that no entries were mis-transcribed. No data identifying any of the participants were entered into the sheets, as that would violate patient privacy and confidentiality. Instead, unique ID number were used to mark the responses of each patient and staff member in the digital dataset.

4.5.3 Statistical Analysis

Table 23 outlines the differences between two opposing types of statistical analyses: parametric and non-parametric analyses. As is shown in the table, the primary difference between the two types of analysis is in terms of the underlying assumptions regarding the sample population, its distribution, as well as the format of the variables and relationships to be examined in the study (Deshpande et al., 2018).

As such, each of those two methods have their appropriate applications, and certain conditions of validity must be met in order to obtain reliable analytical findings using results from tests belonging to either type. Non-parametric methods are considered robust than parametric methods (Jolliffe, 2002), meaning that the tests are able to examine much broader ranges of situations. On the other hand, parametric methods are also known to have much more statistical power, and generally provide stronger and more concise test results, but do not make for accurate means in testing Likert scale data. (Norman, 2010).

The majority of the statistical analyses used to obtain the results in the following section were performed using SPSS 25.0. Furthermore, MS Excel and other MS Office products were used to perform more basic statistical analyses, such as descriptive statistics, and comparisons between participant demographics. These tools were also used to generate the charts and graphs shown throughout this report. While the majority of these figures were generated using built-in charting tools in those software pack. Table 1 1 outlines the differences between two opposing types of statistical analyses: parametric and non-parametric analyses. As is shown in the table, the primary difference between the two types of analysis is in terms of the underlying assumptions regarding the sample population, its distribution, as well as the format of the variables and relationships to be examined in the study (Deshpande et al., 2018).

As such, each of those two methods have their appropriate applications, and certain conditions of validity must be met in order to obtain reliable analytical findings using results from tests belonging to either type. Non-parametric methods are typically thought to be more robust than parametric methods, meaning that these tests are able to examine much broader ranges of situations. On the other hand, parametric methods are thought to have much more statistical power, and generally provide stronger and more concise test results.

Table 23

Differences between Parametric and Non-Parametric Statistical Analyses

Source: Deshpande et al. (2018)

	Parametric Analysis	Non-Parametric Analysis
Assumed Distribution	Normal Distribution	Normal/Non-Normal Distribution
Assumed Variance	Homogeneous Variance	Homo/Heterogeneous Variance
Data Types	Ratio/Interval Data Types	Nominal/Ordinal Data Types
Dataset Relationship	Independent Relationships	Any Relationship Type
Usual Central Measure	Mean	Median
Advantages	Offers more conclusions	Simpler and Less Affected by Outliers

4.5.3.1 Demographics & Descriptive Analysis

Descriptive statistics were used to model demographic data obtained from the study's participants, along with the results of the questionnaires, and several isolated relationships between the examined variables. Several coefficients for the variables were reported on, including the mean and median responses, which are all central tendency measures; along with other measures of the data's variability, which included the standard deviation, variables, and min/max variables.

Regardless of whether these coefficients were reported in the study, calculating all of them was nonetheless essential to conducting other statistical analyses further down the line; and relevant coefficients to the analysis will be the ones for which the final results of the descriptive statistics were obtained.

4.5.3.2 Dimensionality Reduction &Principal Component Analysis

Several issues can often present themselves when working with models containing large amounts of variables, especially in cases such as the built environment, where there appears to be some correlation between a wide range of those variables, especially in terms of their cross-correlation with user needs and outcomes (Mawale & Chavan, 2014).

As a result, reducing the dimensionality of the feature model can help in the case of the study, as it provides a smaller end list of variables to consider, which can aid in estimating the relative effect of each isolated design component.

There are two ways to conduct statistical analysis aimed at dimensionality reduction: (1) feature extraction, and (2) feature elimination (Hira & Gillies, 2015). Both of these methods result in a reduced number of variables for the researcher to consider, with one major difference between the two; while the former filters data and keeps a subset of that data, the latter creates a brand new subset, eliminating the examined one (Jolliffe, 2002).

Feature extraction is our primary area of interest for the purposes of this study, and PCA, a common types of exploratory factor analysis—used for uncovering the underlying structure of a relatively massive set of variables, is a particularly good fit for studies of the built environment (Keast et al., 2010; McNabola et al., 2009). The rationale behind emphasizing feature extraction is that the conceptual framework was developed based on the results of the concepts and theories explored in the literature review, conducted by a single researcher over the course of this study. As such, it would add to the credibility of the conceptual framework used if the constructs developed could be verified and validated as a whole set, establishing the validity of the conceptual component of this study.

Factor rotation using varimax orthogonal rotation was used to interpret the resulting factor matrices; which was conducted with the goal of rotating factors in the multidimensional space as to arrive at the best possible solution; with the simplest structure in relativity to others (Abdi, 2003). An orthogonal rotation method was used in place of an oblique rotation method as it requires factors to be correlated (contrary to oblique rotation) which is expected, given the nature of healthcare environments and the multitude of components comprising it (Abdi, 2003; Brown, 2009).

4.5.3.3 Non-Parametric Analysis of Variance (Kruskal-Wallis)

One-Way ANOVA refers to a collection of statistical analysis methods, primarily use variance used to analyse the difference between the means of two group samples. One-Way ANOVA works as it provides, in its simplest form, an alternative form of the t-test, expanded beyond two means, and aimed at assessing how equal the means of two populations are to each other.

Proposed by statistician and evolutionary biologist, Ronald Fischer, One-Way ANOVAs are conducted under the assumption that the law of total variance, where variances in the observed outcomes are explored through different variables, and are consequently divided into sources of variance can be identified for partitions of the observed variance(Fisher, 1918).

The choice behind using One-Way ANOVA for analysis in this study stems from the fact that the method is ideal for both experimental and observational data analyses, as it can balance statistical rigor and validity with its robustness and adaptability into different models, making it implementable in almost any scope of research similar to this study's, with hardly any violations of its core assumptions occurring (Gelman, 2005).

However, upon evaluating the data acquired for this study for parametric one-way ANOVA, testing, the non-normal distribution of the data collected for this study prevented a parametric method from being fit for use (Krosnick, 2018; Dawes, 2008). As such,the more common alternatives to parametric One-Way ANOVA, the Kruskal-Wallis H Test, as well as the non-parametric alternative to the two-sample t-test the Mann-Whitney U-Test, were used to perform the analysis. This is based on the recommendation of Norman (2010), who states the parametric tests make for poor assessment methods of Likert-scale data.

The tests are very similar in nature, and provide comparable results overall, but the Kruskal-Wallis test is used to analyse variables with three or more categorical items, while the Mann-Whitney test was used to analyse variables with two categorical variables.

The Kruskal-Wallis test (Kruskal & Wallis, 1952), also known as one-way One-Way ANOVA on ranks, refers to a non-parametric method used to evaluate whether two different sample populations originate from the same distribution.

This test is often conducted in cases where the assumption of error normality does not fit the sample population included in the study; which is among the criteria required for conducting a typical one-way One-Way ANOVA (Ostertagova et al., 2014). In much the same way as one-way One-Way ANOVA is calculated, the Kruskal-Wallis test is calculated using the ratio of the treatment sum of squares to the residuals of those sums of squares; with the primary difference being that the ranks of the data are used instead of the raw data.

The results of the Kruskal-Wallis test provide an indication as to the degree to which the actual observed mean ranks differ from their expected value. Depending on the degree of variance from the expected values, the researchers can fail to reject the null hypothesis(small difference), or reject it accordingly (large difference) (Israel, 2008).

According to Laerd Statistics (n.d.), to conduct a Kruskal-Wallis Test, several assumptions and criteria must be fulfilled to yield meaningful results:

1. The dependent variable should be measured at the ordinal or continuous levels. Ordinal variables typically include Likert Scale, such as the 10-point questions used in this study. Continuous variables include things like weight (measured in pounds/kilograms) or time spent in the hospital (measured in hours).

2. Independent observations must be made in each group and between groups to ensure that there is a direct relationship between the observations between those groups.

3. The independent variable should constitute two or more categorical groups. However, it is preferable that variables with two groups be analysed using a similar test

(Mann-Whitney U-Test), while the Kruskal-Wallis Test is used for analyses of variables with three or more groups.

4. While there is no restriction as to the normality of distribution of the data, the data themself must be distributed bearing in mind that the results should have the same variability.

When the Kruskal-Wallis test leads to significant results, this serves as an indicator that there is at least one difference between two samples included in the study. However, among the biggest limitations of this test is that it does not offer much detail on where exactly that the differences exist in the relationships, or even how many relationships there are (Ostertagova et al., 2014).

As such, upon conducting Kruskal-Wallis tests to evaluate the relationships as a collective set of variables influencing a single patient need/outcome, post-hoc Mann-Whitney U-Tests were performed to further examine the relationships between each variable, as to determine the primary source(s) of the effect.

4.6 Ethical Considerations

4.6.1 Contextual Considerations

The basic tenets of good research require that the researcher conduct the study up to a high standard of predetermined criteria, based on well-accredited international research standards.This necessitates that various ethical considerations be identified, not as an afterthought, but as an integral part of the research process and design.

Among the most important factors to consider in this regard is the context in which the study is grounded; which is especially relevant for the purposes of this study, given the delicate nature of the study's targeted population of patients. As a result, this study follows the ethical considerations outlined by a recent WHO report (AHPSR & GHEU, 2019). The report is dedicated to outlining the major ethical considerations for studies conducted in healthcare settings, whose ultimate aim is to improve healthcare policy via the use of credible evidence sources—a description tailored to the aim of this study.

All 13 key ethical considerations outlined in the report are shown in Table 24, all of which were taken into account in this study, and are discussed in detail in their respective sections.

Table 24

Ethical Consideration Points in Healthcare-SituatedResearch

Source: Adapted from AHPSR & GHEU (2019)

No.	Consideration	Rationale	Section(s)
1	Human Participants	Ethical considerations for research involving humans are stricter	Section 4.4.2
2	Research Aspects	Examining whether the elements researched are in line with the aim	Section 4.2.1
3	Ethical Approval	Ethical approval is necessary in cases involving human participants	Section 4.6.2
4	Conflict of Interest	Conflicts may jeopardize the validity of a study and place patients at risk	Section 4.6.5
5	Intervention	Study interventions may increase patient risk (though not exclusively)	N/A
6	Data Collection	To consider whether the means used by the researcher are intrusive	Section 4.5.1
7	Participants	To understand whether it is ethical to research this group of participants	Section 4.4.2
8	Consent	To obtain the required consent from all relevant parties	Section 4.5.1
9	Permission	To obtain the required permission from relevant authorities	Section 4.4.1
10	Engagement	Participants must be prepared and informed on all aspects of the study	Section 4.5.1
11	Privacy & Security	Researchers have an ethical obligation to protect patient data	Section 4.6.3
12	Benefits & Risks	Identifying whether the benefits outweigh the risks	Section 4.6.4
13	Justice & Equity	Establishing that no patients receive more risk or benefit than others	Section 4.6.4
14	Follow-Up	Ensuring that designs with interventions can be followed up with upon completion	N/A

4.6.2 Ethical Approval & Review

Since this research study involves human participants, an ethical approval and review processwas required by the University of Portsmouth, as to account for any relevant ethical issues that may occur throughout conducting the study.

Preliminary approval was obtained from the researcher's supervisors prior to the distribution of any questionnaire, or the making of any observation. Later approval was granted by the Ethical Review Board of the University of Portsmouth, included in appendix B.7.

4.6.3 Confidentiality & Data Handling

To ensure the confidentiality and privacy of hospital inpatients, no photographs were allowed to be taken inside the hospital premises; a verbally stipulated condition by hospital administration prior to undertaking the study.

All patient data were transcribed, collected, and stored on a password-protected university PC and will remain on that for a total duration of 30 years, as is required by the University of Portsmouth. The data will only be stored for retrieval purposes in case the data are required for future analysis and will remain undisclosed to any parties aside from the researcher and designated supervisors.

As for physical documents such as the patient and staff questionnaires, these documents will be safely stored within a locked compartment until the time of the final draft's submission; upon the resolution of which the researcher will properly dispose of all physical documents that have been digitally transcribed, to ensure the safeguarding and confidentiality of sensitive and identifying participant data.

4.6.4 Benefits & Risks for Participants

A cost-benefit analysis would quickly reveal the value added by conducting this study, as the study does not use interventional means to conduct experiments on patients. As there are many ethical restrictions preventing the researcher from implementing any experimental interventions,such designs were forfeited to ensure that no risk or harm would come as a result of the study.

On the other hand, the benefits to be gained from the study are potentially substantial in comparison, both in terms of the study's contribution to knowledge in the field of healthcare environmental design, and to future applications and directions in implementing theory in practice (See Section 1.3).

Justice and equality was also ensured for all participating members, including those special member groups for whom individual design components will be analysed; as no additional measurement or analysis was required to conduct such an analysis, aside from the additional 30-seconds required to answer five quick questions pertaining to the analysed design components.

4.6.5 Conflict of Interest

This research was conducted as part of the requirements to be fulfilled in the completion of a doctorate program at the University of Portsmouth. The study is in no way, shape, or form funded by any persons/agencies/institutions with identifiable conflicts of interest. Furthermore, no substantial contributions (technical help, writing/editing, general support) to the work were made by any external parties—such that they could influence the study's findings; aside from the study's declared author. Any other persons who may have contributed in a personal sense to the researcher are declared in the acknowledgement section of this study.

5 Findings& Discussion

Chapter Overview

This chapter presents the findings obtained via the user perception questionnaires distributed to two relevant groups: hospital inpatients and healthcare staff members, which were gauged on the basis of the factors identified in the systematic review. The chapter will also explore the intercorrelations between different design components, and how the demographic, socioeconomic, and work characteristics of respondents influence the perceptions of these groups.The rest of the chapter provides a discussion of the findings, based on the study's findings, and supplemented by the results of the systematic review, and the researcher's on-site observations. Finally, the chapter concludes with a summary of the study's results, in comparison to those of the systematic review.

5.1 Respondent Profiles

The demographic and socioeconomic profile of the study's respondents, obtained from the patient questionnaire (found in Appendix B.3) and the staff evaluation (found in Appendix B.6), are shown inTable 25 and Table 26 respectively.

5.1.1 Patient Profiles

Table 25presents the demographic profiles of the study's final sample of patients. The total sample of patients constitutes 216 participants in total, all of whose responses were deemed valid by the researcher and are accordingly included in the final discussion of the results.

Table 25

Respondent Demographic & Socioeconomic Profile, Patient Sample

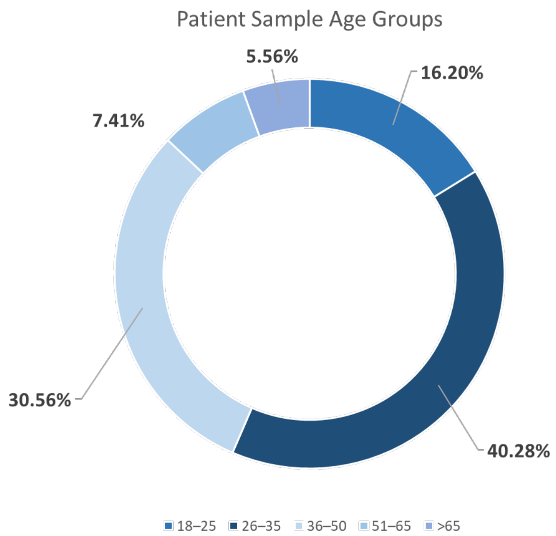
			Patients		
Ref	**Variable**	**Scale/Category**	N=216	**N**	**%**
P1.1	**Gender**	Male		99	**45.83%**
		Female		117	**54.17%**
P1.2	**Age**	18–25		35	**16.20%**
		26–35		87	**40.28%**
		36–50		66	**30.56%**
		51–65		16	**7.41%**
		>65		12	**5.56%**
P1.3	**Education**	High School		23	**10.65%**
		Technical		10	**4.63%**
		Graduate		175	**81.02%**
		Post-Graduate		34	**15.74%**
P1.4	**Employment**	Full-Time		109	**50.46%**
		Part-Time		87	**40.28%**
		Unemployed		24	**11.11%**

			Patients		
Ref	**Variable**	**Scale/Category**	N=216	**N**	**%**
		Retired		21	**9.72%**
P1.5	**General Health** (Pre-Admission)	Excellent		65	**30.09%**
		Great		58	**26.85%**
		Good		63	**29.17%**
		Fair		18	**8.33%**
		Poor		12	**5.56%**
P1.6	**Stay**	First Stay		162	**75.00%**
		Consecutive Stay		54	**25.00%**
P1.7	**Disability**	None		191	**88.43%**
		Visual Impairment		5	**2.31%**
		Acoustic Impairment		9	**4.17%**
		Physical Disability		11	**5.09%**
P1.8	**Days Admitted**	0-6		100	**46.30%**
		7-13		42	**19.44%**
		14-20		35	**16.20%**
		21-30		23	**10.65%**
		>30		16	**7.41%**
P1.9	**Daily Visitors**	0-2		31	**14.35%**
		2-5		74	**34.26%**
		5-10		69	**31.94%**
		>10		22	**19.44%**
P1.10	**Risk Factors** (Post-Admission)	Procedural		19	**8.80%**
		Prescription		31	**14.35%**
		Infection		49	**22.69%**
		Falls & Injury		64	**29.63%**

Among a total of 216 surveyed hospital in-patients, 45.83% (n=99/216) were male, and 54.17% (n=117/216) were female. This is representative of sex ratios in any setting, as males are commonly found to be slightly higher than females, with a ratio of approximately 1:1 (+ or –10%) (Grech, 2002; Pongou, 2013).

The respondents' age groups were also representative of a bell-shaped curve, as the majority of participants fall in the middle of the distribution, with 40.28% (n=87/216) and 30.56% (n=66/216) for age groups 26–35, and 36-45, respectively(see figure 28).

Figure 28
Age Groups of Patient Population



Mostof the study's population were educated individuals holding graduate (81.02%, n=175/216) or post-graduate degrees (15.74%, n=34/216). These figures are also comparable to the participants' employment status, wherein 90.74% (n=196/216) were either employed full-time or part-time, with the remainder either unemployed or retired.

Overall, the population's self-assessment of general health, prior to their admission, was somewhat positive, with 30.09 (n=65/216), 26.85% (n=58/216), and 29.17% (n=63/216), rating their overall health as excellent, great, or good. The remaining participants either ranked their health as fair (8.33%, n=18/216) or poor (5.56%, n=12/216).

As for the patients' stays, 75% (n=162/216) of patients reported this being their first stay at the hospital in which they were residing, while the remaining 25% (n=54/216) stated that they have stayed at the hospital at least once before, which would naturally be the product of patients having had a satisfactory stay in the past (Cho et al., 2004; Jackson et al., 2001); or may just be a function of another unidentified factor.

With regard to the portion of the patient sample with disabilities, they comprised a total of 11.56% (n=25/216). According to a report published by the WHO (WHO, 2011), people with disabilities are at much higher risks leading to their hospitalization, including:

- Greater risk of developing co-morbid conditions
- Greater risk of developing secondary health conditions
- Increased rates of health risk behaviours
- Greater vulnerability to age-related conditions
- Greater risk of being exposed to violence

This is the reason the figure was perceived as somewhat low to begin with by the researcher. However, this observation may simply be the result of the fact that hospitals demanded that they assign a random pool of patients upon exclusion a segment of the population, which may have comprised individuals with major disability; reducing the number of disabled patients in the accessible population by the researcher.

Furthermore, the issue of disabled patients not receiving care is further emphasized by figures cited from a 2002-2004 WHO World Health Survey, which emphasizes the presence of unmet needs for disabled people across the spectrum of healthcare services (WHO, 2004).However, the low number of disabled people can be justified given the nature of the study's sample; considering the fact that the hospital designated a random sample from a subset of the population that excludes sensitive/special groups.

Approximately half (46.30%, n=100/216) of the patients had been admitted for fewer than a week, a fifth (19.44%, n=42/216) had been admitted fewer than 2 weeks, a sixth (16.20%, n=35/216) fewer than 3 weeks, a tenth (10.65%, n=23/216)fewer than a month, and the remaining 7.41% had been admitted to the hospital more than one month ago.

5.1.2 Staff Profiles

Table 26presents the demographic profiles of the study's final sample of staff members. The total sample of healthcare staff constitutes 102 participants in total, all of whose responses were deemed valid by the researcher and are accordingly included in the final discussion of the results.

Table 26

Respondent Demographic & Socioeconomic Profile, Staff Sample

			Staff		
Ref	**Variable**	**Scale/Category**	N=102	**N**	**%**
SQ1.1	**Gender**	Male		44	**43.14%**
		Female		58	**56.86%**
SQ1.2	**Age**	18–25		7	**6.86%**
		26–35		29	**28.43%**
		36–50		53	**51.96%**
		51–65		10	**9.80%**
		>65		3	**2.94%**
SQ1.3	**Education**	Technical		3	**2.94%**
		Graduate		86	**84.31%**
		Post-Graduate		13	**12.75%**
SQ1.4	**Employment**	Full-Time		74	**72.55%**
		Part-Time		28	**27.45%**
SQ1.5	**Work Hours** (Hrs /Wk)	<20		8	**7.84%**
		20-39		46	**45.10%**
		40-59		44	**43.14%**
		>60		4	**3.92%**
SQ1.6	**Experience**	<1		9	**8.82%**
		1–5		13	**12.75%**
		5–10		44	**43.14%**
		>10		36	**35.29%**
SQ1.7	**Clinical Role**	Physician		26	**25.49%**
		Nurse		37	**36.27%**
		Technician		17	**16.67%**
		Therapist		5	**4.90%**
		Assistant		14	**13.73%**

			Staff		
Ref	Variable	Scale/Category	N=102	N	%
		Other		3	2.94%
SQ1.8	Clinical Shift	Morning		59	57.84%
		Night		26	25.49%
		Both		17	16.67%
SQ1.9	Department	Accidents		4	3.92%
		Burns		2	1.96%
		Cardiology		5	4.90%
		Critical Care		18	17.65%
		Emergency		16	15.69%
		General		32	31.37%
		Infections		7	6.86%
		Maternity		3	2.94%
		Neurology		1	0.98%
		Orthopedics		6	5.88%
		Pediatrics		6	5.88%
		Respirology		2	1.96%
SQ1.10	Knowledge	Excellent		8	7.84%
		Great		12	11.76%
		Good		34	33.33%
		Fair		41	40.20%
		Poor		7	6.86%

5.1.2.1 Concluding Remarks

The respondent profiles presented in the above sections are obtained to evaluate whether any links to design components in healthcare environments can be attributed to specific demographic characteristics, or whether these factors can be used to explain a relationship that does not match up with previous literary findings. As such, the data presented in the above tables will be re-examined later in the discussion section below.

5.1.3 Patient Questionnaire Responses

Prior to exploring the validity and reliability of the constructs predefined for the purposes of this study, the design interventions are analysed to interpret along with the primary findings of the study. One way to gain insights on patient satisfaction with the degree of care provided to them is to examine the mean responses for each of the items included in the questionnaire and interpret that item. Results of analysed means are shown in Table 27, Table 28,Table 29 andTable 30which show the mean patients' responses for the Spatial Design section of the patient questionnaire (See Appendix B.5).The tables show the patients' responses on a scale from 1 (strongly disagree) to 10 (strongly agree).

Commented [A38]: [90] Added scale measure

Table 27
Sample Patient Questionnaire Reponses, Spatial Design, Descriptive Statistics

		Response(n)											
Ref	**Scale/Category**	1	2	3	4	5	6	7	8	9	10	**Mean**	**SD**
PQ2.01	Room, Spacious	1	8	2	16	32	10	34	49	20	44	7.21	0.522
PQ2.02	Room, High Ceiling	2	2	12	6	59	31	20	57	16	11	6.47	0.762
PQ2.03	Seating, Tabular	21	3	10	2	72	39	21	3	11	34	5.88	4.734
PQ2.04	Seating, Spacious	15	22	19	2	29	3	39	3	37	47	6.42	0.876
PQ2.05	Bathroom, Proximity	7	5	4	15	19	5	32	3	37	89	7.80	0.544
PQ2.06	Bed, Spacious	10	15	4	4	3	2	12	25	64	77	7.99	1.650
PQ2.07	Wayfinding, General	3	19	43	33	58	29	10	20	1	0	4.65	0.872
PQ2.08	Wayfinding, Signage	31	58	32	19	27	23	6	12	4	4	3.73	0.745
PQ2.09	Room Pathway Cluttered	7	12	11	26	8	51	30	29	8	34	6.33	0.340
PQ2.10	Stairs/Elevators, Accessible	16	24	9	9	4	34	8	52	31	29	6.44	0.382
PQ2.11	Nursing Station, Proximity	0	2	1	30	7	8	48	83	12	25	7.25	0.571

Table 28
Sample Patient Questionnaire Reponses, Ambient Design, Descriptive Statistics

		Response(n)											
Ref	**Scale/Category**	1	2	3	4	5	6	7	8	9	10	**Mean**	**SD**

		Response(n)											
Ref	Scale/Category	1	2	3	4	5	6	7	8	9	10	Mean	SD
PQ3.01	Flooring, Carpeted Materials, Non-Institutional	4	7	22	31	35	35	26	26	21	9	5.84	2.19
PQ3.02	Flooring, Carpeted Materials, Less Slippery	1	4	8	13	39	35	62	39	11	4	6.37	1.68
PQ3.03	Daylight, Sufficient Exposure	12	2	3	4	8	30	26	42	58	31	7.84	1.58
PQ3.04	Natural Elements, Outdoor Garden Access	10	10	3	6	18	41	50	46	25	7	7.07	1.38
PQ3.05	Natural Elements, View from Window	1	3	4	1	32	34	40	51	30	20	7.02	1.37
PQ3.06	Indoor Lighting, Quality/Ambience	10	19	32	1	21	23	39	0	0	71	6.58	2.91
PQ3.07	Indoor Lighting, Illuminance/Intensity	4	7	22	31	35	35	26	26	21	9	5.84	0.89
PQ3.08	Artwork, Landscape/Natural Elements	7	4	11	14	29	35	62	39	11	4	6.38	1.64
PQ3.09	Indoor Noise, Ward & Neighboring Rooms	13	40	28	50	40	12	24	6	3	0	2.87	1.90
PQ3.10	Indoor Noise, Room Equipment	19	7	3	6	21	32	50	56	11	11	7.07	1.38
PQ3.11	Outdoor Noise, External Sources	6	11	2	12	30	36	40	51	13	14	7.02	1.04

Table 29

Sample Patient Questionnaire Reponses, Functional Design, Descriptive Statistics

		Response(n)											
Ref	Scale/Category	1	2	3	4	5	6	7	8	9	10	Mean	SD
PQ4.01	Room, Disability Suited	12	2	13	18	68	39	30	15	9	10	4.41	2.33
PQ4.02	Room, Acuity-Adaptable	2	0	2	12	37	69	52	27	6	9	4.78	2.36
PQ4.03	Storage, Sufficient Space	9	1	3	2	12	35	63	53	30	8	5.19	2.49
PQ4.04	Control, Door Open/Closed	0	12	1	4	36	71	56	25	8	3	5.49	0.51
PQ4.05	Control, Window Shades	12	14	2	12	37	101	28	4	4	2	5.11	1.82
PQ4.06	Control, Indoor Lighting	4	2	1	2	10	37	122	30	8	0	5.19	1.90

		Response(n)											
Ref	**Scale/Category**	1	2	3	4	5	6	7	8	9	10	**Mean**	**SD**
PQ4.07	Control, Temperature	2	1	3	5	13	36	67	52	29	8	5.44	2.04
PQ4.08	Control, Entertainment/Recreation	5	0	3	10	37	69	47	27	9	9	5.87	1.16
PQ4.09	Utility, Communication	1	1	3	3	11	36	69	48	34	10	5.00	2.01
PQ4.10	Utility, Sinks & Hygiene	0	0	2	12	37	71	52	27	6	9	4.98	0.70
PQ4.11	Utility, Facility Ease-of-Use	2	1	2	3	12	39	67	53	29	8	5.01	0.90

Table 30

Sample Patient Questionnaire Reponses, Design Purpose, Descriptive Statistics

		Response(n)											
Ref	**Scale/Category**	1	2	3	4	5	6	7	8	9	10	**Mean**	**SD**
PQ5.01	Sleep Quality & Quantity	2	21	23	12	35	25	56	9	11	22	5.21	1.22
PQ5.02	General Health Improvement	1	12	20	29	19	7	25	11	63	29	4.85	0.95
PQ5.03	Symptom Improvement	6	23	24	15	10	15	35	14	31	43	6.28	1.33
PQ5.04	Sense of Privacy/Security	5	32	25	9	10	18	23	19	41	34	6.21	0.94
PQ5.05	Accessibility/Motility, Around Room	12	21	8	12	23	18	21	36	32	33	5.52	1.72
PQ5.06	Accessibility/Motility, Around Ward	17	10	5	28	54	21	4	1	29	47	5.25	1.64
PQ5.07	Accessibility/Motility, Wayfinding	8	8	22	16	21	25	36	41	27	12	8.74	2.73
PQ5.08	Falls & Fall-Related Injury	12	32	13	25	28	19	21	12	39	13	4.59	1.44
PQ5.09	Communication, Social	15	18	31	18	31	23	22	13	21	24	4.81	1.50
PQ5.10	Communication, Staff	31	21	21	34	10	31	15	14	18	21	4.54	1.42
PQ5.11	Social Visits & Interaction	21	19	4	24	29	17	18	28	44	12	7.35	2.30

Examining the mean responses (descriptive statistics) obtained directly from the patient questionnaire (Table 27, Table 28, Table 29 and Table 30), not much can be inferred regarding the impact of each of the factors on patients' needs. Instead, these figures simply provide a mean estimate of the satisfaction of the patient population with each design component overall.

However, by cross-examining each of these items against the mean responses for the mediating functions evaluated by the patient questionnaire (See Section 5, Appendix B.5), Kruskal Wallis tests could be used to gain more insight on the extent to which each of these design components contributes to the attainment of each need, as facilitated by the mediating functions.

For instance, in conducting the individual Kruskal Wallis test for the Impacts of Indoor Lighting (PQ4.06, shown in Table 29) on Patients' Sleep Quality and Quantity (PQ5.01, shown in Table 30), the Kruskal Wallis test would be conducted by aligning the patients' responses for both Questions (PQ4.06; PQ5.01), inputting the data on SPSS, and setting the criteria for the Kruskal Wallis test from the Non-Parametric set of statistical tests. The values outputted by SPSS would return the Chi-Square value, degrees of freedom, along with the asymptotic P-Value indicating the significance (confidence that the findings are non-random) of the obtained value. P-values that are below 0.05 are interpreted as significant, while P-values below 0.01 are interpreted as highly statistically significant.

5.2 Principal Component Analysis

Bartlett's sphericity test was conducted to assess whether the correlation matrix yielded as an output of the factor analysis in SPSS (shown in Table 51) of this study is suited for a factor analysis. The results of the test for the patient questionnaires showed a statistically significant correlation between the items ($p<0.001$), which implies that the dataset is well suited for a factor analysis.

As a result, an exploratory factor analysis using PCA, and orthogonal varimax factor rotation for all of the 34 combined item groups originally obtained through SPSS in the Total Variance Explained Table (Table 32)[24] for the patient questionnaire was used to calculate the factor loadings for each component (dimension) of design (Table 31).Both tables were obtained as outputs from the PCA test run in SPSS.

As can be seen in the table, none of the items exceeded the recommended factor loading of 0.40, which is a positive indication as to the construct validity of the identified design components and dimensions. Furthermore, the Cronbach Alpha Coefficient for the

[24] However, in accordance with the recommendations of the academic consulting statistician supervising the thesis (faculty of the University of Portsmouth), the table presenting the original 30 item group were redundant, as none of the findings past the 5th item group had any additional value from their inclusion in the table, As such, they were excluded from Table 32.

questionnaire was evaluated to be 0.894, well above the recommended 0.70 indicating internal consistency between the items (Taber, 2017). The individual coefficients for each dimension were also similarly reliable at 0.902, 0.761, and 0.855, for the spatial, ambient, and functional dimensions, respectively.Table 31 demonstrates the final factor loadings for each design dimension, which were rotated using varimax rotation. This analytical measure can be conducted in two ways, both of which are equally valid, and provide some useful insights as to the grouping and validity of the defined constructs.

Table 31

Rotated Component Matrix, Patient Questionnaire Items, Factor Loadings

Principal Component Analysis, Varimax Rotation, Converged within 6 Iterations

	Component		
Item	**Spatial (1)**	**Functional (2)**	**Ambient (3)**
Spaciousness, Seating Area	0.96		
Spaciousness, Room Dimensions	0.96		
Spaciousness, Ceiling Height	0.96		
Layout, Tabular Seating Area	0.94		
Wayfinding, Stairs/Elevators	0.94		
Orientation, Bed towards Door	0.93		
Proximity, Nursing Station to Bed	0.88		
Proximity, Bathroom to Bed	0.86		
Wayfinding, Signage	0.66		
Layout, Pathway Cluttering	0.61		
Spaciousness, Bed Dimensions	0.58		
Wayfinding, General Accessibility	0.51		
Visual, Indoor Lighting, Ambience			0.94
Aesthetic, Fabric Quality			0.94
Nature, Access to Garden			0.89
Acoustic, Indoor Noise, Equipment			0.89
Indoor, Ventilation/Heating			0.87
Nature, View from Windows			0.78
Acoustic, Outdoor Noise, Premises			0.78
Indoor, Room Cleanliness/Hygiene			0.73
Aesthetic, Carpeted Flooring, Homelike Feel			0.69
Visual, Indoor Lighting, Illuminance			0.69
Aesthetic, Carpeted Flooring, Non-Slippery			0.63
Nature, Appropriate Landscape Artwork			0.63
Visual, Daylight, Exposure			0.54
Aesthetic, Wall Colours			0.50
Acoustic, Indoor Noise, Ward			0.88
Facilities, Sufficient Storage Space		0.96	

	Component		
Item	Spatial (1)	Functional (2)	Ambient (3)
Accessibility, Acuity-Adaptable Room		0.95	
Facilities, Visible Sink		0.95	
Control, Open/Closed Door		0.94	
Control, Window Shades		0.93	
Control, Lighting Dimmers		0.93	
Control, Entertainment/Television		0.84	
Facilities, Communication Tools		0.82	
Control, Temperature/Thermostat		0.81	
Facilities, General Ease-of-Use		0.77	
Accessibility, Disability-Accessible Room		0.75	

Extraction Method: Principal Component Analysis, **Rotation Method:** Varimax, with Kaiser Normalization

Empty fields contain numerical figures falling beneath the selected threshold of 0,5

Table 32 shows the percentages to which each of the proposed design dimensions accounts for the variance in the results, which demonstrates the extent to which the predefined measures used to evaluate the outcomes actually influence the outcome as a result of their direct impact. For instance, the spatial dimension accounts for a total of 24.479% of the variance in the results.

Combining the results for all three dimensions, the factor loads for all of the three identified components accounted for 69.910% of the total variance in the results, after varimax rotation. The variance did not appear to be skewed to any of the design dimensions, as the Spatial dimension (Component 1) accounted for 24.479% of the variance, the Ambient dimension (Component 2) accounted for 23.699% of the variance, and the Functional dimension (Component 3) accounted for 21.733% of the variance.

This indicates that approximately 70% of the perceived changes in patients could be presumed to have resulted from factors pertaining to the above-outlined design dimensions (Spatial, Ambient, Functional), while the rest can be accounted for by variables that do not fit within the scope of these constructs. What this indicates is that the components included in the questionnaire are responsible for a total of approximately 70% of the changes in patient need functions, provided the assumption that no confounding factors influence these functions (a limitation of the study, as no research can successfully account for all confounding factors influencing a patient's need, such as sleep, which can be influenced by a wide scope of factors beyond the design of an environment).

Table 32

Principal Component Analysis, Total Variance Explained by Components

	Initial Eigenvalues			Extraction Sum of Square Loadings			Rotation Sum of Square Loadings		
Component	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
Spatial (1)	11.877	31.255	31.255	11.877	31.255	31.255	9.302	24.479	24.479
Ambient (2)	8.818	23.205	54.460	8.818	23.205	54.460	9.006	23.699	48.177
Functional (3)	6.499	17.102	71.562	6.499	17.102	71.562	8.258	21.733	69.910
(4)	1.206	3.175	74.737	1.206	3.175	74.737	1.771	4.660	74.571
(5)	1.059	2.787	77.524	1.059	2.787	77.524	1.122	2.953	77.524

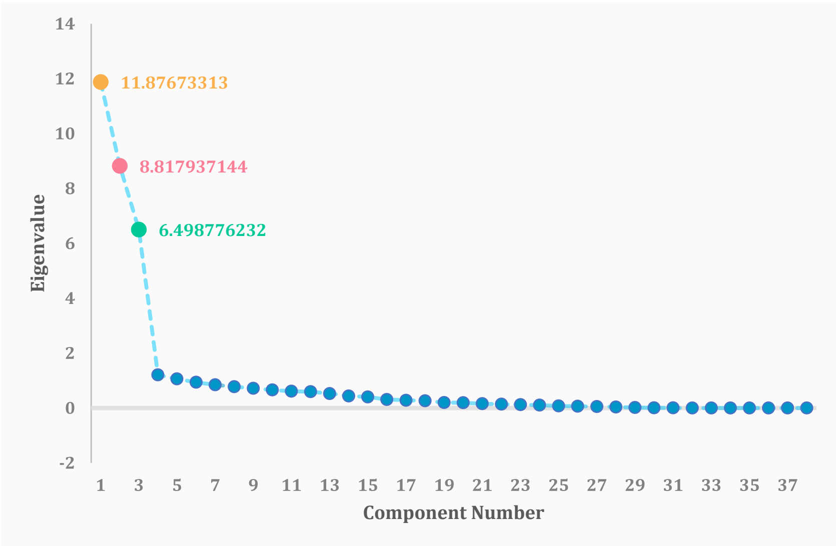
List is restricted to the top five components, as the remaining 29 components are irrelevant as they each account for less than 1% of total variance

Figure 29 shows a scree-plot developed from the results of the principal component analysis results discussed above. The scree plot provides a visual interpretation of the largest components identified in the study (namely, the Spatial, Ambient and Functional components; as described by the researcher).

Figure 29

Principal Component Analysis, Scree Plot, Colour-Coded by Dimension

Yellow: Spatial Design Dimension, Green: Ambient Design Dimension, Red: Functional Design Dimension



Extraction Method: Principal Component Analysis

5.3 User Perceptions of Environmental Design

5.3.1 Patient Perceptions of Environmental Design

Non-parametric ANOVA tests were conducting cross examining each design component against each function, the partial dataset for which is provided in Appendix C.3, in Table 54, Table 55, and Table 56. A summary of the results presented in those tables is provided in Table 33.

Results shown in the summary are portrayed as either statistically significant ($p < 0.05$), shown using a single asterisk (*) or highly statistically significant ($p < 0.01$), shown using a double asterisk (**).The results provide a summary of the individual Kruskal Wallis and Mann-Whitney tests conducted for each design consideration with its hypothesized design function, determined based on the findings of the systematic review.

Commented [A39]: [92] Elaborated more on how table was created

Blocks in red are indicative of a high likelihood and risk of bias are appeared to exist between research, and empty blocks are either blocks where no relationship was observed, or ones were that relationship was only marginally significant.

Table 33

Summary of the Findings of Non-Parametric Design Component Tests

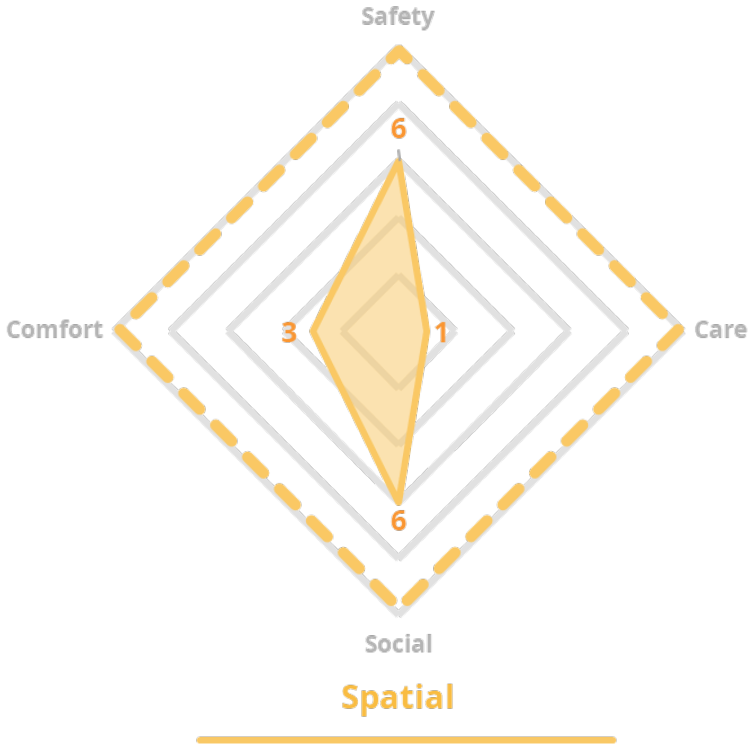
Component/Feature	Larger Room	Larger Bed	Larger Seating Area	Bed to Door	Nursing Station to Bed	Bed to Bathroom	Nursing Station to Bed	Ward Layout	Signage Availability	Stairs/Elevators Location	Room Standardization	Tabular Seating Area	Cluttered Pathway	Carpeted Flooring	Cool/Blue Wall Colour	Fabric Quality/Materials	Daylight Exposure	Indoor Lighting Ambience	Access to Garden	View from Window	Appropriate Artwork	Ventilation/Heating	Cleanliness/Hygiene	Indoor Noise Quality	Outdoor Noise Quality	Disability-Accessible Room	Acuity-Adaptable Room	Sufficient Storage Facilities	Communication Tools	Entertainment Tools	Sink Visibility	Facility Ease-of-Use	Door Openness	Window Shades	Light Dimmers	Temperature
#	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Spaciousness			Orientation		Proximity		Wayfinding			Layout			Aesthetic			Visual		Nature			Indoor		Acoustic		Accessibility		Facilities					Control			
Design Function																																				
Sleep Quality/Quantity																	**	*						**	*					*						
Health Status/Symptoms																	**		*	**	*	*														
Sense of Privacy/Security				*	**		**																					**					*			
Wayfinding/Accessibility								**	**	*	*		**													*	**									
Falls/Fall-Related Injury					**	**	**	*		*	*			*				*																		
Social Communication	**		**									**																	*							
Staff Communication	**		**									**																	*							
Medical Errors																	**	**						**	*		*									
Stress/Anxiety Levels	*													**	*		**		**	**	**			**	**					**	*					*
Sense of Choice/Control	**																															*	*	**	**	**
Pain/Physical Discomfort		**															**	**	*	*	**	**		**		*										**

Component/Feature	Larger Room	Larger Bed	Larger Seating Area	Bed to Door	Nursing Station to Bed	Bed to Bathroom	Nursing Station to Bed	Ward Layout	Signage Availability	Stairs/Elevators Location	Room Standardization	Tabular Seating Area	Cluttered Pathway	Carpeted Flooring	Cool/Blue Wall Colour	Fabric Quality/Materials	Daylight Exposure	Indoor Lighting Ambience	Access to Garden	View from Window	Appropriate Artwork	Ventilation/Heating	Cleanliness/Hygiene	Indoor Noise Quality	Outdoor Noise Quality	Disability-Accessible Room	Acuity-Adaptable Room	Sufficient Storage Facilities	Communication Tools	Entertainment Tools	Sink Visibility	Facility Ease-of-Use	Door Openness	Window Shades	Light Dimmers	Temperature
#	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Spaciousness			Orientation		Proximity		Wayfinding			Layout			Aesthetic			Visual		Nature			Indoor		Acoustic		Accessibility		Facilities					Control			
Contamination/Infection														**		*						**	**													

The radar charts, presented in the following, show the overall impacts linking each design dimension to each of the four patient needs. It is important to note that this figure does not necessarily signify the strength of the links/relationships examined, it simply shows how many links were found between each dimension and need.

Figure 30

Number of Relationships between Spatial Design & Patient Needs, Radar Chart



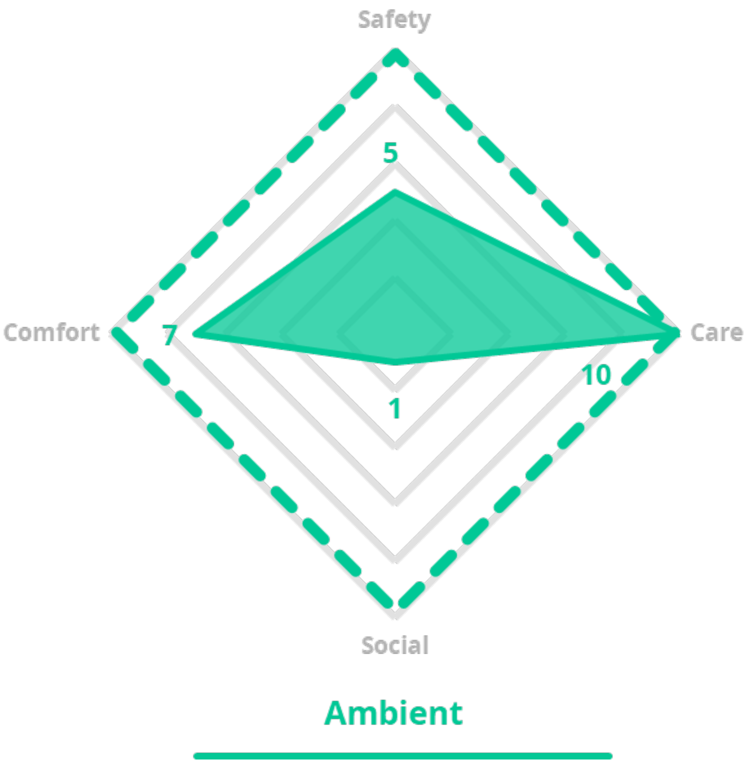
Thespatial design dimension, shown in Figure 30,has a strong overall impact on the social and safety needs of patients (6 links), comfort needs next (3 links), and little relative impact on the care needs of patients (1 link).

The strong correlation between spatial design and the safety of patients can be explained via the mediating function of reduced falls, as falls were identified in the systematic review to be most frequently associated with the physical design and layout of the space (Calkins et al., 2012; Ulrich et al., 2004; 2008).

The strong correlation between spatial design and the social needs of patients can be explained by the fact that the two most commonly mentioned components with regard to the presence of family members and other visitors is the size and arrangement of the room area. Patients whose visitors feel welcomed to stay at the hospital are more likely to stay as a result.

Figure 31

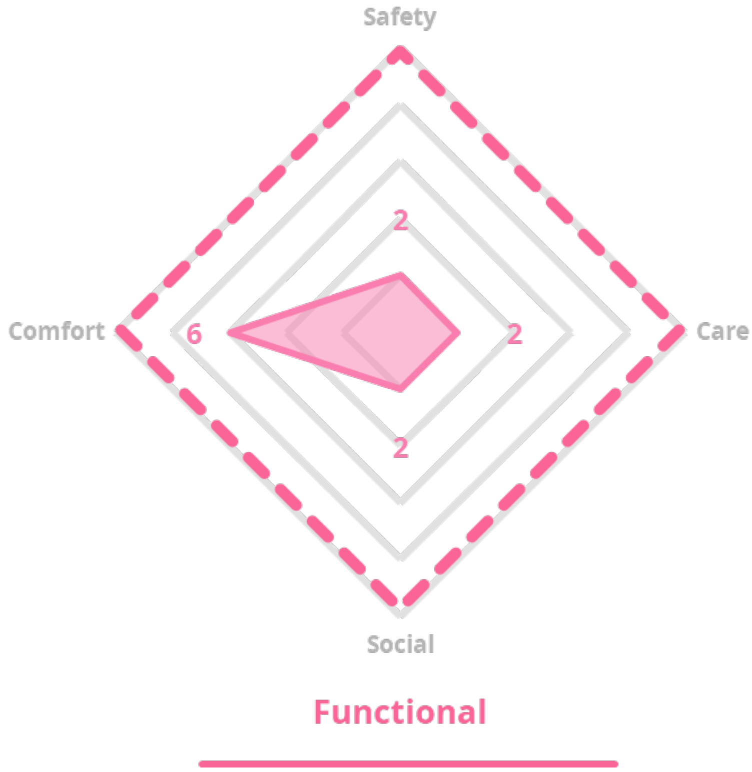
Number of Relationships between Ambient Design & Patient Needs, Radar Chart



For the ambient design dimension, the need most affected by this dimension are patient care needs, indicative of the impact of sensory perception on alleviating pain and reducing stress and anxiety. Furthermore, pain and physical discomfort is consistently identified in the literature to be linked to sensory experience, including links between reduced pain through increase exposure to daylight (Hadi et al., 2012; Huisman et al., 2012; Ulrich et al., 2008; Walch et al., 2005), reduced noise levels (Allaouiche et al., 2002; Bayo et al., 1995), and natural views (Ulrich, 1974; Huisman et al., 2002).

Figure 32

Number of Relationships between Functional Design & Patient Needs, Radar Chart



Finally, functional design has the fewest relationships with patient needs. A comparable number of factors were examined for each of the design dimensions in order to reduce the likelihood of results such as the one shown in Figure 32 being indicative of bias.

The most strongly influenced need as a result of functional design elements is that of patients' comfort needs, as mostly mediated via providing the patients with sufficient control and choice over design components in the environment (Calkins et al., 2012; Huisman et al., 2012;Ulrich, 1991). The rest of the relationships identified correlating to the functional design dimension can be distributed evenly across the three other needs.

Furthermore, staff were asked to generally report on the extent to which the staff believed their functions influence the needs of patients, in the same form of a 10-point Likert-based scale.

The results for both patients and staff members are shown inTable 34 and Table 36. Similarly, staff's responses to the above questions, the perceptions of staff participants, shown in Table 36 were positive overall, as approximately 83.3% and 94.1% of the population provided the same feedback regarding the first and second questions in this set.

Table 34

Patient Perceptions of Environmental Design Impacts, Section 5, Set 2

		Yes		No		Uncertain	
Ref	Statement	**n**	**%**	**n**	**%**	**n**	**%**
PQ5.16	**Implementation Makes Healing Space**	**169**	**78.2 %**	22	10.1 %	**25**	**11.5%**
PQ5.17	**Implementation Better Address Needs**	**185**	**85.6 %**	17	7.8%	**14**	**6.6%**

As is indicated by the results shown in the table above, the vast majority of patients believed that the implementation of the aforementioned design interventions will facilitate the creation of a more suitable healing space (78.2%, n=169/216), and will be better able to address the needs of patients (85.6%, n=185/216).

Following the analysis of means and other descriptive statistics analysed based on patient responses, the non-parametric ANOVA analysis results were used to yield the final relational results between each design component, their mediating function, and by extension, the needs of the users. These two tests included the Kruskal-Wallis Test, as well as the Mann-Whitney Test, based on the criteria outlined in Section 4.5.3.3.

A summary of the non-parametric component tests are shown in Table 33, which demonstrate whether the researcher identified any relationship between the examined design components and each of the mediating factors linking them to patient needs.

Appendix C.3 presents three additional matrices depicting the final results (p-values) for each of the design components in relation to patient needs, which were plotted manually from the individual Kruskal-Wallis test results obtained from SPSS.

Either a single asterisk, a double asterisk, or nothing is used to signify the quality of the relationship at hand, helping determine the likelihood of correlation between two design components/features, and potentially, whether a causal link to needs and outcomes.

5.3.1.1 Researcher's Observations

An observation made by the researcher was thatthe nature of the staff members' work activities (given the departments in which they are assigned) (PQ1.07) had some implication on which aspects of the built environment they were most likely to emphasize. For instance, those working in Intensive Care Units (ICU) were much more likely to overestimate the impact of the built environment on patient care, and tended to focus on the mediating function of pain in particular. Similarly, staff members working in departments that relate directly to specific functions were much more likely to focus on aspects pertinent to their work (staff in infections department discussed design components likely to have the most impact on infection and contamination)[25].

A similar effect was also observed with regard to the patients, where design features that were viewed as subtle by their recipient group were much more overemphasized by non-recipients. For instance, using data collected and recorded in the observation sheet, it was also found that patients located in rooms with no windows or little daylight were much more likely to focus on those aspects, and a similar effect was also observed in patients located in more noisy wards.

The availability of a dedicated room for family or staff members was also found to a have a statistically significant impact on the number of daily visitors that hospital inpatients received.

Design was also found to contribute to a great extent to factors relating to patients' cultural and spiritual preferences, and qualitative remarks were recorded regarding relatively minor visual cues; but mostly about the spatial aspects of a room's design, such as whether patients had sufficient room to pray without having to relocate to a far-off location on five separate occasions per day[26].

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This observation, along with other observations in Section 5.3.1.1, are not supported by quantifiable findings. Instead, they simply refer to observations recorded by the researcher in the observation sheet (Section 4.5.1.3), and are thus unverifiable using the primary results of this study, and may be subject to researcher bias.

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Five obligatory prayer times are expected of Muslims to perform on different time periods throughout the day, which made it particularly inconvenient for patients to relocate to far away places for each and every prayer. This may also have some impacts on patient safety, given that an additional five trips to a far-off location may significantly increase the likelihood of patient falls and related injuries. However, this effect could not be explored in the study, as there was not a sufficient enough sample, notwithstanding the fact that these results were collected using qualitative feedback measures, rather than quantitative ones.

5.3.1.2 Impacts of Room Spaciousness[27]

Room Spaciousness (PQ2.01, PQ2.02) was found to have some influence on patients' comfort needs; although the impact was not significant. No difference in impact could be observed between the two variants of capacity explored in the study [Var 1: General Vertical/Horizontal Capacity (PQ2.01), and Var 2: Ceiling Height (PQ2.02)].

However, there were some differences between the two variants of capacity in terms of their impact on contamination and infections in the facilities[28]. This finding was not originally discovered in the systematic review, although specific searches conducted upon the conclusion of this work indicate that a few literary sources (e.g. Andersen, 2016; Eames et al., 2009; Fox, 1969) point towards a relationship between higher ceilings and reduced contamination, citing reasons such as displacement ventilation and an increased overall volume as the rationales behind this effect.

Furthermore, the overall capacity of the room (PQ2.01) was found to strongly influence the social needs of hospital inpatients (Table 54,m=7.21, p=0.04), as it allowed for an increased number of family members to occupy the room at once; increasing the likelihood of more visits. Furthermore, staff members were also more likely to be more comfortable staying within the proximity of patients, which made communication with staff members take place more frequently. This relationship was also confirmed by correlating it with the number of visitors that patients received daily (PQ1.09).

5.3.1.3 Arrangement of Seating Area

In accordance with the findings of Holahan (1972) and Huisman et al. (2012), the arrangement of seating patterns around a table (in contrast to shoulder-to-shoulder layout) (PQ2.03) was found to significantly impact social communication and interaction with visitors (Table 54, m=5.88, p=0.002). Holahan (1972) emphasized the role of comfortable seating on the extent to which visitors tended to establish contact, also linking seating arrangement to their duration of stay.

[27] This subsection (5.3.1.3), along with the following ones in this section, presents the results of each design component in terms of the mean response to the questionnaire item, and the p-value of the relationship between that component and the discussed design function. As such, the means are not directly responsible for explaining the impact of each component on the relationship with each specific variable, but rather, they are indicative of the overall extent of the impact on patient needs, and are shown for reference only.

[28] While the difference in impact between the two was significant, the results for each on their own are non-significant considering the p-value parameters for this study, at (p=0.06 and p=0.13).

5.3.1.4 Impacts of Bed Spaciousness

Bed spaciousness (PQ2.06) was among the most influential aspects to determine the quality and quantity of sleep that patients received (Table 54, m=7.99, p=0.002). Furthermore, the size of the bed (PQ2.06) was also associated with the care needs of patients, as not being able to comfortably turn on the bed places much tension on patients who stay in a critical condition for longer durations (Table 54, m=7.99, p=0.04).

Some of the findings also suggested that patients with larger beds were able to better communicate with family, friends, and staff (Table 54, m=7.99, p=0.002). However, this finding may be caused by a bias where larger beds would have to be situated within larger rooms, as one of the significant impacts of larger rooms is better communication (Section 5.3.1.1).

5.3.1.5 Bathroom Proximity to Beds

As the study's sample was exclusively composed of participants in SORs, the majority of the patient bathrooms were private to the patients and located in close proximity to their beds.Bathrooms in close proximity to patient beds (PQ2.05) were found to result in fewer falls (Table 54, m=7.8, p=0.005).

5.3.1.6 Wayfinding & Accessibility

Patients who reported that they were easily able to find their way around the hospital (e.g. to the cafeteria, pharmacy) (PQ2.07) reported similarly high rankings of the accessibility and motility (PQ5.05, PQ5.06, PQ5.07) (Table 54, m=4.65, p=0.001).These patients were also much less likely to suffer from falls and fall-related injuries. (Table 54, m=4.65, p=0.003) Stairs and elevator locations/proximity were evaluated (PQ2.10), with similarly significant results—though to a smaller extent (Table 54, m=4.65, p=0.02).

5.3.1.7 Cluttering

Cluttering and furniture spacing (PQ2.09) was found to strongly contribute to patient safety via enhancing patients' accessibility and motility (Table 54, m=6.33, p=0.04). Contrary to what was presumed, given the findings of Ulrich et al. (2008) and Calkins et al. (2012), there was only a marginal association between cluttering and a higher likelihood of falls and injury. However, these findings may be subject to some bias, as an evaluation of what constitutes a cluttered environment is quite subjective to one's personal preferences, and there were often mismatches between the researcher's observations and patients' reporting on furniture cluttering. Furthermore, the results may also present some bias as cluttering can be temporary; for instance, resulting from prior-hand visit of a family member, and repeat observations must be made to gain more reliable insight on whether the environment is cluttered on a frequent basis.

5.3.1.8 Door Orientation & Proximity to Nursing Stations

Proximity to the nursing station (PQ2.11) was found to be linked to patients' sense of security. However, the observed effect was non-significant (m= 7.25, p=0.06); presumably as these patients had relatively easier access to staff members should they have needed them. Similarly, patients whose beds were oriented towards the door, as well as those whose beds were oriented directly facing the nursing station, were both found to report a much stronger sense of security (observation sheet).

5.3.1.9 Carpeted Flooring

While no link was established linking carpeted flooring to patients' comfort needs (PQ3.01), the researcher acknowledges this to the limitation that the sample population did not comprise many rooms with carpeted flooring, and the results may also be somewhat biased as a result of the smaller sample size. However, two strong links were found relating to reduced stress/anxiety levels (Table 55, m=5.84, p=0.04) and reduced falls/fall-related injuries (PQ3.02) (Table 55, m=6.37, p=0.03) though similar preservations are acknowledged as to the reliability of those results, for the same reasons acknowledged earlier.

5.3.1.10 Fabric Quality

The researcher was unable to draw any consistent links between fabric quality and any of the mediating functions/patient needs; though the descriptive statistics obtained directly from the patient questionnaires (PQ3.15) indicate a very high degree of variance between different groups of the sample, presumably as a result of the use of different fabrics/material quality in different facilities.However, as no data was collected on the specific fabrics/materials used in each of the patient rooms, the extent of the impact of fabric quality on patient satisfaction is somewhat unclear.

5.3.1.11 Wall Colour

None of the facilities included in the sample population of this study had any comparative groups with differently coloured walls, and this variable remains unexamined as a result.

5.3.1.12 Lighting Quality

Daylight exposure (PQ3.03) had one of the most significant impacts of all of the examined components, and has been found to be strongly correlated to three of the four primary patient needs: 1) Safety, by reducing medical error (Table 55, m=7.84, p=0.009); 2) Care, by improving sleep and reducing stress/anxiety (Table 55, m=7.84, p=0.002); 3) Comfort, by reducing physical discomfort in terms of visual quality (Table 55, m=7.84, p=0.003).

Indoor lighting (PQ3.06, PQ3.07) was generally found to contribute in an almost identical manner to natural daylight, and the results were also consistent in terms of the significance of the findings (Table 55, m=6.85; m=5.84, p=0.001; p=0.008; p=0.003).

The use of nightlights might have some further implications for patient safety, an intervention suggested by several staff members. However, no quantitative criterion directly referencing nightlights was included in the questionnaire, and all data collection hours took place in morning hours, as verbally stipulated by hospital administration, as not to interfere with patient sleep.

5.3.1.13 Natural Elements (Gardens/View/Artwork)

In a comparative analysis between two groups with access to gardens/elements of nature, and four groups with no such access, the study identifies a strong connection between nature and patients' perceptions of pain. Furthermore, the study found very strong statistical evidence linking access to a garden (outdoor space) (PQ3.04) to much better social communication. While this effect may be explained to be the result of a confounding effect (where patients with more acute conditions do not have access to nature, and are unable to go outside), a well-established literary pool with well-controlled studies demonstrates a this effect (Malenbaum et al., 2008; Ulrich, 1991; Ulrich et al., 2008)

Similarly two other design components relating to natural elements (view through window, PQ3.05; Landscape Artwork, PQ3.08) were examined in this study, and showed significant correlations to the care needs of patients, in terms of all three relevant mediating functions:, health status and symptoms, stress and anxiety levels as well as pain and physical discomfort (Table 55, p<0.05).

5.3.1.14 Acoustic Quality

On a related note, acoustic quality was another important factor shown to impact a variety of different patient needs. Indoor noise was examined in three different questions (Indoor noise from neighbouring rooms, PQ3.09; Indoor noise from machinery and equipment within the rooms, PQ3.10; Outdoor noise from the surrounding premises, PQ3.11) on the basis of the source from which the noise originated. In line with the findings of the systematic review, there were no differences in terms of which aspects were impacted by noise, but rather, the link was in terms of the magnitude of the impact, as indoor noise sources (PQ3.09, PQ3.10) had a much more significant impact than outdoor noise sources (PQ3.11), on aspects including sleep quality (Table 55, m=7.07, p=0.002, p=0.005), patients' perceptions of pain and physical discomfort (Table 55, m=7.07, p=0.001), as well as stress and anxiety levels (Table 55, m=7.07, p=0.006).

5.3.1.15 Cleanliness & Hygiene

Cleanliness and hygiene factors (PQ3.12), as well as indoor air quality and Thermal comfort (PQ3.14) appeared to be most correlated to patients' comfort needs, by influencing the health status and symptoms of patients (Table 55, m=7.06, p=0.04) most significantly via reducing physical discomfort (Table 55, m=7.06, p=0.004). Furthermore, they were linked to contamination and infection rates (Table 55,m=7.06, p=0.002) in the patient rooms.

5.3.1.16 Control over Design

Control over design components (PQ4.04, PQ4.05, PQ4.06, PQ4.07) within the facility was shown to be the most significant aspect regarding the functional design elements, which were explored in the fourth section of the patient questionnaire. These elements were mostly linked to the comfort needs of patients, not only in terms of physical comfort, but in terms of psychological comfort as well. Significant findings were reported for patients quality of sleep (Table 55, m=5.11,m=5.19, p=0.002, p=0.005), health status (Table 55, m=5.19, p=0.04), stress and anxiety (Table 55, m=5.87, p=0.06), pain and physical discomfort (Table 55, m=5.87, p = 0.004, p = 0.001).

5.3.1.17 Disability-Accessible & Acuity-Adaptable Designs

A strong link was established between disability-design considerations (PQ4.01) and patients' safety needs, as disabled individuals in particular have a more specific need more safety, given that their disabilities on their own can result in patient falls and injury (Table 56, m=4.41, p=0.02).

Acuity-adaptable rooms (PQ4.02) were examined in the context of both wayfinding and medical/staff prescription error, and the findings were only considered statistically significant for the case of the wayfinding (Table 56, m=4.41, p=0.024). Additional significant findings were observed with regard to the patients' privacy and security, which were not identified in the literature (Table 56, m=4.41, p=0.001).

5.3.1.18 Storage Spaces

Having sufficient storage space (PQ4.03) within the patients are able to store their belongings was also identified to be strongly correlated to patients' sense of security, which was determined to have significant influence over patients' comfort levels. However, the results were non-significant, at (Table 56, m=4.03, p=0.002).

5.3.1.19 Communication Tools

Communication tools (PQ4.09), such as phones and were among the few facilities that were directly determined to influence the extent to which patients commenced social (Table 56, p=0.003) and staff (Table 56, m=5.00, p=0.004) communication, thereby strongly affecting their social needs.

5.3.1.20 Recreational Tools

Entertainment utilities and other recreational tools (PQ4.08) were also identified to have a strong link to the comfort needs of hospital inpatients. These utilities mainly include the Television, Radio, as well as other additional support utilities, such as free Internet, and nearby wall sockets in which the patients could plug their electronic devices.

5.3.1.21 Sink Visibility

Having visible sinks (PQ4.10) which the staff members could use in the front of the patients was also determined to influence patient comfort by lowering stress/anxiety levels (Table 56, m=4.98, p=0.006), aside from its implications on contamination and infection rates among patients.

5.3.1.22 Facility Ease of Use

Finally, no findings could be confirmed with regard to the ease-of-use of in-room facilities (PQ4.11), as the only facilities common to all patient rooms were included in other questionnaire items, such as communication and entertainment tools and utilities.

5.3.2 Staff Perceptions on Environmental Design

Based on the results shown in the matrix in Table 35, which correspond to Section 5 of the staff questionnaire, there is considerable evidence supporting the findings of the systematic review about the influence of staff members (Gross et al., 1998; Huisman et al., 2012; Wensley et al., 2017). This section was used to gauge staff perceptions with regard to the outcomes of patients that are indirectly affected as a result of the environmental impact on staff needs.

The results of this section of the questionnaire are presented in Table 35:

Table 35

Staff Questionnaire, Matrix of Staff Functions and Patient Needs, Mean Responses

Outcome / Patient Need	Job Satisfaction	Efficiency & Workflow	Visibility & Engagement	Sleepiness & Fatigue	Contamination & Infection
Question	SQ5.06a	SQ5.06b	SQ5.06c	SQ5.06d	SQ5.06e
Safety Needs	5.67	9.34	8.94	7.12	8.89
Question	SQ5.07a	SQ5.07b	SQ5.07c	SQ5.07d	SQ5.07e
Comfort Needs	3.89	3.19	2.80	2.10	3.67
Question	SQ5.08a	SQ5.08b	SQ5.08c	SQ5.08d	SQ5.08e
Social Needs	8.21	1.98	7.54	5.80	4.78
Question	SQ5.09a	SQ5.09b	SQ5.09c	SQ5.09d	SQ5.09e
Care Needs	8.44	4.78	7.99	9.04	8.12

Similarly, staff's responses to the above questions, the perceptions of staff participants, shown in Table 36 were positive overall, as approximately 83.3% and 94.1% of the population provided the same feedback regarding the first and second questions in this set.

Table 36

Staff Perceptions of Environmental Design Impacts, Section 6, Set 2

		Yes		No		Uncertain	
Ref	Statement	n	%	n	%	n	%
SQ6.06	Implementation Makes Healing Space	85	83.3 %	10	9.8%	7	6.8%
SQ6.07	Implementation Better Address Needs	96	94.1 %	5	4.9%	1	0.9%

Commented [A40]: [93] This table is here as earlier feedback recommended that I move it later to be alongside other staff responses

Accordingly, it can be concluded that the perceptions of both patients and healthcare staff are generally positive towards the implementation of design interventions established in theory in actual practice.

Staff memberswere asked questions inquiring about whether they believed the discussed design features facilitated the creation of a more effective healing space (PQ5.16), and whether they felt it would create a facility that is better suited to attaining all patient needs (PQ5.17).

Staff members' perceptions and awareness appear to come from practical experience and knowledge, rather than stemming from knowledge specific to the field of environmental design. Referring back to Table 26, it was observed that there was a high degree of correlation between the work experience that staff members had, and their likelihood to have some background on the field of environmental design. Furthermore, this same relationship was also identified in terms of the of the shift worked per week, as those staff members who worked longer durations were also found to possess more knowledge on this topic.

For instance, a study by Abulruz and his colleagues, who examined nurses' perceptions of higher workload in 7 Jordanian hospitals, indicated higher-experience workers and those who work considerably more hours to have a strongerlikelihood to remain updated on new evidence and practical applications of EBD (AbuRuz et al., 2017). This claim is also supported by the findings of this study, as can be seen in Figure 33, which outlines staff members' self-reported knowledge on the field of EBD, against the employment status of those staff members.

A more expanded partial dataset, showcasing staff responses on the research knowledge question (SQ1.10), sorted by employment status and hours worked, can be found in Appendix A.1.

Figure 33shows staff members' perceived level of knowledgeability and follow-up on environmental design research, matched with the staff members' employment status, and their weekly working hours. As is evident in the chart, there is a clear trend demonstrating a direct positive relationship between the two variables. The results are also demonstrated in Table 37.The key takeaway from these findings is that staff members who tended to work longer hours within healthcare facilities were more likely to be aware of the long-term impact of design on both their performance and patients' healing, as is demonstrated by their higher level of knowledgeability on EBD overall.

Commented [A41]: [94] Elaborated more on key takeaway

Referring back to the feedback provided by nurses with regard to the location and orientation of nursing stations, staff members noted that nursing stations could be located a little further away from patient rooms (to reduce ambient noise and enhance patients' acoustic comfort).

However, this is in direct conflict to another component that is critical to patient safety, which is having nursing stations in close proximity to the rooms to allow staff members to intervene, an element frequently identified in the literature to contribute to reducing patient falls (e.g. Lu et al., 2014; Zborowsky et al., 2010).

Figure 33

Staff EBD Self-Reported Knowledge vs. Employment Status, Stacked Bar Chart

Numbers on Top: Part-Time & Full-Time figures refer to hours per week worked by the staff members

Numbers on Bottom: Scale of staff members from 0% to 100%

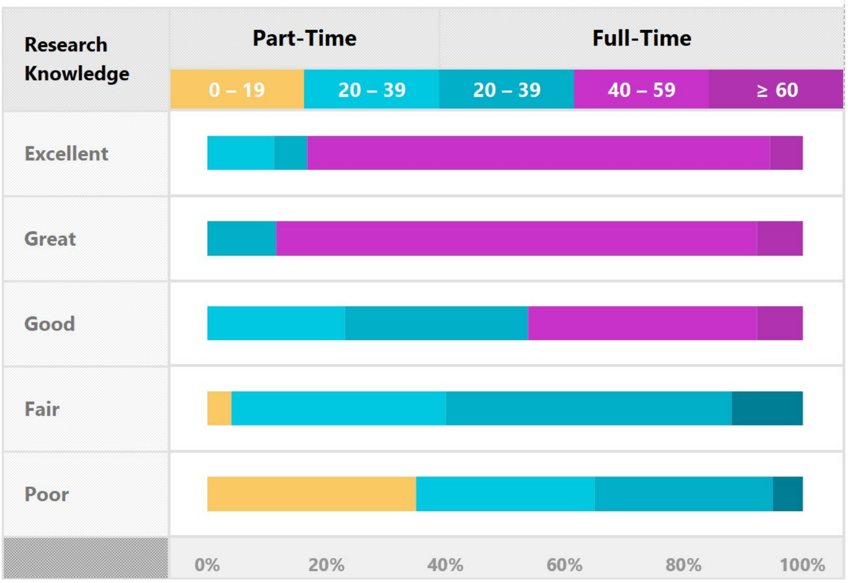


Table 37

Staff Research Knowledge vs. Employment Status, Partial Dataset

Ref	ED Knowledge	Employment	N = 102	N	%
SQ1.10	Excellent	Part-Time		2	1.96%
		Full-Time		16	15.69%
		Subtotal		18	17.65%
	Great	Part-Time		0	0.00%
		Full-Time		26	25.49%
		Subtotal		26	25.49%
	Good	Part-Time		3	2.94%
		Full-Time		10	9.80%
		Subtotal		13	12.75%
	Fair	Part-Time		10	9.80%
		Full-Time		15	14.71%
		Subtotal		25	24.51%
	Poor	**Part-Time**		13	12.75%
		Full-Time		7	6.86%
		Subtotal		20	19.61%

The underlying cause behind the relationship between work duration, employments status, and Environmental Design Knowledgeabilityis fairly easy to hypothesize: Staff who are more dedicated and work longer hours are much more likely to be affected by the environment and are thus much more likely to attempt to research and understand the degree to which it affects them.

Furthermore, several factors related to staff members were also found to be linked to the design of the healthcare facility, mainly be inducing staff outcomes that were directly linked to facilitating better patient care, among other patient needs.For instance, nursing station orientation was found to be strongly linked to the safety and social needs of patients.

Exposure to daylight not only enabled patients to heal and achieve better care outcomes, but it also facilitated the comfort of staff members, which had a direct influence on their job satisfaction, influencing their dedication to facilitating quality care to patients. This is supported by the findings of Al-Zubaidi et al. (2013) and Shepley et al. (2012) on the impacts of daylight on staff performance.

Both outdoor and indoor sources of light were found to have a significant influence on staff sleepiness and fatigue, efficiency and workflow, and served to reduce medical prescription errors as was described via the findings of the previous section.

Furthermore, noise was also determined to have strong influence over the functions performed by staff members, mainly by reducing their job satisfaction, as well as reducing their ability to work in an effective manner.

The findings presented through patient perceptions were also confirmed via the results of staff members, who stated that the orientation of the sink (whether the sink directly faced patient beds, or was hidden away from sight) had strong implications on the contamination and infection rates within the facility.

Standardized rooms were found to be strongly linked to the staff members' efficiency and workflow, as it provided the staff members with a familiar layout to work within, reducing wasted time in terms of routine and mundane tasks.

Carpeting appeared to have no direct link on the staff members' functions towards patients and was not linked to patients' care needs. However, the results indicated the existence of a strong link between the use of carpeting and job satisfaction among staff members, which can be rationalized via the fact that the use of carpeting provides a non-institutional feel to the facility (Reiling, 2008).

Finally, some conflicting implications were found that were related to features that facilitated the control and choice that patients had over physical components within their rooms. For instance, staff members iterated some major concerns regarding this feature through verbal feedback, stating that it hinders their ability to monitor patients' health condition during their stay. Furthermore, control over temperature (SQ3.08) in particular were both found to strongly influence the efficiency and workflow of staff members, especially in cases where the air conditioning was turned up in the winter months, where a hot facility combined with a constantly mobile staff may make them more exhausted and sleepy, reducing their ability to tend to the care needs of inpatients.

Finally, several components in the facility were found to have a strong influence over the staff members' ability to establish communication with the patients, which include the proximity and orientation of the nursing station relative to the room, whether patients had control over the door, the communication tools at the patients' disposal, and whether the bed was oriented towards the door.

5.4 Impacts of Design on Patient Needs

Table 38cross examines the relationships between components belonging to the three design dimensions, and the four identified patient needs.21 or22relationships were identified pertaining to each need, with the exception of patients' social needs (12 relationships), as these needs appear to be the least influenced by the environmental design of the facility overall.

The numerical figures outlined in the table simply represent the number of relationships (links) identified in the following subsections, not the strength and bias associated with the findings. As such, higher values are indicative of design dimensions' high range of impacts on a particular need, but the relationships identified vary in terms of their strength and likelihood to account for the true effect.

Table 38

Environment-Need Relationships Confirmed

		Safety	Care	Social	Comfort	Total
Dimension						
Spatial	Confirmed	6	1	6	3	**16**
	Unconfirmed	3	1	2	2	**8**

		Safety	Care	Social	Comfort	Total
Dimension						
	Subtotal	9	2	8	5	24
Ambient	Confirmed	5	10	1	7	**23**
	Unconfirmed	5	5	1	7	**18**
	Subtotal	10	15	2	14	41
Functional	Confirmed	2	2	2	6	**12**
	Unconfirmed	1	2	2	9	**14**
	Subtotal	3	4	4	15	26
	Total Confirmed	13	13	9	16	**51**
	Total Unconfirmed	9	8	3	5	**40**
	Total Relationships	**22**	**21**	**12**	**21**	**91**

The relationships between the design components and the patient needs are identified as either confirmed or unconfirmed. Confirmed relationships are those identified in the systematic review as well as the primary findings, and the relationships identified in the systematic review, but not in the primary research findings (obtained via the questionnaire).

The relationships which were not confirmed relate to factors whose effect could not be studied, as the sample were not exposed to that design component. For instance, wall colour is one such factor, where no patient rooms were painted in any warm or cool shades, making any interpretation of the non-parametric test results likely to be biased; as the patients had not experienced the effects of the design feature first-hand.

The total number of relationships refers to the total number of confirmed relationships, in addition to the unconfirmed relationships; which were identified in the literature, but unverifiable in the study.

The following sections examine these relationships in terms of the mediating functions relating to a need, as to evaluate which of these functions contributes to needs and in relative comparison to other mediating functions.

5.4.1 Patient Safety Needs

Several strong relationships were identified by this study to significantly impact patient falls, the majority of which are in line with findings in the literature. For instance, authors such as Calkins et al. (2012) and Tzeng & Yin, (2012) report that a very significant portion of falls occur in relation to the bathroom.

Referring back to the patient questionnaire, the final question of the profile section (P1.10) aimed to identify the various risk factors that the patients faced within the facility, assessing the degree to which procedural errors, prescription errors, infections, and fall/injury took place across the hospitals sampled for this study.

Table 39 explores the extent of the impact of environmental design on the safety needs of hospital inpatients, outlined in terms of the number of relationships confirmed linking each design dimension and mediating function in the patient questionnaire.

The safety needs of patients were accounted for by more than a quarter (25.49%) of the examined and confirmed relationships. The spatial, ambient, and functional dimensions, ranked in that order in their extent of impact on patient needs, for which functional design had the least contribution to addressing patient needs.

While the finding may be somewhat surprising, given the fact that functional design often constitutes components identified to enhance the physical safety of patients, this effect was somewhat reduced as the safety needs of patients do not only constitute physical safety, but also safety from infections and medical errors (which functional design has little effect on).

As such, the impacts of spatial and ambient design are much more direct on patient safety overall, with the spatial dimension enabling better wayfinding and accessibility, and reducing falls, while the ambient dimension is responsible for reducing medical/prescription errors, and reducing contamination/infection levels.

Table 39

Number of Design-Need Relationships Confirmed, Safety Needs

Safety Needs	Spatial	Ambient	Functional	Total
Wayfinding & Accessibility	4	0	1	5
Falls&Fall-Related Injury	2	1	0	3
Medical Prescription Errors	0	2	1	3
Contamination&Infections	0	2	0	2
Total Confirmed (Safety)	6	5	2	**13**
Total Relationships (Safety)	**9**	**10**	**3**	**22**
% Confirmed of Safety	**66.67%**	**50%**	**66.67%**	**59.09% (Avg)**

% Confirmed of Overall	**11.76%**	**9.80%**	**3.92%**	**25.49%**

Overall, there is an evident need for reducing risk factors contributing to adverse events including falls and fall injuries, infections, medical/prescription errors, and procedural errors. The demographic results of Question(P1.10) are as follows:

- 8.80% (n=19/216) reported the occurrence of a procedural error
- 14.35% (n=31/216) reported the occurrence of prescription error
- 22.69% (n=49/216) reported contracting a post-admission infection
- 29.63% (n=64/216) reported having fallen and/or being injured

While the sum of these items is 75.47% (n=163/216), the total is indeed considerably lower, due to the fact that the above selection is not made up of mutually exclusive choices[29]. Falls and fall-related injury were the most frequently reported adverse events taking place, and it is arguably the biggest issue to be addressed in the majority of healthcare settings, with respect to patient safety and functional status, as is also highlighted in the literature (Abraham, 2011; Calkins et al., 2012; Huisman et al., 2012; Ulrich et al., 2008).

Wheelchair accessibility is another unmet need in Jordanian healthcare facilities. For instance, an article in The Jordan Times (Dupire, 2018), the majority of online resources do not yet offer information on whether a facility is accessible for disabled people.

In an interview conducted by the author, Jordanian ALS patient, Lana Bataineh, who is a wheelchair user, points out that her use of a wheelchair is not as big an issue as the fact that she is unable to see a doctor when she needs to. The patient states that:

[29] Several of the patients reported having two or more risk factors.

"The majority of doctors and dentist clinics here [in Jordan] do not have access for wheelchairs: they either do not have ramps, or their clinics are in buildings with an elevator that is too small for any wheelchair,"

"...whenever I have my regular check up at the doctors, I am obliged to admit myself into the emergency ward at the hospital instead."

Dupire (2018)

5.4.2 Patient Care Needs

Table 40 explores the extent of the impact of environmental design on the care needs of hospital inpatients, outlined in terms of the number of relationships confirmed linking each design dimension and mediating function in the patient questionnaire.

With regard to the care needs of patients, three mediating functions were found to have relatively similar significant impacts on patients' overall satisfaction with care. These mediating functions included stress and anxiety levels, sleep quality and quantity, as well as the health status and symptoms that the patients showed.

One noteworthy finding is the fact that ambient design accounted for the majority of the observed effort on care needs on its own, and constituted a total of 15 relationships identified in the systematic review of the literature, of which 10 were confirmed in the study.

An important observation to note is the evident dissatisfaction of healthcare staff with their employment at Jordanian hospitals, which is also supported by Mrayyan (2007), who asked students in Jordan to report on nursing practice issues in Jordanian private hospitals. Referring back to the researcher's observation records, there were 68 cases of staff member complaints and verbal remarks by staff members: and nurses in particular, indicating some of sort of dissatisfaction with their current employment status.

Table 40

Number of Design-Need Relationships Confirmed, Care Needs

Care Needs	Spatial	Ambient	Functional	Total
Sleep Quality & Quantity	1	4	0	5

Care Needs	Spatial	Ambient	Functional	Total
Health Status & Symptoms	0	4	0	4
Stress & Anxiety Levels	0	2	2	4
Total Confirmed (Care)	**1**	**10**	**2**	**13**
Total Relationships (Care)	**2**	**15**	**4**	**21**
% Confirmed of Care	**50%**	**66.67%**	**50%**	**61.90% (Avg)**
% Confirmed of Overall	**1.96%**	**19.61%**	**3.92%**	**25.49%**

This issue requires careful consideration in the future, as patient satisfaction levels have been shown to be ~~re~~markedly lower in direct correlation to nurse satisfaction levels. Nurse's satisfaction has also been linked to the quality of care received by patients, as well as their perceptions of health gains following their leaving~~from the~~ hospital (McHugh, 2010; Kanai-Pak, 2008).

Among the most influential factors contributing to patients' care needs were the spaciousness of the beds, nursing station proximity, all design components providing access to views of nature, and indoor/thermal quality. These findings are also indicated by the radar chart shown in Figure 31 earlier, demonstrating the importance of ambient design to the healing needs of patients above the other two design dimensions.

The findings of this study agree with the ~~literary~~ findings of Smith et al. (2017), Buchanan et al. (1991), Walch et al. (2005), Calkins et al. (2012), Pati et al. (2012), Hadi et al. (2019) on ambient design's links to patient healing and care.

5.4.3 Patient Social Needs

Referring back toTable 25, there is some variance as to the number of visitors received by any given patient over the course of one day. Fewer than a sixth (14.35%, n=31/216) reported receiving no visitors to two visitors on a daily basis, 34.26% (n=74/216) reported receiving two to five visitors in total, 31.94% (n=69/216) reported receiving 5-10 visitors in total, and 19.44% reported an even higher figure than that.

Social connection and interaction are of crucial importance to local culture and tradition in Jordan, which can potentially be driving such figures, and which may be considered rather high in other regions of the world (Shaqrah et al., 2013).

Social interaction was also found to correlate to a patient's social and care needs. As Shaqrah et al. (2013) identifies a critical relationship between social behaviour and knowledge sharing in general contexts, the same relationship could be said to hold true in healthcare settings, as is indicated by the results of the first question in Section 2 of the staff questionnaire (S1.01), which was centred around patients' knowledge sharing. Patients who communicate more frequently with their caregivers may be able to provide more information on their healing and symptoms, leading to better treatment, and faster discharge times (Chandra et al., 2018; Clever et al., 2008).

Another factor potentially influenced by Jordanian culture is the availability of a designated family area, and overall room spaciousness, since it is well known that the Jordanian culture places emphasis on maintaining good family relationships and remaining socially connected; especially in times of sickness and duress. Jordanians (and the Arab World, on a larger scale) have always emphasized the extended family unit as a basic social institution in society, where family structure and connectedness are considered, including social interaction with remote family members—in contrast to common culture and practice in many Western nations (Hammad et al., 1999).

Table 41 explores the extent of the impact of environmental design on the social needs of hospital inpatients, outlined in terms of the number of relationships confirmed linking between each design dimension and mediating function in the patient questionnaire.

Table 41

Number of Design-Need Relationships Confirmed, Social Needs

Social Needs	Spatial	Ambient	Functional	Total
Social Communication	3	1	1	5
Staff Communication	3	0	1	3
Total Confirmed (Social)	**6**	**1**	**2**	**9**
Total Relationships (Social)	**8**	**2**	**2**	**12**
% Confirmed of Social	**75%**	**50%**	**100%**	**75% (Avg)**
% Confirmed of Overall	**11.76%**	**1.96%**	**3.92%**	**17.65%**

Two primary mediating functions were identified to be relevant to the topic of patients' social needs, which were classified based on the purpose for which patients are establishing communication. The first of those functions is communication for social purposes, which took place with family members and friends, while the second is communication for medical purposes with healthcare staff. As was observed via the qualitative observational results collected from patients and staff members, patients mostly established communication with staff members in order to obtain information of their health condition, or to request medical/supportive assistance from staff.

The spatial dimension was identified to be the most relevant to patients' social needs, comprising a total of 11.76% of the overall confirmed relationships, while the ambient and functional design combined barely amount to half that estimated impact. This finding was anticipated however, as the layout of the facility ~~are~~ is well-known to be of paramount importance for facilitating communication, among many other aspects that enable better communication and social behaviour, such as allowing more visitors to stay over (Douglas & Douglas, 2014).

5.4.4 Patient Comfort Needs

Finally, Table 42explores the extent of the impact of environmental design on the comfort needs of hospital inpatients, outlined in terms of the number of relationships confirmed linking each design dimension and mediating function in the patient questionnaire.

Table 42

Number of Design-Need Relationships Confirmed, Comfort Needs

Comfort Needs	Spatial	Ambient	Functional	Total
Sense of Privacy & Security	3	0	1	5
Sense of Control & Choice	0	0	5	3
Pain & Physical Discomfort	0	7	0	3
Total Confirmed (Comfort)	**3**	**7**	**6**	**16**
Total Relationships (Comfort)	**5**	**7**	**9**	**21**
% Confirmed of Comfort	**60%**	**100%**	**66.67%**	**76.19% (Avg.)**
% Confirmed of Overall	**5.88%**	**13.73%**	**11.76%**	**31.37%**

Results in Table 42 indicate that the spatial design dimension had the least observable effect on patient comfort, in comparison to the ambient and functional design dimensions. The impact of the spatial dimension was mainly on the sense of privacy and security that patients felt. Privacy, in particular, appears to be mediated entirely via aspects relating to the spatial design of the facility; whereas a sense of security was mediated by one additional component in the functional design components (having sufficient storage spaces in which the patient could store their personal belongings).

Ambient design had a significant impact mainly in terms of improving the visual and acoustic quality for patients throughout their stay, as all 7 of the confirmed relationships related to reducing patient pain and physical discomfort. Lighting, both natural and artificial, along with internal noise sources, had the most significant impact on the pain levels reported by patients. Noise sourced from external sources (the premises surrounding the hospital) showed no such observable impacts in comparison to noise sourced from inside the hospital, be that noise from the equipment within the room, or the noise levels in the ward outside, coming from the patients and visitors residing in nearby rooms.

Functional design, on the other hand, mainly impacted patient comfort by providing the patients with the ability to control four design components of the built environment (indoor lighting, daylight received through dimmers, temperature/heating, and the ability to close/open the door). Allowing patients to have control over these design components and features appeared to have significant impacts that were largely similar in their magnitude, but on differing patient needs.

5.5 Impacts of Design on Patient Outcomes

As for patient outcomes, each of the 216 included participants received a mean score for each of the three patient outcomes established in the conceptual review section of this study.

Regarding the first outcome, patients' satisfaction with care, the mean score was obtained by calculating the mean of the responses for all of the design components explored in the patients' questionnaires. As these statements were are all phrased in such a way that they emphasized the outcome of satisfaction (e.g. I am generally very satisfied with…), they can thus be established as a good measure of this outcome.

However, in line with common practice in the literature, the two other outcomes were evaluated for patients from the perspectives of the staff members with whom they were matched in the data collection phase of the study, as these questions are often more technical in nature, and involve a diverse set of considerations.

This part of the analysis was based on the assumption that all of the interviewed staff members were licensed professionals who are able to provide ~~if but~~ at least preliminary estimates of the outcomes of their patients, as they were identified solely on the basis of being the primary caregiver to at least one of the patients (See Section 4.4.4.2).

The results were evaluated using a Pearson Correlation Matrix, as there is no basis to assume a direct impact between the needs and outcomes of patients, making a correlation analysis the most suitable approach to determine any links relating patient needs and staff outcomes owed to patients' outcomes.

The results for the Pearson Correlation Matrix are shown in Table 43.

Table 43

Pearson Correlation Matrix, Intercorrelations between Select Needs & Outcomes

		Patient Needs				Staff Outcomes				
		Safety Needs	Care Needs	Social Needs	Comfort Needs	Job Satisfaction	Efficiency & Workflow	Visibility & Engagement	Sleepiness & Fatigue	Reduced Contamination
Patient Outcomes	Care Satisfaction	0.55	0.91	0.72	0.87	0.91	0.45	0.32	0.53	0.31
	General Well-Being	0.77	0.39	0.94	0.79	0.75	0.76	0.69	0.72	0.91
	Functional Status	0.96	0.92	0.35	0.40	0.88	0.85	0.86	0.91	0.27

Marked values (yellow) are above the selected threshold of 0.7

Interpreting the strength of the impacts of each of the identified design outcomes on the four patient needs was evaluated as a collective by identifying the overall number of the relationships and links associated with each need and dimension.

A noteworthy finding is that patients' satisfaction with care appears to be directly correlated to the staff members' satisfaction with their jobs, implying the importance of satisfying both user groups to an equivalent extent, as the intercorrelations between their outcomes means that tending to one group with have significant ramifications on the needs and outcomes of the other groups.

Furthermore, another observation based on the researcher's interpretation of the above figures, is that the majority of staff outcomes appear to have a significant influence on the functional status of patients, first and foremost; their general well-being to a less extent, and little impact (aside from one outcome) on patients' satisfaction with the level of care provided.

Based on the correlations identified between the relevant needs and outcomes (Table 43), a summary of the links between patient needs and outcomes is presented in Figure 34,Figure 35, and Figure 36. These figures specifically outline the different staff outcomes directly influenced by the built environment, and how those outcomes in turn affect patients' needs. The lines drawn on Figure 35 are based on the values outlined in the correlation matrix [which are greater correlations than 0.7, a commonly used measure of internal consistency (Taber, 2018)]

Figure 34is presented in terms of general perspectives, rather than outcomes, such as those related to patients. This is done as staff outcomes are not explored in-depth to the extent that patient outcomes were and presenting those outcomes as such would be somewhat misleading.

Figure 34

Patient Outcomes, Correlation to Patient Needs

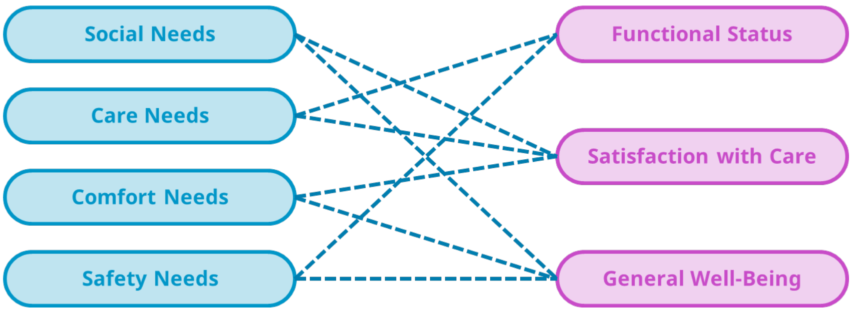
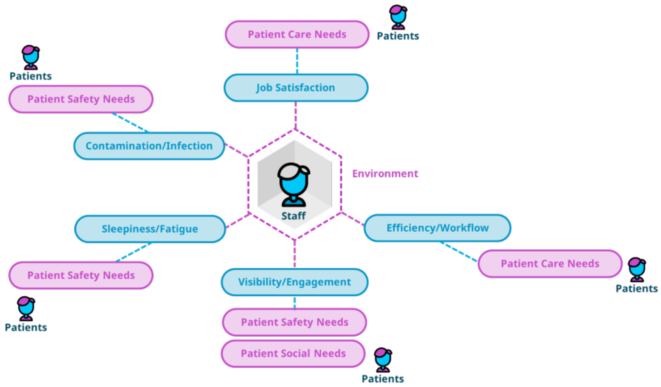


Figure 35specifically outlines the different staff outcomes directly influenced by the built environment, and how those outcomes in turn affect patients' needs. This figure is presented in terms of general perspectives, rather than outcomes, such as those related to patients. This is done as staff outcomes are not explored in-depth to the extent that patient outcomes were and presenting those outcomes as such would be somewhat misleading.

Figure 35

Patient Outcomes, Correlation to Staff Needs



The links between each of the staff outcomes and the patient needs were not evaluated in-depth by the researcher, as the study focused more on the needs of patients in the case of this study. However, based on the potential links between the staff outcomes and the healing process of patients, this field of study should receive more attention in future research.

5.6 Chapter Conclusion

The process followed in conducting this thesis began with the introduction of the main concepts in the conceptual review to identify the extent to which the field has been developed in the past, identifying the most important terms and concepts relevant to this study. Using the concepts established in the conceptual review, a systematic approach was used to conduct the second part of the literature review process, which involved identifying studies linking healthcare setting design on patients' needs and outcomes.

Upon completing the systematic review, the different approaches undertaken by researchers became evident, and the most suitable approach was then identified to be the collection of observations from patient and staff groups. As such, two questionnaires were designed. Starting off with the patient questionnaire, many factors had to be considered to account for the nature of the research sample. The questionnaire mainly consisted of questions structured in the form of a 10-point Likert-scale. asking that patients to rank their level of agreement with statement linking different environmental design features to their perceived needs and outcomes.

Other types of questions included in this questionnaire comprise simple and easy-to-understand question types, including: (1) single-response multiple-choice, (2) multi-response Multiple Choice, and (3) Fill-in-the-Blanks. The staff questionnaire was developed bearing in mind the same considerations as the patient questionnaire, with one minor alteration: the terms used throughout the questionnaire were a little more complex in nature, as to ensure that the participants fully understood what was being asked of them.

The population of 44 accessible private hospitals in Amman, Jordan were visited by the researcher, of which a final sample population of 6 hospitals granted the researcher access to collect data from patients and staff members.

Patient and staff questionnaires were distributed to a final sample population of 216 and 102 participants, respectively. These quantitative data sources, along with direct observations recorded by the researcher in non-standardized forms, were used for data collection. Data extraction and analysis were then performed using Microsoft Excel and IBM SPSS, extracting the data into digital format, which enabled the statistical analysis of the data.

In conclusion, the findings of the study confirm many of the relationships identified in the systematic review chapter (Chapter 3) and contribute to the development of the literature by validating the dimensions introduced in Chapter 2 using a PCA analysis, and categorizing different interventions under each of these dimensions based on the results.

Using the findings for each of these components, which were assorted into a matrix linking each component to each patient need and outcome, a design framework was then developed to facilitate the practical application of design interventions identified in theory in real practical cases.

Patient and staff perceptions were analysed using the data collected via the participant questionnaires, both of which aimed to identify the most important direct impacts of environmental design on the patients' needs, as well as the indirect impacts affecting them through the realization of staff needs.

The findings of the study will accordingly be used to introduce the Needs Realization Management Process (Chapter 6), which details the developmental and validation processes used to create a framework aimed at enhancing the applications of theoretical findings in practical healthcare settings. Furthermore, the framework may also be used in other environments by extension, as the steps constructed in the model are standardized for application in a systematized manner. The process used to conduct this study will be used as a sample to showcase how the model works.

Furthermore, the findings of the study will aid in developing the main points upon which the validation process relies, which will be explored via a focus group discussed in the final section of Chapter 6. In accordance with the recommendations provided by the focus group members, recommendations can be offered for future improvements upon this model.

6 Process Development & Validation

Chapter Overview

Finally, Chapter 6 presents the Needs Realization Management Process, a framework developed by the researcher based on the work undertaken in this study. The chapter explores the different phases of the framework over the course of the following few sections. Accordingly, a visual model of the framework, presented with a brief summary of each of the phases examined throughout the chapter. Finally, the validation process used to ensure the proper formulation and flow of the process is detailed in the final section, amending the process based on the validation results.

6.1 Needs Realization Management Process Model

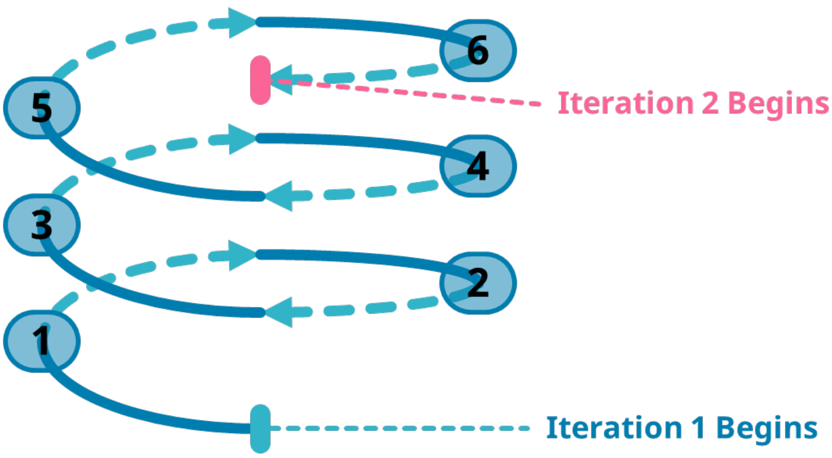
6.1.1 Process Model Overview

The following framework is developed with the intent of providing a practical interpretation of the work presented in the study above, allowing designers, policy makers among other stakeholders to ensure the full potential of environmental design in their facilities is realized, and helping in the decision-making process with regard to implementing design changes.

The model introduced in this chapter, titled ***Needs Realization Management Process*** and can be described as a design decision and management process model centred around the fulfilment and realization of the needs of different environmental users. The model, applied in the case of this study, will be outlined below in the context of the healthcare environment, focusing on patients as the primary user of the healthcare facility, while also examining the interactions between those patients and other users (healthcare staff) and stakeholders (family members, hospital administration, policy-makers and regulators, etc…).

The framework's model, shown in Figure 36, can be described as a A) cyclical, B) iterative, and C) progressive framework, constituting six primary steps. Each of these characteristic traits and steps will be outlined in the following sections.

Figure 36
Need Realization Management Process, Framework Model



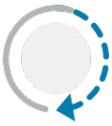
Each of the steps included in Figure 36 above~~was~~ is included on the basis of a process or finding identified by the researcher whilst conducting the study, which are summarized below:

- Step 1: Identified based on the conceptualization of environmental stakeholders and user groups, discussed in Section 2.4.1.1, along with the influence of staff members (indirect) on patient groups (Section 5.5), which urged the need to consider all relevant stakeholder groups as a result.
- Step 2: Identified based on the differences in needs of stakeholder groups based on the locations and environmental factors they were most exposed to (Section 2.5.1.1) as well as the difference in findings for perceptions of both staff and patient groups (Sections 5.3.1; 5.3.2), which demonstrated that groups in the same settings have fundamentally different needs.
- Step 3: Identified based on the conceptualization phase of healthcare settings, which showed that different authors may propose alternate categorizations of components of the environment on different bases, which may all be correct (Section 2.8).
- Step 4:Identified based on the results of the systematic review (Section 3.4), which showed that different environmental design interventions yielded different outcomes, as well as the difference in findings for perceptions of both staff and patient groups (Sections 5.3.1; 5.3.2).
- Step 5: Identified based on the differences in impact in the perspectives of both staff and patient groups (Sections 5.3.1; 5.3.2), which is why both of these groups (among others) must be considered in the policy-development process.
- Step 6: Identified in examining the influence of policy-making on the actual implementation of design changes and policy amendments (Section 2.4.2.4), along with the consideration of how these changes can impact patient well-being and outcomes in general, which warrants their consideration by relevant authorities (Section 5.5).

6.1.2 Features and Characteristics

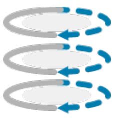
The model can be characterized in terms of the following three traits, which are as follows:

- ***Cyclicality*** describes the fact that the model is repeated in regular patterns that occur at set intervals, enabling the framework's user to begin at whichever point in the process that best suits them. Upon the completion of the final step in the framework, the cycle is repeated, beginning back at the first step in the framework.



This feature is depicted in the model above via the circularnature of each iteration, in which the process, upon the completion of each iteration (step 6), starts over at the beginning stage (step 1).

- ***Iteration***describes the model's cyclicality on an even larger scale, referring to a more expansive cycle of repetition, in which the design interventions/changes are identified, tested, and analysed repeatedly; and are refined in each iteration in the process. Each iteration loop takes place upon the completion of the sixth step of the process, and the loop is not necessarily established back in step 1 of the process, rather, the process can be looped back from steps 3 or 5 if the need is not warranted for previous steps.



This feature reflects the cyclicality of the model on an even larger scale, in that the completion of (step 6) in iteration 1, for instance, moves over to (step 1 or 3 or 5) in iteration 2, depending on the nature of the environment in question.

- ***Progressiveness*** describes how the model leads to the advancement and implementation of changes/interventions in environmental design, leading towards better policies, conditions, and methods of reform. Upon the completion of iterative cycle in the process, the framework's users will have progressed towards a healthcare environment that is more suitable to addressing their users' and stakeholders' needs.

Upon the completion of each iteration, the application of this framework adds value to the overall design of the healthcare facility and progresses the facility to become more of a healing space.

6.2 Steps of the Process

6.2.1 Step Pairings & Applications

Referring to a point mentioned regarding the iterative cycle of the framework, it was stated that each iteration loop can be started at any of the steps 1, 3 or 5. This is a result of the steps being paired together in terms of couplets (referred to as duos from this point onwards). The rationale behind these pairings is presented in Table 44.

Table 44

Needs Realization Management Process, Step Pairings

	Step			
Duo	**No**	**Brief Description**	**Loop Start* (?)**	**Pairing Rationale**
A	1	Identifying Relevant Environmental Stakeholder and User Groups	Yes, looping back to this phase makes for a completed cycle	Steps 1 and 2 are paired on the basis that the users must be clearly identified before their needs and outcomes can be determined
	2	Determining the Needs and Outcomes of each User Group	No, looping back to needs evaluation requires re-evaluating stakeholder/user groups	
B	3	Identifying Environmental Design Components and Features	Yes, looping back to step 3 is done in settings where the user groups do not change on a frequent basis	Steps 3 and 4 are paired on the basis that relevant design components and features must be fully understood before linking them to the different stakeholder groups
	4	Linking Environmental Design to Stakeholder Groups	No, looping back to the linking phase requires re-evaluating the design components within an environment	
C	5	Evaluating Stakeholder Perspectives and Decision Value	Yes, looping back to step 5 is done in cases where neither the groups nor the environment change on a frequent basis	Steps 5 and 6 are the most important to be paired, as the latter is very dependent on the former, and applying the latter on its own would result in a single step process of just implementing changes, which can have very adverse impacts on the groups, contrary to what is sought
	6	Implementing Environmental Change and Reform	No, looping back to the phase would only result in a process of implementation of changes upon preference, not evidence	

* **Can the loop start back at this step of the process?**

Furthermore, this can be presented in a visual application of the model depicted earlier in Figure 36.

Figure 37
NRMP Model Application, Fixed Environment

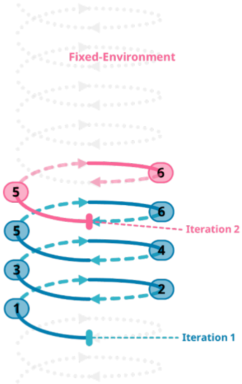


Figure 38
NRMP Model Application, Semifixed Environment

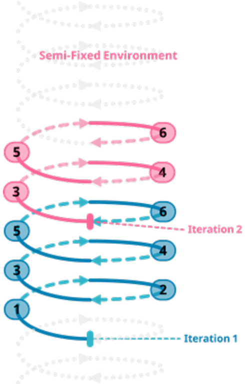
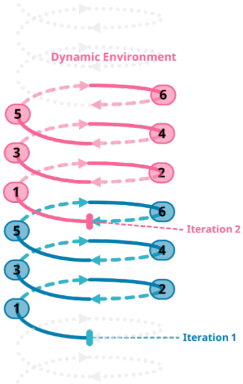


Figure 39
NRMP Model Application, Dynamic Environment



Determining which steps to loop back from in a subsequent iteration will require some information about the nature of the environment and its users, and whether those aspects are dynamic (continually changing), fixed (never changing), or semi-fixed (in-between).

6.2.2 Step 1: Determining Stakeholders & Users

The first step of NRMP is to determine the different stakeholders and users in an environment. The distinction between the two was outlined in Section 2.4.1.2c above. Briefly restating this difference: While stakeholders can be anyone who stands to influence/be influenced by the environment, a user is someone who comes into direct and continuous contact with the environment for a set period of time.

In the context of this study, two primary users were defined for healthcare environments, who are: hospital inpatients, and staff members administering their care and treatment.

As for the stakeholders of healthcare environments, they potentially encompass a much greater scope of individuals, as the range of stakeholders not only includes those who may interact with the facility in the current time, but they also include anyone who may interact with the facility at some point in the future. As such, all members of the general public who stand to receive healthcare in the future can be included in the stakeholder group.

Distinguishing the groups clearly is essential to the proper application of this framework, as the primary focus of the model is addressing the needs of user groups, first and foremost, and then the needs of other stakeholders such as family members, hospital administration, and policy-makers and regulators.

Furthermore, making the distinction between the two groups of users and stakeholders allows for the creation of a hierarchy ~~of sorts~~ in terms of to whom design changes should be targeted ~~at~~. In the case of this study, the hierarchy would begin with patients, who are followed by staff members, family, and finally, hospital administration. This hierarchy is based on the level of direct influence that each of these groups have on the core group of focus: hospital inpatients.

6.2.3 Step 2: Identifying Needs & Outcomes

Following the identification of the different stakeholder and user groups of an environment, the next step would be to identify the needs and outcomes of each of those groups, focusing on the needs and outcomes of the main group of focus, which depends on the purpose of the model's development.

For instance, if the main objective and goal of the framework is its use in implementing healthcare reform—as is the assumption for the case of this study, then it is evident that the focus of the framework should be to identify the needs and outcomes of the hospital inpatient group.

Classifying and categorizing these needs can be ~~a little tricky~~complex, especially given the fact that different researchers ~~are bound~~tend to use different terminologies and interpretations of what each need and outcome constitutes. Some needs can be fairly intuitive, such as the patient's need for healthcare, as that is the primary factor leading that patient to seek healthcare in the first place. Other needs may be somewhat unobvious at first. For instance, a patient's social needs may not be the first thing to come to mind in attempting to identify the different needs of hospital inpatients; which is why thorough research must be done to examine the perspectives of prominent past authors on the topic, as to ensure that no potentially relevant needs are left unexamined.

Following the identification of needs, outcomes can in turn be described as reductions in these needs; or in other words, evidence that one or more user/stakeholder need(s) have been partially/completely realized. At the current stage of the process, it is ~~yet~~ not that important to ensure that the needs/outcomes have been realized as a result of an environmental design component/feature; as that will come later in turn in the fourth step of the process.

Further adding to the confusion in identifying patient needs and outcomes is the fact that some constructs can be rightly identified as either, as is commonly evident in the literature.

A potential resolution to such conflicts, which was implemented in this study, is to replace one of the constructs with another more suitable one, where that may be applicable. For instance~~,~~

~~For instance~~, patient safety is often discussed in the literature terms of it being both a need and outcome, which makes sense if both concepts were examined exclusively. However, patient safety was clearly identified as the avoidance of adverse events in the environment for this study, and the outcome functional status (another commonly referenced term in contemporary literature) was used in reference to the physical safety and well-being of patients, to differentiate between safety as a need, and safety as an outcome.

6.2.4 Step 3: Identifying Design Components & Features

~~Moving onwards, t~~The next step of the process is to identify the different environmental design components and features within an environment. Prior to examining the specific components and design features ~~specifically~~, it can be useful to gain some insights as to what design components are commonly referred to in relevant literature. This should be performed as some design features may not be so obvious upon empirical examination.

According to Wanigarathna (2019), the evidence sources used to obtain information on design features come in two primary forms:

1. **Active Knowledge**

   Knowledge that designers acquire on their own, either through designing the built environment themselves, or by experiencing it vicariously through the designs of others (Wanigarathna, 2014; Wanigarathna, 2019).

   e.g. *A designer using past experience and memory in practice*

2. Passive Knowledge

Knowledge that designers acquire from secondary sources, without any direct interaction or vicarious experience with the built environment (Wanigarathna, 2014; Wanigarathna, 2019).

e.g. *A designer using solutions published within published guidance*

It is most often the case that designers use both active and passive knowledge pools for re-use in practice, although the effectiveness of passive knowledge use remains heavily contested in the literature.

For instance, Fruchter & Demain(2002) state that the number one factor limiting how applicable passive knowledge is in practice is that designers almost never have full contextual and informal knowledge to the design cases in question, and may consequently fail to understand the rationale behind a given design solution, and why it proved successful in a particular case.

Another ~~logical~~ reason which may limit the re-usability of designs in healthcare is the fact that healthcare administration will want to keep details of their most successful design features secret, since such details are typically a primary source of competitive advantage for healthcare providers, making releasing them for the use of competitors a strategically damaging move.

After listing the most common design components available in ~~literary~~ literaturesources of knowledge, a close-up review and analysis of the features of an environment should be conducted to record which of these items are currently provided in the facility, and which are not. A sample of data that could potentially be collected about a certain design feature is shown in Table 45. Furthermore, to help the reader understand each item, sample items from this study were provided as examples. This is to showcase that this structure was specifically tailored to the context of the built environment in healthcare, and that it should be adopted in a way such that it is adapted to the environment in question.

Table 45
List of Items & Considerations in Recording Design Components

Category	Item	Example(s)
Environment	**Description**	Healthcare Facility

	Type	Hospital Ward
	Unit(s)	Patient Room, Nursing Station
	Zone(s)	Patient Zone, Staff Zone
Component	**Primary Object**	Nursing Station
	Quality/Feature	Decentralized/Nuclear Layout
	Contrasting	Centralized/Standard Layout
	Relational Object	Patient Bed
	Quality/Feature	Visible from Station
	Contrasting	Non-Visible from Station
Users	**Direct User**	Inpatients
	Indirect User	N/A
Notes		N/A

Altringer (2010) establishes the need for research to be conducted linking design and healthcare; stating that while there has been renewed focus on the field over the course of the past decade, proven links upon which developmental policies are based have been very few and limited in nature.

Therefore, the implementation of any design change or intervention must at least be carried out following a rigorous study conducted by the organization/institution/party in question, as to evaluate the extent to which current indicators are reliable as a measure of the effect of design changes on patients' satisfaction and well-being.

Commented [A42]: [104] Finished sentence

6.2.5 Step 5: Evaluating Perspectives & Decisions

The primary issue in applications of evidence in practice is the complexity inherent to healthcare facilities and different design interventions, which makes it almost impossible for there to be a 100% correct standpoint on which factors are most influential with regard to the build environment (Ulrich et al., 2008)

Among the most influential themes that the researcher felt was inadequately modelled in the literature was the correlations between design users and stakeholders of healthcare facilities, and how those correlations should be integrated in the environmental design process. While this study did not single-handedly focus on the needs of other healthcare users in much detail, the correlations identified between the needs of other stakeholders, and whether any crossover exists in terms of the shared impacts of design on needs.

Furthermore, looking beyond just the stakeholder and user groups of the environment, the external context can also play a major role in determining the implementation of design changes in the environment.

For instance, according to Shepley & Song (2014), the economic context in which a country's circumstances lie has a huge impact on the healthcare infrastructure of that country. In fact, in a review of more than 500 articles in the EBD literature on a global scale, the authors point out that the total healthcare expenditures often parallel the prevalence of healthcare environmental design research.

As such, examining the context of this study, design research conducted in developing countries should be focused on factors such as infection control, rather than more leisure aspects, such as SORs, or privacy in those rooms (Abbas, 2012).

In the context of environmental design, the decision to research/study any given component is outlined in a simple and effective model by Hamilton & Watkins (2006), shown in Figure 40. Framing the concept of decision-making in research ~~is~~ insuch simple questions and responses, the authors attempt to reduce the room for mistakes~~that researchers have~~ in the decision-making process of conducting research, by minimizing the room for error due to misinterpretation and technicalities.

Figure 40

Criteria for Value of Decision-to-Research in Evidence-Based Design

Source: Adapted from Hamilton & Watkins (2006), as cited in Malkin (2008)

In accordance with the four level's identified in IOM's 2001 report (IOM, 2001), different participant groups are identified who contribute to discussions of patient-centred care. The four groups are as follows:

Experience Level

First and foremost, this level refers to the individual patient's experience of healthcare. At the experience level, care is more focused on the individual needs of the patients themselves, and the participation of patients and their family members is encouraged.

Clinical Micro-System Level

This level refers to healthcare service provision on a scale larger than that of individual hospital patients, but not yet quite at the scale of the organization as a whole. Such a level is concerned with the perspective of relevant departments and programs, such as members of a quality improvement team.

Organisational Level

This level overlaps a single clinical micro-system level, encompassing all clinical micro-systems in a healthcare organization. At this level, all key stakeholders are relevant participants in discussions; including public consumers who do not (yet) have direct interaction with the healthcare environment.

Environmental Level

Finally, this level refers to the regulatory level of a healthcare system. This level includes the various previously mentioned stakeholders at organisational levels, who are encouraged to partake in discussions informing local, state and international healthcare policy. Policymakers and regulators, in turn, contribute their share by offering reimbursement incentives to support the engagement of patients and other stakeholders in the healthcare decision-making process.

A common misconception about healthcare interventions aimed at meeting patients is that such interventions must necessarily be costly; especially in larger healthcare organizations. Altringer (2010) refutes this claim, stating that many interventions "…have not only been well received by the patients and staff, but have also proved financially viable.

6.2.6 Step 6: Implementing Environmental Design Reform

Building further upon the performance gap section of this report, Coleman et al. (2018) identified three important performance gaps between design and implementation, which are:

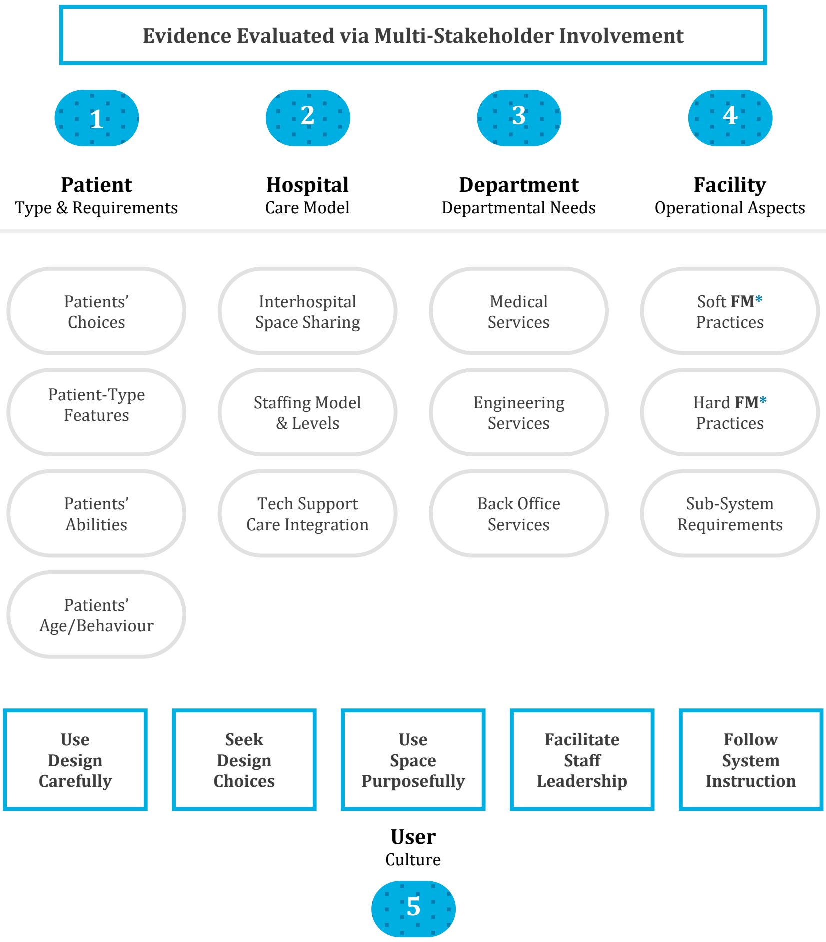
1. Prediction Gaps: Constitute differences in predicted vs. actual use of resources.
2. Expectations Gaps: Designer expectations regarding the performance of an environment, in comparison to the actual tested post-occupancy evaluations of the building's residents.
3. Outcomes Gaps: What is most often understood to be a performance gap, in terms of measured vs actual performance results

Taking into account these different gaps will enable relevant regulators to set milestones and establish general future directions and set future goals for economic sectors as a whole, and for projects on a more individual level.

Referring back to the fourth step of the process, and to the re-use of findings from research, it is important to consider a number of different criteria to allow for the effective re-use of environmental design knowledge in practice. In a recent study, Wanigarathna et al. (2019) applied a thematic approach in the analysis of three case studies of design re-use. The authors identified four key criteria elements that determined whether a design intervention should be applied as is, with little change, or not at all. These criteria are shown in Figure 41.

Figure 41

Criteria for Effective Design Re-Use in Healthcare



***FM**	Facilities Management

Source: Adapted from Wanigarathna et al. (2019)

While it may be unlikely that this model specifically can be applied as is in any given scenario, that is not its intended use by the author. Rather, the model serves to outline how the needs and outcomes of different stakeholder groups could be taken into account in the implementation of long-term change in healthcare facilities.

According to Malone & Dellinger (2011), maximizing the outcomes of infrastructure investments, such as technology, equipment, and furniture, requires an "internal synergy of effort between leaders who can transform organizational culture, and a staff that can reengineer clinical and administrative processes."

Synergy, in this sense, can refer to either the synergy of different design components, or synergy between the different user and stakeholder groups. Both of these considerations must be taken into account for the implemented changed to work as intended, as the majority of stakeholders often have an important role to play in that regard.

Post-implementation, the act of monitoring progress based on predefined criteria and goals is another key consideration that ensures the success of any reform strategy in any industry. In accordance with the observed monitoring results, the key decision-makers can then apply the necessary changes to either enhance the changes implemented, integrate other changes alongside the original ones to observe the outcomes, or decide upon a cost-effective way to reduce unintended harms in a timely manner.

6.2.7 Summary of the Steps

Based on the ideas mentioned earlier, the six steps comprising the Needs Realization Management Process can be summarized as follows:

1. **Step One: Determining Environmental Stakeholders and Users**

   Involves establishing who the different parties relevant to the design of the environment are, and classifying those parties into groups in a way that is meaningful in practice and application, based on their contribution, and the extent to which they are influenced by/have influence over the environment.

2. **Step Two: Identifying Stakeholder Needs and Outcomes**

   Involves identifying the different needs and outcomes associated with each stakeholder (inclusive of users), focusing mainly on the needs and outcomes of the group central to the discussion, and expanding further to examine how the needs and outcomes of other stakeholders influence this central group.

3. **Step Three: Identifying Environmental Design Components & Features**

Involves identifying all relevant design components and features within the environment, evaluating the extent to it is feasible to implement change to each of those features and environmental components, or making other considerations such as replacing design components whole. Furthermore, in the same way as the previous steps, the different design components/features are classified and categorized in terms of meaningful constructs.

4. **Step Four: Linking Design Components to Needs & Outcomes**

After establishing the particulars of who the relevant user and stakeholder groups are, this step involves linking each of the discussed design components to the different needs and outcomes of each stakeholder group, determining the extent of the impact in terms of individual component, as well as the categorical constructs defined in the previous step.

5. **Step Five: Evaluating Stakeholder Perspectives & Decision-Value**

Involves evaluating the different perspectives of the various stakeholder groups relevant to the discussion, determining the role that each of those stakeholders has to play in facilitating effective change and decision-making in the process of implementing change, and how each group contributes to this implementation.

6. **Step Six: Implementing Environmental Decisions &Reform**

Finally, upon evaluating the perspectives and decision-making criteria, as well as identifying the most pressing environmental design components to change at the current time, the selected decisions are implemented in application, in a manner that allows for the monitoring and evaluation of the actual rate of change caused by the different changes, and incrementally building upon those changes to reflect research and practical findings in the future.

6.3 Process Validation Method

Having described the developed process in-depth, the method undertaken to validate the framework to become the final product shown above is described in this section. Bearing this in mind, it should be noted that the models and explanations shown in the sections above describe the process prior to the validation process. In turn, any edits resulting from the validation process are outlined in Section 7.5 below.

The validation process involved the use of a focus group discussion conducted with 6 academic experts on the field of the study. The discussion took place over a live conference call conducted using Skype; the aim of which was to participate in a meaningful discussion with people familiar with theoretical and practical influences of environmental design on patients' needs.

A full transcript of the focus group meeting is provided in the Appendix D1, however the meeting and discussion can be summarized into the following stages:

- An introductory stage where the researcher introduced the topic of the study, its aims and objectives, the methods used to conduct the study, and the primary findings obtained as a result
- Upon introducing the topic, the process model discussed in the previous section was showcased to the group, and the group were allotted some time afterwards to inquire about the specific details of each step, and the rationale behind the development of each step
- After the respondents were fully informed of the various steps involved in the process, a semi-structured question guide was used to ask open ended questions to begin the feedback and contributions stage, and the group individually contributed their feedback about each individual step, and where they believed the biggest room for improvement was in the process model
- The discussion concluded with a general recap of the discussed topics, and consensus was taken as to the implementation of each idea in a show of votes for the proponents for and against each

6.4 Extended Process Model

The focus group members were selected from a group of design and engineering professionals with more than 15 years of experience each, each of which were an expert in their domain. The professions and specialties of each of the participants is shown in Table 46.

Table 46

Professions and Specialties of Focus Group Participants

Participant	Professional Title	Field of Specialty	Experience (Years)
R1	**Professor**	**Project Management**	**16**
R2	**Civil Engineer, Manager**	**Project Management**	**22**
R3	**Civil Engineer, Manager**	**Facility Design**	**21**
R4	**Engineering Consultant**	**Facility Design**	**25**
R5	**Engineering Consultant**	**Facility Design**	**18**
R6	**Architect, Consultant**	**Facility Design**	**25**

Based on the mutually identified and agreed upon adjustments proposed by the focus group members, the process was evaluated to be a valid process model for implementation, provided that the following minor adjustments be made to different parts of the model to improve applicability, which are summarized in Table 47.

Table 47

Extended Needs Realization Management Process Feedback & Improvements

#	Discussion Point	Consensus Reached?	Recommended Changes
1	Developing a proof-of-concept prototype for practical application	Yes (6/6)	Based on the recommendations of the focus group, the researcher proposes that independent researchers conduct their own practical theoretical and practical critical evaluations of the model process, culminating in the development of a proof-of-concept prototype to aid in the decision-making practicality of the model
2	Integrating the process into an Information Technology application to enhance use and develop a system based on the process model	Yes (5/6)	Furthermore, building on the proof of concept prototype developed in future research, it was also recommended that an IT system be developed using a structured approach for the implementation and monitoring of each of the six steps of the process
3	Separating monitoring of the implemented changes as a seventh step to the process model	Yes (5/6)	Finally, the third implemented change was the addition of a new step of the process, originally integrated into the sixth step, which is to monitor implemented changes on a continuous basis to evaluate the extent to which

	patients are affected by design interventions

6.5 Recommendations

Based on the above-mentioned findings, this section of the report presents some recommendations for research and practice in the field of healthcare environmental design, for both researchers and practitioners. These recommendations are explored in the two subsections below.

6.5.1 Directions for Future Research

Intercorrelation between the needs and outcomes of different facility users remains a yet unexplored topic in contemporary literary sources. As controlled experiments constitute the most credible source of knowledge in the field of environmental design, the researcher also recommends the development of experimental pilot studies to test presumed interactions between the needs/outcomes of different stakeholders in healthcare facilities (See Section 5.3, 5.4, 5.5).

With regard to research in Jordan specifically, similar research should also be conducted in the context of public hospitals in the country—should researchers be able to obtain approval from public hospital administration. The importance of undertaking this research cannot be overstated, as the study's focus on examining patients in private hospitals may neglect relevant findings pertaining to the larger portion treated in public institutions (See Section 4.4.2 and 4.4.3).

Furthermore, healthcare facilities in Jordanian public hospitals are presumed to receive much less care than those of private hospitals of the same scale, as private hospitals are naturally required to maintain a certain standard of care to remain competitive in the private marketplace. As a result, conducting such research in public hospitals may reveal additional issues pertaining to environmental design that remain unaddressed in the Jordanian healthcare system; which is essential to enabling policy-makers to fully comprehend the current status of healthcare in Jordan, and to develop a better understanding of critical matters that need to be addressed sooner, rather than later (See Section 4.4.2).

While the study verified the existence of some links between staff members' outcomes and patients' needs, there needs to be more research conducted in the future cross-examining the different impacts facilitated through the attainment of the needs of one group (who could potentially benefit the needs of another group in turn). The importance of the need of this field of study cannot be overstated, as it can serve to provide real value to maximizing the fulfilment of needs and attainment of outcomes for all involved users and stakeholders (Section 5.5).

Referencing the NRMP (Needs Realization Management Process), a model developed based on the work covered in this research (See Chapter 6), it is recommended based on the validation process conducted (See Section 6.4) that a prototype be developed and evaluated by independent researchers in a similar manner applied in this research, as to test and amend the model's applicability to practical decision-making in environmental design.

6.5.2 Directions for Future Practice

As was repeatedly established over the course of this study, implementing theory in practice has been among the most challenging aspects in the field of healthcare environmental design. And while frameworks such as EBD and POE repeatedly attempt to address the matter of research application, testing ungrounded theory is extremely costly in reality, and plenty more solid evidence is often required before such investments can be warranted (See Section 2.5.1).

Furthermore, policy and regulation often serve as the tool dictating the application of research-based claims in their respective national contexts. However, policymakers and agencies are often hesitant to establish regulations and recommendations for much the same reasons as healthcare providers (See Section 2.4.2).

However, all change must begin somewhere, and while becoming the first to encourage the widespread implementation of theory-based evidence in practice may prove a costly and highly risky decision to make, provided enough expenditure and trial-and-error, these costs and risks may also be potentially met with equivalent benefits over the long-run.

Scaling back to application in the context of national healthcare providers, culture remains a critical, but often overlooked factor that shapes the implementation and application of research findings in practice. It is of considerable importance to factor in any cultural considerations prior to making any major decisions or applications relating to healthcare environmental design, as culture can often serve to diminish the relative importance of one evidence-based design application, in comparison to other applications which may be more warranted (See Section 5.3.1.1).

For instance, while some emphasis was placed on the contribution of family area size to patients' social needs, other studies may find little to no need for such intervention. In such a case, this may be a result of extended family structure being a cultural norm in Jordan and other Arab neighbours, while the same would not be applicable to Western and East Asian nations, for instance (See Section 5.3.1.1).

7 Conclusion

Chapter Overview

This chapter presents a general recap of the study's aims and objectives, along with the researcher's concluding remarks, in accordance with the primary findings of the study and systematic review. The chapter concludes with the main limitations of the study.

7.1 Research Conclusion

This study aimed to investigate the relationship between different design factors and the built environment in healthcare systems, identifying how this environment facilitates the realization of patient needs and outcomes; which can then be implemented in practical applications in hospitals and other healthcare facilities. A systematic review of the literature was used to investigate the various design interventions influence the design of built environment in healthcare. A conceptual framework was developed using the findings of the review, upon which astudy was conducted by the researcher, using two questionnaires distributed to patients and staff members at five hospitals located in Amman, Jordan.

To summarize the fulfilment of the research objectives, the table below summarizes the main links between the objectives and different chapters in the thesis, describing how each objective was resolved, and the contribution of the chapter(s) in resolving each objective.

Table 48: Research Objectives, Links to Chapters

No.	Objective	Linked Chapter	Description
1	***To examine the conceptualization of patient needs in literary works, and explore the practical implications of these conceptualizations***	Chapter 2	**The theoretical review chapter explained past theoretical developments with regard to the use of design in influencing patient outcomes, yielding the concepts and their implications in the context of this research**
2	***To investigate the nature of the relationship between redesigning the built environment to be more patient-centred on the outcomes of patients, as well as other stakeholders such as staff, management, and regulatory authorities.***	Chapter 3	**The systematic review was used to better understand the links between design and patient needs and outcomes in the context of healthcare settings in particular, upon which the main design of the study was modelled**
3	***To assess the role that healthcare environmental design plays in improving patient healing processes, and if possible, isolate causal therapeutic impacts arising from certain design interventions***	Chapter 5	**The primary findings of the study were shown in Chapter 5, in which empirical evidence was obtained linking design to patient healing**
4	***To evaluate whether a performance gap exists between theoretical and practical healthcare environmental design***	Chapter 2, 5	**The performance gaps between theory and practice were evaluated in both the theoretical components of the literature**

No.	Objective	Linked Chapter	Description
	applications, and how a framework can be designed to close such a performance gap		**review, as well as the study's main findings**
5	***To introduce a facility design decision framework, centred around meeting patient (and other users') needs and improving outcomes, conceptualized based on empirical and theoretical research findings***	Chapter 6	**The framework introduced as a result of the findings of both the systematic review and the primary research data is portrayed in the sixth chapter**

Numerous design components and features were found to patients needs and outcomes, mediated via direct functions (e.g. reducing stress & anxiety levels), or via the indirect functions of other users, such as healthcare staff (e.g. enhancing efficiency & workflow). Furthermore, patient needs also appear to be linked to the outcomes of other facility stakeholders, such as family members and hospital administration.

Given the performance gap between the current situation, and what the situation could potentially look like in the future, the need to establish a framework linking the built environment and patient needs/outcomes becomes apparent. Furthermore, this need has been well-established in the fields of design and healthcare both; as the scale of the impact of environmental design on healthcare facility users' safety, social, care and comfort needs are quite apparent.

Chapter 6 introduced the development of a new design framework, referred to as the Needs Realization Management Process, which outlines a series of steps through which the process of environmental design could be linked to patients' and other users' needs, integrating all of those needs together to maximize value and utility gained from the implementation of design changes in healthcare facilities.

The process consists of six steps aimed at enabling practitioners to identify the needs of their target groups and incorporate design enhancements to the facilities in accordance with those needs.

7.2 Limitations

Several limitations of this study must be pointed out, as to enable readers to place research findings in their appropriate context, and aid in the interpretation of the work's validity. Furthermore, these limitations can also serve to contribute to future research in the field of environmental design in Jordan, as researchers aware of the potential limitations of past works may be able to take them into account prior to conducting their own research.

Aside from limitations pertinent to the systematic review process, which are explored in Section 0, the following limitations and shortcomings are acknowledged for this study:

Some cultural aspects may also contribute to shaping the findings of the study, which may only be relevant to the Jordanian population (and the Arab World, by extension). As such, further research may be required for the development of universal and fully generalizable research findings (See Section 5.3.1.1).

Without being too critical of observational research—as it is in many cases too harshly dismissed, an argument could be made for experimental design being more befitting for the purposes of this study. A major limitation preventing the undertaking of controlled experiments is Hospital policy in Jordan, wherein such experiments are highly restricted; a fact that is also supported by the researcher's review of the literature, as none of what few studies were conducted in Jordan were shown to use experimental research designs on hospital inpatients (See Section 3.2.5.5, 3.5).

Among the few stipulations made hospital administration at all 6 sampled hospitals was that management, first and foremost, got to select patients in suitable enough health condition to participate in the study; after which the participants were individually and privately asked whether they wished to participate; under no obligation to do so. As such, this narrowed down the researcher's ability to conduct assessments of individual design components (e.g. lighting, flooring, etc…), as in the majority of cases, there weren't sufficient (or any) comparable groups for which the assessment is to be performed (See Section 4.4.2).

Another limitation is with respect to obtaining objective measurements of noise levels and daylight intensity in patient rooms. Aside from the technical difficulty of obtaining the tools required to perform measurements, maintaining patients' sense of privacy and security was strongly accentuated by hospital administration, and the taking of physical/environmental measurements implicitly prohibited. As not to infringe on patients' privacy and security, the researcher instead opted to replace such measurements with subjective self-reported observations, and evaluations of healthcare facility users (patients and staff members) (See Section 5.3.1.12, 5.3.1.14).

Furthermore, assessment tools such as the FEET (Falls Environment EvaluationTool) developed by Calkins et al. (2012) to evaluate patient safety, as well as the safety assessment tool developed by the CHD both required undertaking measurements for prolonged periods of upto 1 hour within patient rooms. Such a timeframe was simply too long and may be detrimental to the treatment of hospitalized patients, and intrusive to their care and comfort needs (See Section 3.3).

While the range of environmental components can be limitless in theory, many constraints define certain limits to how much intervention can be undertaken by the designers, depending on the capacity and availability of technology; along with many other considerations pertinent to the healthcare administration, such as any budgeting concerns and many other factors that limit real life applications, which should be factored in future research (See Section 2.4.2).

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This section of the study contains all of the sources, references, and materials cited throughout the report. The bibliography is referenced and cited in-text using 1 7th Edition[30] reference style, with a few purposeful, non-technical exceptions[31].

[30]Note: The referencing and citation style used throughout this report is based on the guidelines established by the APA, which have been updated in October, 2019. The new 7th Edition of the APA Publication Manual was used to cite and reference all of the below sources, to the best of the researcher's ability. As a result, some technical differences may be discerned from the 6th Edition referencing, commonly used since its publication in 2009. Most notably the differences in comparison to the previous style include:

A In-text citations are shortened right away from the first instance in the body text

B URLs are no longer preceded by the terms "Retrieved from"

C Up to 20 authors (in contrast to just 6 in earlier Editions) are now included in the entry

[31]Two primary exceptions to the APA Guideline use are with regard to

A DOI formatting, in which the term "DOI:" was set to be excluded by the 7th Edition, but was maintained in this study to distinguish sources with DOIs from those without them, and were colored as they are intended to be hyperlinks to the reference sources (along with other identifiers, including ISBN, ISSN, OCLC and URLs)

B Locations of books and reports' publishers are no longer required in the new edition, but were nonetheless maintained to differentiate between governmental reports and other similar cases, in which a bibliography entry citing the DOS (Department of Statistics), for instance, had some indication to issuer's location

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Commented [A43]: Added whatever references I cited after the changes

Glossary

Presented in Table 49 are some of the most important terms relevant to the discussion presented in the following sections:

Table 49

Needs Realization Management Process, Glossary of Terms

Topic	Term / Definition	Type / Relevant Concepts
Evidence	**Active Knowledge** Knowledge that a designer acquires either via practice, or by vicariously experiencing the designs of others.	**Category / Grouping** *See Contrasting Term* **Passive Knowledge**
Need	**Deficiency Basis (for Needs)** Used in reference to needs that an individual would no longer be motivated to pursue once initially fulfilled.	**Category / Grouping** *See Contrasting Term* **Growth Basis**
Design	**Design Re-Use** The process whereby a designer integrates a well-tried past design intervention/feature into new practical design applications; either as is or introducing change in the process to adapt the design to its new environment.	**Activity / Process**
Evidence	**Empirical Approach** The classic trial and error approach to conducting research, where an observation is via direct sensory interaction and interpretation.	**Method** *See Relevant Term* **Scientific Approach**
Evidence	**Scientific Approach** An approach to conducting research where a specialized instrument/tool is used to explore and measure the properties of something.	**Method** *See Relevant Term* **Empirical Approach**
Design	**Environmental Design** The process of addressing surrounding environmental parameters when developing buildings, plans, programs or policy, seeking to people's interactions with and perceptions of that area.	**Activity / Process**
Design	**Evidence-Based Design** The process of constructing a built environment, undertaken using the maximum amount of evidence, critically applied from credible research sources, aimed at improving the health outcomes of the different users of healthcare facilities	**Activity / Process**
Need	**Growth Basis (for Needs)** Used in reference to needs that an individual would be further motivated to pursue once initially fulfilled.	**Category / Grouping** *See Contrasting Term* **Deficiency Basis**
Evidence	**Passive Knowledge** Knowledge that a designer acquires from secondary sources, without having interacted with or vicariously experienced the design.	**Category / Grouping** *See Contrasting Term* **Active Knowledge**
Need	**Basic Need** Those needs which are fundamental, minimal aspects of living; required for physical survival.	**Category / Grouping** *See Contrasting Term* **Higher Need**

Glossary

Topic	Term / Definition	Type / Relevant Concepts
Need	**Higher Need** A higher order of need, which is associated with personal growth and self-fulfilment. Can only be fulfilled once basic needs are met.	**Category / Grouping** *See Contrasting Term* **Basic Need**
Population	**Users** A term used to denote all past and current individuals who directly interact with an environment. Those who may potentially interact with the built environment in the future (i.e. the general public, in context of healthcare) are excluded from this population.	**Category/Grouping** *See Similar Term* **Stakeholder**
Population	**Stakeholder** A term used to denote anyone who is, in any way, invested in, affected by, or a party of interest to a built environment. Those who may potentially be of interest in the future (i.e. the general public, in the context of healthcare) are excluded from this population.	**Category/Grouping** *See Similar Term* **User**

Appendices

Appendix A

Supplements to Systematic Review

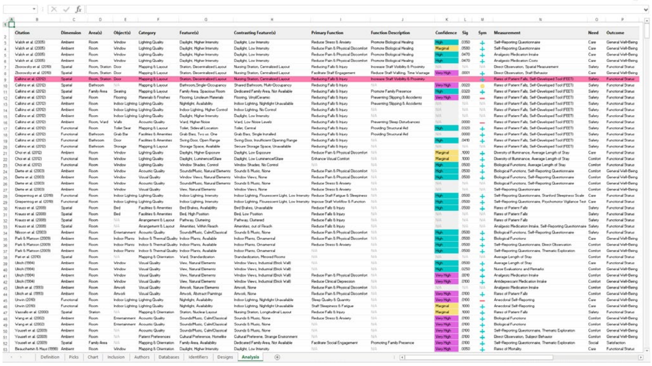
A.1 Partial Dataset Samples, MS Excel

Figure 42

Systematic Review, Partial Dataset Sample, MS Excel, Uncoded Analysis Data

Studies (n = 17); Entries (n=50)

Red Highlight Excluded entry from Calkins et al. (2012), for High Bias



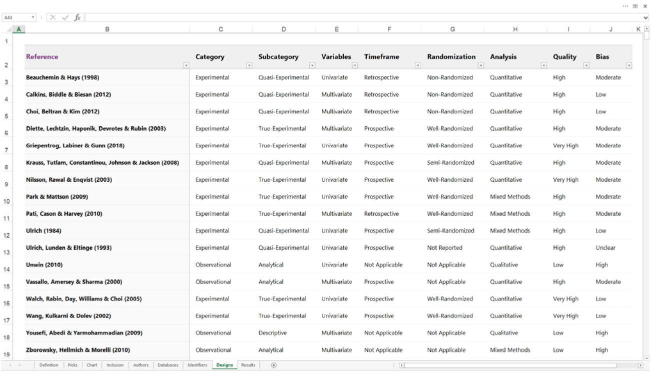
Fields, listed in consecutive order from left to right:

Citation, Dimension, Area(s), Object(s), Category, Feature(s), Contrasting Feature(s), Primary Function, Function Description, Confidence, Significance, Symbol (Relationship), Measurement, Need, Outcome

Figure 43

Systematic Review, Partial Dataset Sample, MS Excel, Uncoded Design Data

Studies (n = 17); Entries (n=17)



Reference	Category	Subcategory	Variables	Timeframe	Randomization	Analysis	Quality	Bias
Beauchemin & Hays (1998)	Experimental	Quasi-Experimental	Univariate	Retrospective	Non-Randomized	Quantitative	High	Moderate
Calkins, Biddle & Biesan (2012)	Experimental	Quasi-Experimental	Multivariate	Retrospective	Non-Randomized	Quantitative	High	Low
Choi, Beltran & Kim (2012)	Experimental	Quasi-Experimental	Multivariate	Retrospective	Non-Randomized	Quantitative	High	Low
Diette, Lechtzin, Haponik, Devrotes & Rubin (2003)	Experimental	True-Experimental	Multivariate	Prospective	Well-Randomized	Quantitative	High	Moderate
Griepentrog, Labiner & Gunn (2018)	Experimental	True-Experimental	Univariate	Prospective	Well-Randomized	Quantitative	Very High	Moderate
Krauss, Tutlam, Constantinou, Johnson & Jackson (2008)	Experimental	Quasi-Experimental	Multivariate	Prospective	Semi-Randomized	Quantitative	High	Moderate
Nilsson, Rawal & Enqvist (2003)	Experimental	True-Experimental	Univariate	Prospective	Well-Randomized	Quantitative	Very High	Moderate
Park & Mattson (2009)	Experimental	True-Experimental	Univariate	Prospective	Well-Randomized	Mixed Methods	High	Moderate
Pati, Cason & Harvey (2010)	Experimental	True-Experimental	Multivariate	Retrospective	Well-Randomized	Mixed Methods	High	Moderate
Ulrich (1984)	Experimental	Quasi-Experimental	Univariate	Prospective	Semi-Randomized	Mixed Methods	High	Low
Ulrich, Lunden & Eltinge (1993)	Experimental	Quasi-Experimental	Univariate	Prospective	Not Reported	Quantitative	High	Unclear
Unwin (2010)	Observational	Analytical	Univariate	Not Applicable	Not Applicable	Qualitative	Low	High
Vassallo, Amersey & Sharma (2000)	Observational	Analytical	Multivariate	Prospective	Not Applicable	Quantitative	High	Moderate
Walch, Rabin, Day, Williams & Choi (2005)	Experimental	True-Experimental	Univariate	Prospective	Well-Randomized	Quantitative	Very High	Low
Wang, Kulkarni & Dolev (2002)	Experimental	True-Experimental	Univariate	Prospective	Well-Randomized	Quantitative	Very High	Low
Yousefi, Abedi & Yarmohammadian (2009)	Observational	Descriptive	Multivariate	Not Applicable	Not Applicable	Qualitative	Low	High
Zborowsky, Hellmich & Morelli (2010)	Observational	Analytical	Multivariate	Not Applicable	Not Applicable	Mixed Methods	Low	High

Fields, listed in consecutive order from left to right:

Reference, Category, Subcategory, Variables, Timeframe, Randomization, Analysis, Quality, Bias

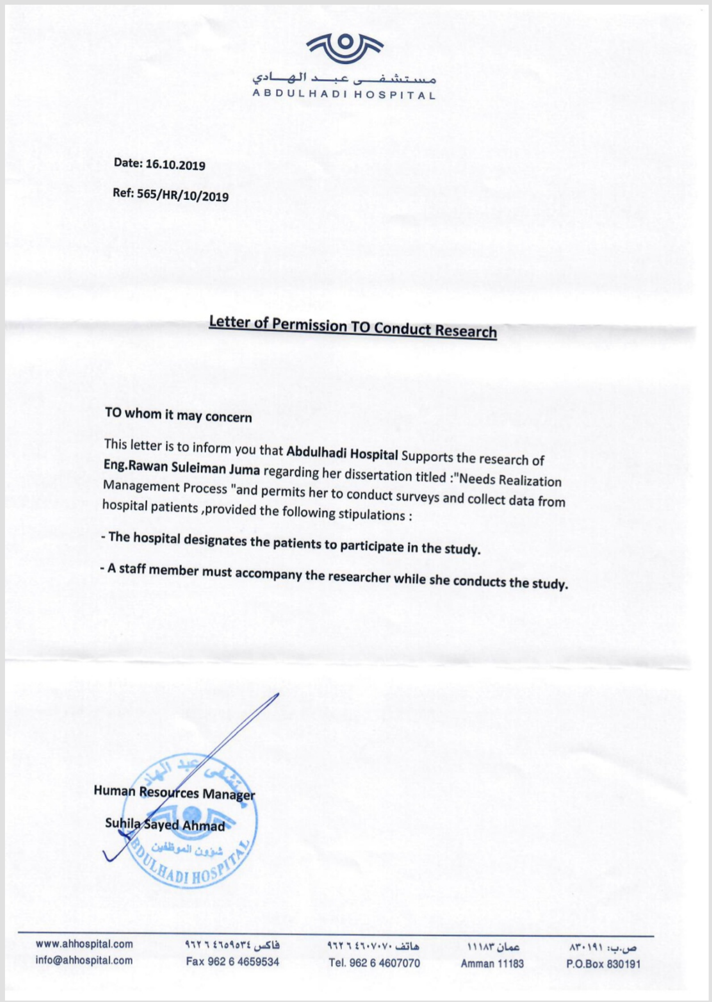
Appendix B

Supplements to Methodology

B.1 Letters of Permission to Conduct Research

Figure 44

AbdulHadi Hospital, Letter of Permission



مستشفى عبد الهادي
ABDULHADI HOSPITAL

Date: 16.10.2019

Ref: 565/HR/10/2019

Letter of Permission TO Conduct Research

TO whom it may concern

This letter is to inform you that **Abdulhadi Hospital** Supports the research of **Eng.Rawan Suleiman Juma** regarding her dissertation titled :"Needs Realization Management Process "and permits her to conduct surveys and collect data from hospital patients ,provided the following stipulations :

- **The hospital designates the patients to participate in the study.**
- **A staff member must accompany the researcher while she conducts the study.**

Human Resources Manager

Suhila Sayed Ahmad

مستشفى عبد الهادي
شؤون الموظفين
ABDULHADI HOSPITAL

www.ahhospital.com
info@ahhospital.com

فاكس ٩٦٢٦ ٤٦٥٩٥٣٤
Fax 962 6 4659534

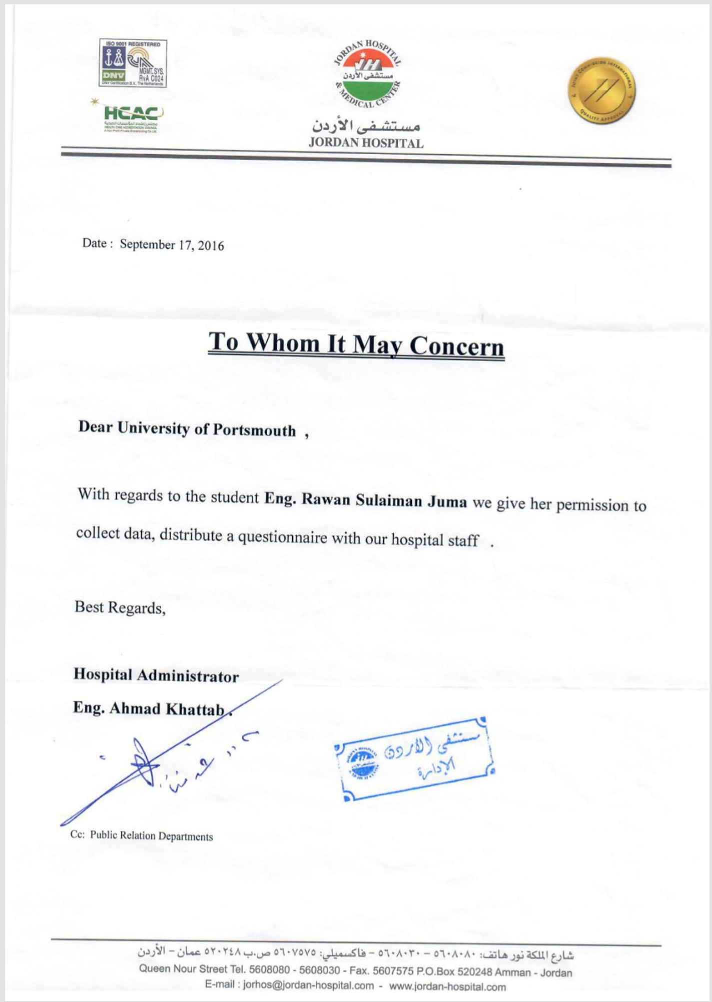
هاتف ٩٦٢٦ ٤٦٠٧٠٧٠
Tel. 962 6 4607070

عمان ١١١٨٣
Amman 11183

ص.ب: ٨٣٠١٩١
P.O.Box 830191

Figure 45

Jordan Hospital, Letter of Permission (1)



مستشفى الأردن
JORDAN HOSPITAL

Date : September 17, 2016

To Whom It May Concern

Dear University of Portsmouth ,

With regards to the student **Eng. Rawan Sulaiman Juma** we give her permission to collect data, distribute a questionnaire with our hospital staff .

Best Regards,

Hospital Administrator

Eng. Ahmad Khattab .

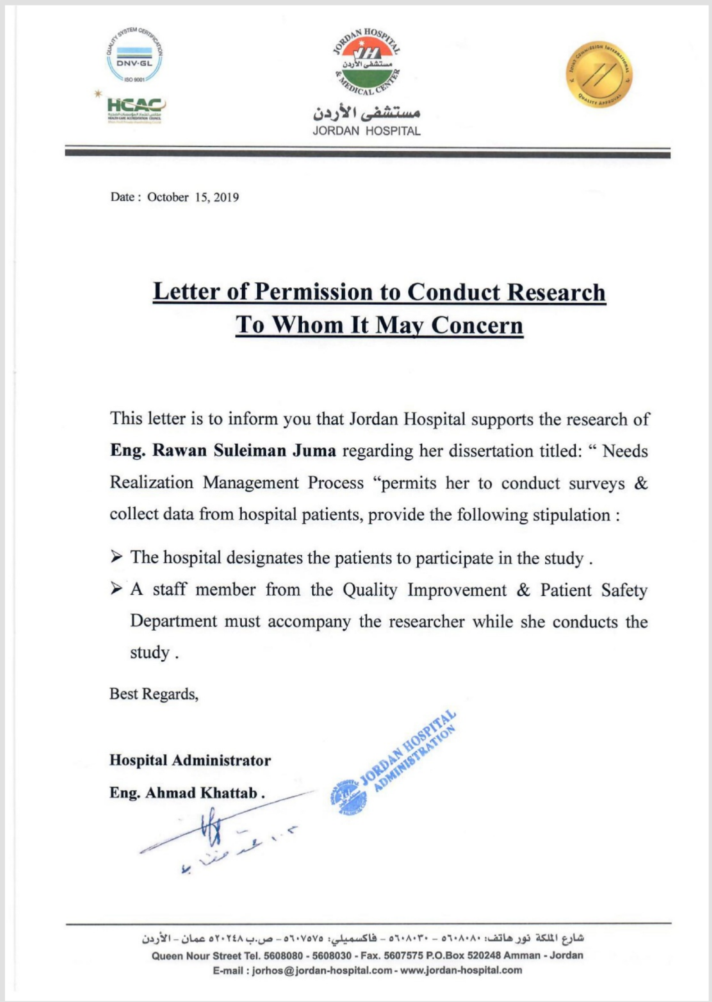
مستشفى الأردن
الإدارة

Cc: Public Relation Departments

شارع الملكة نور هاتف: ٥٦٠٨٠٨٠ – ٥٦٠٨٠٣٠ – فاكسميلي: ٥٦٠٧٥٧٥ ص.ب ٥٢٠٢٤٨ عمان – الأردن
Queen Nour Street Tel. 5608080 - 5608030 - Fax. 5607575 P.O.Box 520248 Amman - Jordan
E-mail : jorhos@jordan-hospital.com - www.jordan-hospital.com

Figure 46

Jordan Hospital, Letter of Permission (2)



مستشفى الأردن
JORDAN HOSPITAL

Date : October 15, 2019

Letter of Permission to Conduct Research
To Whom It May Concern

This letter is to inform you that Jordan Hospital supports the research of **Eng. Rawan Suleiman Juma** regarding her dissertation titled: " Needs Realization Management Process "permits her to conduct surveys & collect data from hospital patients, provide the following stipulation :

- The hospital designates the patients to participate in the study .
- A staff member from the Quality Improvement & Patient Safety Department must accompany the researcher while she conducts the study .

Best Regards,

Hospital Administrator

Eng. Ahmad Khattab .

JORDAN HOSPITAL ADMINISTRATION

شارع الملكة نور هاتف: ٥٦٠٨٠٨٠ – ٥٦٠٨٠٣٠ – فاكسميلي: ٥٦٠٧٥٧٥ – ص.ب ٥٢٠٢٤٨ عمان – الأردن
Queen Nour Street Tel. 5608080 - 5608030 - Fax. 5607575 P.O.Box 520248 Amman - Jordan
E-mail : jorhos@jordan-hospital.com - www.jordan-hospital.com

Figure 47

Ibn-Al Haitham Hospital, Letter of Permission

IBN - AL HAITHAM HOSPITAL

مستشفى ابن الهيثم

Date: 14/10/2019

Letter Of Permission To Conduct Research

To whom it may concern

This letter is to inform you that **Ibn Alhaytham Hospital** supports the research of Eng. Rawan Suleiman Juma regarding her dissertation titled:**"Needs Realization Management Process"** & permits her to conduct surveys & collect data from hospital patients, provided the following stipulations:

- The hospital designates the patients to participate in the study.
- A staff member from the Quality Improvement & Patient Safety Department must accompany the researcher while she conducts the study.

Quality Improvement & Patient Safety Director
Dr. Ghada Alkhatib

دائرة تطوير الجودة وسلامة المرضى

Figure 48

Gardens Hospital, Letter of Permission

مستشفى الجاردنز
GARDENS HOSPITAL

Date: 14.10.2019

Ref: 823/GH/8/2019

Letter Of Permission To Conduct Research

To whom it may concern

This letter is to inform you that Gardens Hospital supports the research of Eng. **Rawan Suleiman Juma** regarding her dissertation titled: **"Needs Realization Management Process"** and permits her to conduct surveys and collect data from hospital patients, provided the following stipulations:

- The hospital designates the patients to participate in the study.
- A staff member must accompany the researcher while she conducts the study.

Human Resources Director

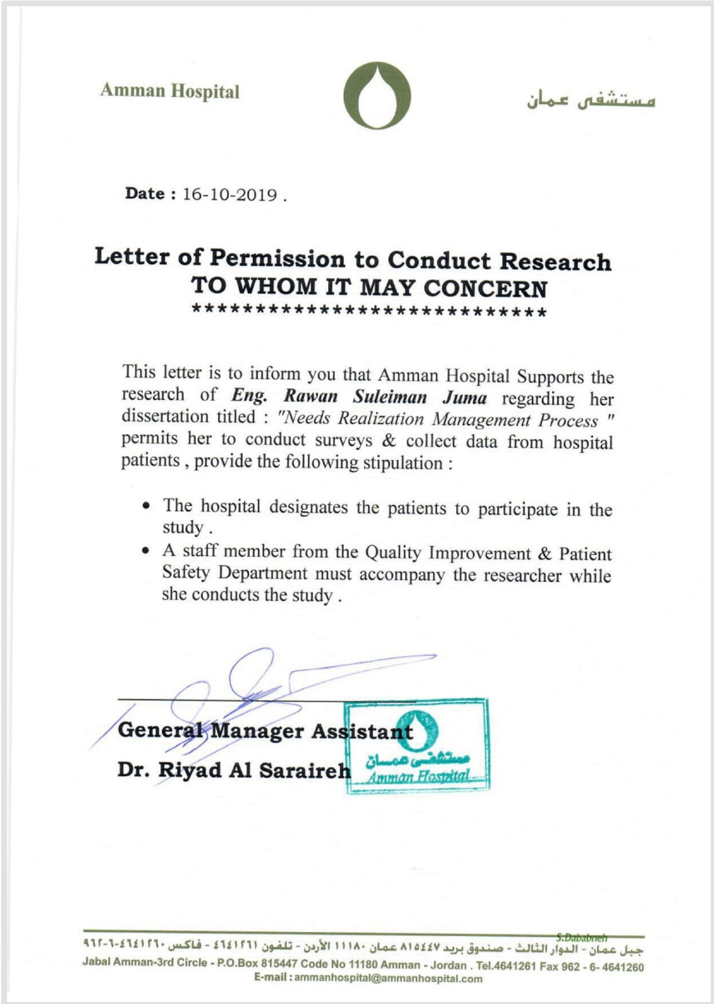
Dr. Majdi Abu Al Hija'a

-14.10.2019-

Address : Wasfi Al - Tal Street
Tel. : 06 5777 111
Fax : 06 5777 110
Mob: 079 736 5555

Figure 49

Amman Hospital, Letter of Permission



Amman Hospital مستشفى عمان

Date : 16-10-2019 .

Letter of Permission to Conduct Research
TO WHOM IT MAY CONCERN

****

This letter is to inform you that Amman Hospital Supports the research of ***Eng. Rawan Suleiman Juma*** regarding her dissertation titled : *"Needs Realization Management Process "* permits her to conduct surveys & collect data from hospital patients , provide the following stipulation :

- The hospital designates the patients to participate in the study .
- A staff member from the Quality Improvement & Patient Safety Department must accompany the researcher while she conducts the study .

General Manager Assistant
Dr. Riyad Al Saraireh

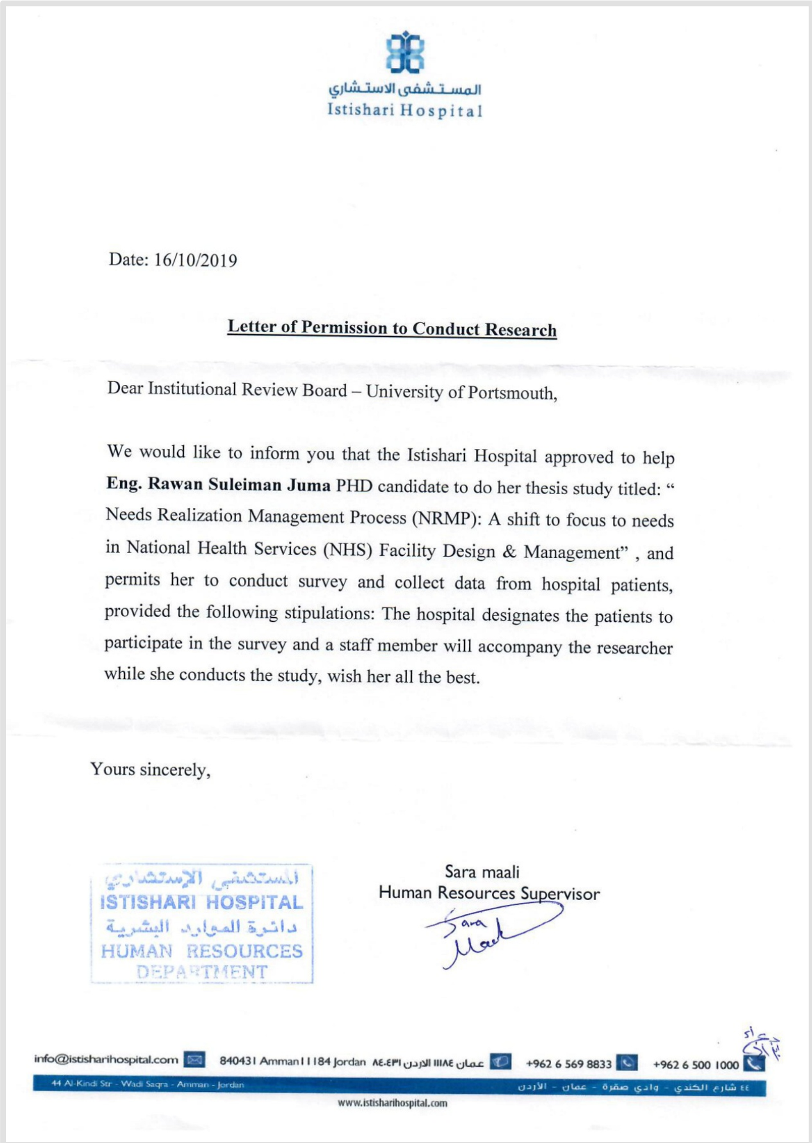
مستشفى عمان
Amman Hospital

S.Dababneh

جبل عمان - الدوار الثالث - صندوق بريد ٨١٥٤٤٧ عمان ١١١٨٠ الأردن - تلفون ٤٦٤١٢٦١ - فاكس ٤٦٤١٢٦٠-٦-٩٦٢
Jabal Amman-3rd Circle - P.O.Box 815447 Code No 11180 Amman - Jordan . Tel.4641261 Fax 962 - 6- 4641260
E-mail : ammanhospital@ammanhospital.com

Figure 50

Istishari Hospital, Letter of Permission



المستشفى الاستشاري
Istishari Hospital

Date: 16/10/2019

Letter of Permission to Conduct Research

Dear Institutional Review Board – University of Portsmouth,

We would like to inform you that the Istishari Hospital approved to help **Eng. Rawan Suleiman Juma** PHD candidate to do her thesis study titled: " Needs Realization Management Process (NRMP): A shift to focus to needs in National Health Services (NHS) Facility Design & Management" , and permits her to conduct survey and collect data from hospital patients, provided the following stipulations: The hospital designates the patients to participate in the survey and a staff member will accompany the researcher while she conducts the study, wish her all the best.

Yours sincerely,

المستشفى الإستشاري
ISTISHARI HOSPITAL
دائرة الموارد البشرية
HUMAN RESOURCES
DEPARTMENT

Sara maali
Human Resources Supervisor
Sara Maali

info@istisharihospital.com 840431 Amman 11184 Jordan عمان ١١١٨٤ الاردن ٨٤٠٤٣١ +962 6 569 8833 +962 6 500 1000
44 Al-Kindi Str - Wadi Saqra - Amman - Jordan ٤٤ شارع الكندي - وادي صقرة - عمان - الأردن
www.istisharihospital.com

Figure 51

Al-Khalidi Hospital & Medical Centre, Sample Letter of Rejection

University of Portsmouth

Dr Salam Al-Bizri
Senior Lecturer
School of Civil Engineering & Surveying
The University of Portsmouth

26 August 2019

Messer's: Al-Khalidi Hospital and Medical Center
Address: Amman, Jordan

To whom it my concern,

This is to certify that Eng. Rawan Sulaiman Juma is a PhD student at the University of Portsmouth and has been assigned to gather data from your reputable hospital to support her PhD thesis.

We really appreciate your support to provide Rawan with the needed information as such.

Faithfully yours,

Salam Al-Bizri

Dear Sir/Madam

According to hospital policy we are not distributing questionaires to patient

[illegible]

B.2 Participant Information Sheet

Dr. Dominic Fox

Head of School
Email: Dominic.fox@port.ac.uk
Telephone: +44 (0) 23 9284 2420

School of Civil Engineering and Surveying

Portland Building
Portland Street
Portsmouth, PO1, 3AH

Participant Information Sheet

Study Title:

Needs Realization Management Process (NRMP): A Shift of Focus to Need-Centred HealthcareService Design and Management in Jordan

Name and Contact Details of Researcher(s): Rawan Juma

Email: rawan.juma@port.ac.uk

Name and Contact Details of Supervisor (if relevant): Salam Al-Bizri

Email: salam.al-bizri@port.ac.uk

REC Ref No: ....

We would like to invite you to take part in our research study. Before you decide we would like you to understand why the research is being done and what it would involve for you. Talk to others about the study if you wish. Ask us if there is anything that is not clear

This research will introduce a process based on Needs Realisation Management processes and investigate if it can improve patient outcomes by linking healthcare building design with patient's needs and expectations from the first stage.

What is the purpose of the study?

The purpose of this research is to examine current design approaches of healthcare facilities adherence to patient's needs satisfaction and establish whether there is a performance gap in healthcare buildings design then investigate whether shifting the focus to need realisation is crucial to bridge this gap hence introducing a new process through which healthcare providers can ensure the delivery of care on the basis of human needs.

Why have I been invited? Do I have to take part?

The participants are chosen according to the sample of data needed in this research; it is up to you to decide to join the study. We will describe the study and go through this information sheet. If you agree to take part, we will then ask you to sign a consent form.

What will happen to me if I take part?

This research has many objectives and taking part in this research you will help to achieve these objectives:

1. To examine how patient needs/outcomes are currently understood by researchers and practitioners

2. To investigate the nature of the relationship between the built environment and the needs/outcomes of different user groups

3. To assess the role that healthcare environmental design plays in improving patient healing processes, and if possible, isolate causal therapeutic impacts pertinent to certain design interventions

4. To evaluate whether a performance gap exists between theoretical and practical healthcare environmental design applications, and how a framework can be designed to shift such a performance gap

5. To introduce a facility design decision framework, centered around the realization of patient (and other users') needs and outcomes, conceptualized based on empirical and theoretical research findings

What will I have to do?

Research participants are expected to filling questionnaires, participate in interview survey.

What are the possible disadvantages and risks of taking part?

There are no known risks associated with participating in this study.

What are the possible benefits of taking part?

The benefits of taking part in this research are to improve health services and achieve better understanding of human needs.

Will my taking part in the study be kept confidential?

If you join the study, it is possible that some of the data collected will be looked at by authorised persons from University of Portsmouth. Data may also be looked at by authorised people to check that the study is being carried out correctly. All will have a duty of confidentiality to you as a research participant and we will do their best to meet this duty.

Participants' data will be collected and stored securely, giving the custodian and level of identifiably (e.g. coded, anonymous, etc.).

It must be clear if the data is to be retained for use in future studies and whether further REC approval will be sought. Authorised persons such as researchers, supervisors, sponsors, regulatory authorities & R&D audit will have access to view identifiable data

Participants have the right to check the accuracy of data held about them and correct any errors.

What will happen if I do not want to carry on with the study?

Once the data have been analysed it might prove impossible to withdraw any individual's personal contribution.

What if there is a problem?

If you have a query, concern or complaint about any aspect of this study, in the first instance you should contact the researcher(s) if appropriate. If the researcher is a student, there will also be an academic member of staff listed as the supervisor whom you can contact. If there is a complaint and there is a supervisor listed, please contact the Supervisor with details of the complaint. The contact details for both the researcher and any supervisor are detailed on page 1.

If your concern or complaint is not resolved by the researcher or their supervisor, you should contact the Head of Department:

The Head of Department, DR DOMINIC FOX, dominic.fox@port.ac.uk, tel: 023 9284 2420

School of Civil Engineering and Surveying

University of Portsmouth
Portland Building, Portland Street, Portsmouth, PO1 3AH

If the complaint remains unresolved, please contact:

The University Complaints Officer, complaintsadvice@port.ac.uk, tel: 023 9284 3642

Appendices

What will happen to the results of the research study?

The result of this research will be published and summarised into a form which would be accessible to participants. Participants will not be identified in any report/publication unless they have given their consent.

Who is organising and funding the research?

This research is fully funded by the researcher.

Who has reviewed the study?

Research in the University of Portsmouth is looked at by independent group of people, called a Research Ethics Committee, to protect your interests.

This study has been reviewed and given a favourable opinion by _________________________ Research Ethics Committee.

Concluding statement

Thank you for taking time to read the information sheet, regardless your decision to participate or not. If you decide to participate you will be given a copy of the information sheet to keep and your consent will be sought.

B.3 Participant Consent Form

Dr. Dominic Fox

Head of School
Email: Dominic.fox@port.ac.uk
Telephone: +44 (0) 23 9284 2420

School of Civil Engineering and Surveying

Portland Building
Portland Street
Portsmouth, PO1, 3AH

Participant Information Sheet

Study Title:

Needs Realization Management Process (NRMP): A Shift A Shift of Focus to Need-Centred HealthcareService Design and Management in Jordan

Name and Contact Details of Researcher(s): Rawan Juma

Email: rawan.juma@port.ac.uk

Name and Contact Details of Supervisor (if relevant): Salam Al-Bizri

Email: salam.al-bizri@port.ac.uk

Please tick the box corresponding to each statement:

1. I confirm that I have read and understand the information sheet dated ………………………. for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.	
3. I understand that data collected during the study, may be looked at by individuals from University or from regulatory authorities. I give permission for these individuals to have access to my data.	
4. I agree to my interview being audio / video recorded.	
5. I agree to being quoted verbatim.	
6. I agree to take part in the above study.	

Name of Participant: ____

Date: ____

Signature: ____

Name of Person Taking Consent: ______________________________

Date: ____

Signature: ____

B.4 Request for Participation in Research Study

School of Civil Engineering and Surveying Researcher(s): Rawan Juma

Email: **rawan.juma@port.ac.uk**

Supervisor: Salam Al-Bizri

Study Title:

Needs Realization Management Process (NRMP): A Shift in Focus to Needs in Health Services Facilities Design and Management

REC Ref No: ………………………………………………………….

Dear Potential Participant,

My name is Rawan Juma, I am a PhD student at The University of Portsmouth and I would like to invite you to participate in a research study about the design of healthcare facilities here in Jordan, and how this design can be tailored to fulfilling patient needs. This focus of the study is to examine how focusing on the human aspect of healthcare facility design can help improve patient healing, and result in an overall better stay at the facility.

I would be very grateful if you would give me 15-20 minutes of your busy schedule to conduct this questionnaire, through which I will briefly ask you about different elements of the healthcare facility's design, and to what extent you are satisfied with these design choices. I will also ask you how each relate to your different needs as a patient.

If you have any questions, now or moving forward, I would be very happy to answer any question you may have and can be contacted on the email address above. If you decide to participate in this research, an information sheet will be given to you and a consent form will be sought.

I look forward to hearing from you in due course. Thanking you in anticipation.

Sincerely,

Rawan Juma

B.5 Patient Questionnaire

Section 1

Patient Demographics & Admission Information

In the first section of this survey, I would like you to begin by telling me a little bit about yourself, and about your stay here at the hospital.

Please answer the following questions:

QN	Question	Item
PQ1.01	What is your gender?	Male
		Female
PQ1.02	What is your age?	Years
PQ1.03	What is your educational background?	No formal education
		High School Diploma
		Technical Degree
		Graduate Degree
		Post-Graduate Degree
PQ1.04	What is your current labour force status?	Employed, Full-Time
		Employed, Part-Time
		Unemployed
		Retired
PQ1.05	Generally speaking, how would you rate your health?	Excellent
		Great
		Good
		Fair
		Poor
PQ1.06	Is this your first stay at this healthcare facility?	Yes

QN	Question	Item
		○ No
PQ1.07	Do you have any health disabilities?	○ Yes
		○ No
		○ Prefer not to say
	If yes, kindly elaborate further:	
PQ1.08	How many days has it been since you were first admitted to this healthcare facility?	Days
PQ1.09	On average, how many friends / family members come to visit you per day?	Visitors
PQ1.10	Have any medical errors/accidents taken place post-admission? (Please tick any and all that apply)	○ Procedural Error
		○ Prescription Error
		○ Infection
		○ Fall / Fall-Related Injury

End of Section 1 of Patient Questionnaire

Section 2

Satisfaction with Spatial Design Features

Spatial Design refers to characteristics relating to the layout, size and arrangement of a physical environment.

In the second section of this survey, I would like to ask you some questions about how you feel about your room and facility's spatial design.

Scale Definition:

1	2	3	4	5	6	7	8	9	10
Strongly Disagree				Neutral					Strongly Agree

Please rate your satisfaction with the following items on the basis of the above scale:

QN	Statement	1 (SD)	2	3	4	5	6	7	8	9	10 (SA)
PQ2.01	I am satisfied with my room's spaciousness in terms of overall capacity and size	○	○	○	○	○	○	○	○	○	○
PQ2.02	I am satisfied with my room's spaciousness in terms of the distance from bed to ceiling	○	○	○	○	○	○	○	○	○	○
PQ2.03	I am satisfied with the size of the seating area, as it allows me to have many family/friends over	○	○	○	○	○	○	○	○	○	○
PQ2.04	I am satisfied with the arrangement of the seating area, as it allows me to have easily communicate with family & friends	○	○	○	○	○	○	○	○	○	○
PQ2.05	I am satisfied with my bed's proximity to the bathroom area	○	○	○	○	○	○	○	○	○	○
PQ2.06	I am satisfied with the spaciousness & size of my bed	○	○	○	○	○	○	○	○	○	○
PQ2.07	I am easily able to find my way around the hospital (ex. Cafeteria, Pharmacy, etc..)	○	○	○	○	○	○	○	○	○	○
PQ2.08	There is sufficient signage, indicating to my visitors and me the locations of any relevant areas within the hospital	○	○	○	○	○	○	○	○	○	○
PQ2.09	The furniture is well spaced-out across the room, and I am able to move around with ease	○	○	○	○	○	○	○	○	○	○

QN	Statement	SD 1	2	3	4	5	6	7	8	9	SA 10
PQ2.10	The stairs and elevators are easy to locate and use throughout the healthcare facility	○	○	○	○	○	○	○	○	○	○
PQ2.11	Having my room close to the nursing station would provide me with a sense of security	○	○	○	○	○	○	○	○	○	○
PQ2.12	Having my bed oriented towards the door would provide me with a sense of security	○	○	○	○	○	○	○	○	○	○

End of Section 2 of Patient Questionnaire

Section 3

Satisfaction with Ambient Design Features

Ambient Design refers to aesthetic and sensory qualities of an environment that enhance user interaction and stimulation with that environment.

In the third section of this survey, I would like to ask you some questions about how you feel about your room's ambient design.

Scale Definition:

1	2	3	4	5	6	7	8	9	10
Strongly Disagree				Neutral					Strongly Agree

Please rate your satisfaction with the following items on the basis of the above scale:

		SD									SA
QN	**Statement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
PQ3.01	I would prefer carpeted floors to tile floors, as they provide a more homely feel to the room	○	○	○	○	○	○	○	○	○	○
PQ3.02	I would prefer carpeted floors to tile floors, as they are less slippery and reduce the likelihood of accidents	○	○	○	○	○	○	○	○	○	○
PQ3.03	I receive sufficient and unobstructed daylight through my room's window	○	○	○	○	○	○	○	○	○	○
PQ3.04	There is a good outdoor space / garden that is easily accessible to me over the course of the day	○	○	○	○	○	○	○	○	○	○
PQ3.05	I am satisfied with the view outside my window	○	○	○	○	○	○	○	○	○	○
PQ3.06	I am satisfied with the quality of indoor light inside my room	○	○	○	○	○	○	○	○	○	○
PQ3.07	I am satisfied with the intensity & brightness of indoor light inside my room	○	○	○	○	○	○	○	○	○	○
PQ3.08	Having artworks of landscape / peaceful scenery would decrease my stress levels and provide visual comfort	○	○	○	○	○	○	○	○	○	○
PQ3.09	I am satisfied with the indoor noise levels coming from the neighbouring rooms	○	○	○	○	○	○	○	○	○	○
PQ3.10	I am satisfied with the indoor noise levels coming from machinery within the room	○	○	○	○	○	○	○	○	○	○
PQ3.11	I am satisfied with the outdoor noise levers coming through the window	○	○	○	○	○	○	○	○	○	○

		SD									SA
QN	Statement	1	2	3	4	5	6	7	8	9	10
PQ3.12	My room is generally clean, well-taken care of, and smells nice	○	○	○	○	○	○	○	○	○	○
PQ3.13	Having cooler (blue/green) walls would make me feel more comfortable than warmer (red/pink) walls	○	○	○	○	○	○	○	○	○	○
PQ3.14	My room is well-ventilated, and the indoor air quality is good	○	○	○	○	○	○	○	○	○	○
PQ3.15	I am satisfied with the fabric quality and materials of my bed and furniture	○	○	○	○	○	○	○	○	○	○

End of Section 3 of Patient Questionnaire

Section 4

Satisfaction with Functional Design Features

Functional Design refers to the extent to which an environment and its components are designed with purposeful consideration that make it more access

In the second section of this survey, I would like to ask you some questions about how you feel regarding the room and facility's spatial design.

Scale Definition:

1	2	3	4	5	6	7	8	9	10
Strongly Disagree				Neutral					Strongly Agree

Please rate your satisfaction with the following items on the basis of the above scale:

		SD									SA
QN	**Statement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
PQ4.01	The room/building design is generally well-suited for disabled individuals	○	○	○	○	○	○	○	○	○	○
PQ4.02	I would feel more comfortable if unused equipment was tucked away until needed	○	○	○	○	○	○	○	○	○	○
PQ4.03	There are sufficient storage spaces for me to safely store my belongings	○	○	○	○	○	○	○	○	○	○
PQ4.04	I would feel more comfortable if I was able to close and open the door, in case I need some privacy	○	○	○	○	○	○	○	○	○	○
PQ4.05	I have sufficient control over the light coming through my window (window shades)	○	○	○	○	○	○	○	○	○	○
PQ4.06	I have sufficient control over the electrical light brightness levels inside my room	○	○	○	○	○	○	○	○	○	○
PQ4.07	I have sufficient control over the temperature inside my room	○	○	○	○	○	○	○	○	○	○
PQ4.08	My current room provides sufficient entertainment/recreational facilities and tools	○	○	○	○	○	○	○	○	○	○
PQ4.09	I am satisfied with the communication tools (ex. telephone) available in my room	○	○	○	○	○	○	○	○	○	○

QN	Statement	SD 1	2	3	4	5	6	7	8	9	SA 10
PQ4.10	Having sinks and other hygiene facilities (for staff members) would make me feel more comfortable	○	○	○	○	○	○	○	○	○	○
PQ4.11	I am able to easily use/access all of the facilities inside my room	○	○	○	○	○	○	○	○	○	○

End of Section 4 of Patient Questionnaire

Section 5

Realization of Needs & Outcomes

In the fifth and final section of this survey, I would like to ask you some general questions on whether you feel that your different needs/outcomes have been fulfilled over the duration of your stay.

Scale Definition:

1	2	3	4	5	6	7	8	9	10
Strongly Disagree				Neutral					Strongly Agree

Please rate your satisfaction with the following items on the basis of the above scale:

		SD									SA
QN	**Statement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
PQ5.01	Sleep Quality & Quality	○	○	○	○	○	○	○	○	○	○
PQ5.02	Health Improvement	○	○	○	○	○	○	○	○	○	○
PQ5.03	Symptom Improvement	○	○	○	○	○	○	○	○	○	○
PQ5.04	Sense of Privacy & Security	○	○	○	○	○	○	○	○	○	○
PQ5.05	Accessibility & Motility (Around the Room)	○	○	○	○	○	○	○	○	○	○
PQ5.06	Accessibility & Motility (Around the Ward)	○	○	○	○	○	○	○	○	○	○
PQ5.07	Accessibility & Motility (Locating Areas)	○	○	○	○	○	○	○	○	○	○
PQ5.08	Safety from Falls & Accidents	○	○	○	○	○	○	○	○	○	○
PQ5.09	Social Communication with Visitors	○	○	○	○	○	○	○	○	○	○
PQ5.10	Social Visits & Stay Durations	○	○	○	○	○	○	○	○	○	○
PQ5.11	Relief from Physical Comfort & Pain	○	○	○	○	○	○	○	○	○	○
PQ5.12	Stress & Anxiety Levels	○	○	○	○	○	○	○	○	○	○
PQ5.13	Sense of Choice & Control	○	○	○	○	○	○	○	○	○	○
PQ5.14	Staff Communication & Information	○	○	○	○	○	○	○	○	○	○
PQ5.15	Hospital-Acquired Infections	○	○	○	○	○	○	○	○	○	○

Considering your earlier responses, please answer the following questions:

QN	Question	Item
PQ5.16	Do you agree that implementing the discussed design features would make for a more effective healing space?	○ Yes
		○ No
		○ Not Sure
PQ5.17	Do you feel like implementing the aforementioned design features would create a facility that is better suited to meet all of your needs as a patient?	○ Yes
		○ No
		○ Not Sure

End of Section 5 of Patient Questionnaire

I understand how valuable your time is, and I am very grateful that you took the time to participate in my survey.

Thank You

End of Patient Questionnaire

B.6 Staff Questionnaire

Section 1

Staff Demographics & Admission Information

In the first section of this survey, I would like you to begin by telling me a little bit about what you do at this hospital

Please answer the following questions:

Ref	Question	Item
SQ1.1	What is your gender?	○ Male
		○ Female
SQ1.2	What is your age?	____ Years
SQ1.3	What is your educational background?	○ No formal education
		○ High School Diploma
		○ Technical Degree
		○ Graduate Degree
		○ Post-Graduate Degree
SQ1.4	What is your current labour force status?	○ Full-Time
		○ Part-Time
SQ1.5	On average, how many hours do you work per week?	○ <20
		○ 20-39
		○ 40-59
		○ >60
SQ1.6	How many years of experience do you have working in the healthcare industry?	○ >1 Year
		○ 1-4 Years
		○ 5-9 Years
		○ <10 Years

Ref	Question	Item
SQ1.7	What is your clinical role at this hospital?	Physician
		Nurse
		Technician
		Therapist
		Assistant
		Other
SQ1.08	What shift are you currently employed?	Morning Shift
		Night Shift
		Both/Either Shift
SQ1.09	In which department are you currently employed?	Accidents
		Burns
		Cardiology
		Critical Care
		Emergency
		General
		Infections
		Maternity
		Neurology
		Orthopaedics
		Paediatrics
		Respirology
SQ1.10	How would you rank your current knowledge in the fields of environmental design in healthcare studies?	Excellent
		Great
		Good
		Fair

Ref	Question	Item
		○ Poor

End of Section 1 of Staff Questionnaire

Appendices

Section 2

Design Components Affecting Patient Safety Needs

In this section, we will examine the design components you believe affect patient safety:

Scale Definition:

1	2	3	4	5	6	7	8	9	10
Strongly Disagree				Neutral					Strongly Agree

Please rate the following design components in terms of how significantly they impact patient safety needs, as mediated by staff members:

		SD									SA
QN	**Statement**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SQ2.01	Nursing Station Orientation	○	○	○	○	○	○	○	○	○	○
SQ2.02	Exposure to Daylight	○	○	○	○	○	○	○	○	○	○
SQ2.03	Lighting Ambience/Type	○	○	○	○	○	○	○	○	○	○
SQ2.04	Lighting Illuminance/Brightness	○	○	○	○	○	○	○	○	○	○
SQ2.05	Noise Coming from the Ward	○	○	○	○	○	○	○	○	○	○
SQ2.06	Noise Coming from the Equipment	○	○	○	○	○	○	○	○	○	○
SQ2.07	Noise Coming from the External Premises	○	○	○	○	○	○	○	○	○	○
SQ2.08	Sink Orientation	○	○	○	○	○	○	○	○	○	○
SQ2.09	Room Standardization	○	○	○	○	○	○	○	○	○	○

End of Section 2 of Staff Questionnaire

Section 3

Design Components Affecting Patient Care Needs

In this section, we will examine the design components you believe affect patient care:

Scale Definition:

1	2	3	4	5	6	7	8	9	10
Strongly Disagree				Neutral					Strongly Agree

Please rate the following design components in terms of how significantly they impact patient care needs, as mediated by staff members:

QN	Statement	SD 1	2	3	4	5	6	7	8	9	SA 10
SQ3.01	Lighting Ambience/Type	○	○	○	○	○	○	○	○	○	○
SQ3.02	Lighting Illuminance/Brightness	○	○	○	○	○	○	○	○	○	○
SQ3.03	Daylight Exposure	○	○	○	○	○	○	○	○	○	○
SQ3.04	Using Carpeting for Flooring	○	○	○	○	○	○	○	○	○	○
SQ3.05	Sink Orientation Towards Patient	○	○	○	○	○	○	○	○	○	○
SQ3.06	Acuity-Adaptable Rooms	○	○	○	○	○	○	○	○	○	○
SQ3.07	Control over Doors	○	○	○	○	○	○	○	○	○	○
SQ3.08	Control over Temperature	○	○	○	○	○	○	○	○	○	○

End of Section 3 of Staff Questionnaire

Section 4

Design Components Affecting Patient Social Needs

In this section, we will examine the design components you believe affect patient social behaviour:

Scale Definition:

1	2	3	4	5	6	7	8	9	10
Strongly Disagree				Neutral					Strongly Agree

Please rate the following design components in terms of how significantly they impact patient social needs, as mediated by staff members:

QN	Statement	1 (SD)	2	3	4	5	6	7	8	9	10 (SA)
SQ4.01	Spaciousness of Seating Area	○	○	○	○	○	○	○	○	○	○
SQ4.02	Nursing Station Proximity	○	○	○	○	○	○	○	○	○	○
SQ4.03	Control over Door	○	○	○	○	○	○	○	○	○	○
SQ4.04	Communication Tools (e.g. Phones)	○	○	○	○	○	○	○	○	○	○
SQ4.05	Bed Orientation to Door	○	○	○	○	○	○	○	○	○	○

End of Section 4 of Staff Questionnaire

Section 5

Staff Outcomes & Patient Needs

In this section, we will examine your outcomes as a healthcare staff member, and to what extent you perceive them to impact patients' different needs:

Scale Definition:

1	2	3	4	5	6	7	8	9	10
Strongly Disagree				Neutral					Strongly Agree

Please rate the extent to which you feel the environmental design of the facility impacts your following outcomes in your capacity as a staff member:

		SD									SA
QN	Outcome	1	2	3	4	5	6	7	8	9	10
SQ5.01	Enhancing Job Satisfaction	○	○	○	○	○	○	○	○	○	○
SQ5.02	Enhancing Efficiency & Workflow	○	○	○	○	○	○	○	○	○	○
SQ5.03	Enhancing Visibility & Engagement	○	○	○	○	○	○	○	○	○	○
SQ5.04	Reducing Sleepiness & Fatigue	○	○	○	○	○	○	○	○	○	○
SQ5.05	Reducing Contamination & Infection	○	○	○	○	○	○	○	○	○	○

Furthermore, please rate the extent of impact of each of those outcomes on the different patient needs:

		SD									SA
QN	Outcome	1	2	3	4	5	6	7	8	9	10
SQ5.01	Enhancing Job Satisfaction										
a	**Patient Safety Needs**	○	○	○	○	○	○	○	○	○	○
b	**Patient Comfort Needs**	○	○	○	○	○	○	○	○	○	○
c	**Patient Social Needs**	○	○	○	○	○	○	○	○	○	○
d	**Patient Care Needs**	○	○	○	○	○	○	○	○	○	○
SQ5.02	Enhancing Efficiency & Workflow										
a	**Patient Safety Needs**	○	○	○	○	○	○	○	○	○	○

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		SD									SA
QN	Outcome	1	2	3	4	5	6	7	8	9	10
b	**Patient Comfort Needs**	○	○	○	○	○	○	○	○	○	○
c	**Patient Social Needs**	○	○	○	○	○	○	○	○	○	○
d	**Patient Care Needs**	○	○	○	○	○	○	○	○	○	○
SQ5.03	Enhancing Visibility & Engagement										
a	**Patient Safety Needs**	○	○	○	○	○	○	○	○	○	○
b	**Patient Comfort Needs**	○	○	○	○	○	○	○	○	○	○
c	**Patient Social Needs**	○	○	○	○	○	○	○	○	○	○
d	**Patient Care Needs**	○	○	○	○	○	○	○	○	○	○
SQ5.04	Reducing Sleepiness & Fatigue										
a	**Patient Safety Needs**	○	○	○	○	○	○	○	○	○	○
b	**Patient Comfort Needs**	○	○	○	○	○	○	○	○	○	○
c	**Patient Social Needs**	○	○	○	○	○	○	○	○	○	○
d	**Patient Care Needs**	○	○	○	○	○	○	○	○	○	○
SQ5.05	Reducing Contamination & Infection										
a	**Patient Safety Needs**	○	○	○	○	○	○	○	○	○	○
b	**Patient Comfort Needs**	○	○	○	○	○	○	○	○	○	○
c	**Patient Social Needs**	○	○	○	○	○	○	○	○	○	○
d	**Patient Care Needs**	○	○	○	○	○	○	○	○	○	○

End of Section 5 of Staff Questionnaire

Section 6

Patient Matching and Outcomes

Finally, in this section, you are asked to evaluate, from your perspective as a healthcare professional, the outcomes of the different patients included in this study's sample, to which you provide immediate care:

Firstly, based on the list of included participants provided to you by the researcher, please state which of the patients, if any, you tend to on a direct basis:

	Room Number	Participant Number
Patient 1		
Patient 2		
Patient 3		
Patient 4		
Patient 5		

1	2	3	4	5	6	7	8	9	10
Poor				Neutral					Excellent

Next, based on the scale shown above, please provide an estimate of how you would rate the general well-being and functional status of each of the patients listed above.

If you are uncertain or feel hesitant above the response you provided, please tick the question mark field to the right of the numbered fields shown below:

	Functional Status											General Well-Being										
	1	2	3	4	5	6	7	8	9	10	?	1	2	3	4	5	6	7	8	9	10	?
SQ6.01 - Patient 1	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	
SQ6.02 - Patient 2	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	
SQ6.03 - Patient 3	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	
SQ6.04 - Patient 4	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	
SQ6.05 - Patient 5	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	

Appendices

Considering your earlier responses, please answer the following questions:

QN	Question	Item
SQ6.06	Do you agree that implementing the discussed design features would make for a more effective healing space?	○ Yes
		○ No
		○ Not Sure
SQ6.07	Do you feel like implementing the aforementioned design features would create a facility that is better suited to meet all of your needs as a patient?	○ Yes
		○ No
		○ Not Sure

End of Section 6 of Staff Questionnaire

I understand how valuable your time is, and I am very grateful that you took the time to participate in my survey.

Thank You

End of Staff Questionnaire

University of Portsmouth

Faculty of Technology

B.7 Ethical Committee Approval Form

Technology Faculty Ethics Committee

ethics-tech@port.ac.uk

Date9/3/17

Rawan Juma,

School of Civil Engineering and Surveying

Dear Rawan,

Study Title:	**Needs Realisation Management Process (NRMP): A shift of focus to needs in health service facilities design and management**
Ethics Committee reference:	RJ1

The Ethics Committee reviewed the above application by an email discussion forum between the dates of 15/2/17 and 2/3/17.

Ethical opinion

The members of the Committee present gave a favourable ethical opinion of the updated submission of the above research on the basis described in the Application Form, Participant Information Sheet, Invitation letter and letters of support.

Conditions of the favourable opinion

Conditions

1. Recruitment

1.1. The recruitment of patients is still unclear and refers to the "most affected group" this needs to be defined, as does how the person who administers and promotes the survey in the hospital will ensure anonymity and confidentiality. When defined this should be submitted with the patient questionnaire for FECapproval.

2. Consent

2.1. The architects, designers and doctors are also participants in the research so need to give consent. The consent arrangements and interview questions with the architects need to be reviewed by the FEC before the datacollection.

2.2. Letters from the hospitals need to explicitly give permission for patients to be approached; the example submitted only gives permission for distributing a questionnaire to hospitalstaff.

2.3. The participant information sheet needs to be rewritten in layman's terms to avoid subject specific jargon ('needs realisation management processes') and remove the objectives and methods table. When rewritten this should be submitted with the

Faculty of Technology

patient questionnaire for FECapproval.

3. DataManagement

3.1. How the data will be securely stored during collection should be defined and the audio recordings should be erased once transcripts have been generated. When defined this should be submitted with the patient questionnaire for FECapproval.

3.2. Section 11.4 needs to be redrafted because at the moment it reads that the patients involved are only expected to have a life span of 30 years even though recruitment may involve any one over the age of18.

4. Version number still reads as 03, but the submission document title seems to be V4 and the date is Jan 16 in the appendices list, these details need to becorrected.

Recommendations: (You should give these due consideration but there is no obligation to comply or respond)

- Section 6.2 should be reviewed as it does not actually identify the main ethical issues arising from theproject.

The favourable opinion of the EC does not grant permission or approval to undertake theresearch. Management permission or approval must be obtained from any hostorganisation, including University of Portsmouth, prior to the start of the study.

Summary of discussion at the meeting

The reviewers still had several reservations about the application, but to save the time of the committee and progress the project it was felt that these could be addressed by the applicant and supervisors and considered by the FEC when the research instruments were sent for review.

Documents reviewed

The documents reviewed at the meeting were:

Document	*Version*	*Date*

Application Form Jan 2016	4	Jan 2016
Participant Information Sheet(s)	03	Jan 2016
Consent Form(s)	03	Jan 2016
Invitation Letter	1.0	
Evidence letter for external organization asking for support	Aug 2016	
Evidence From External Organisation Showing Support	Sept 2016	

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements set out by the University of Portsmouth

After ethical review

Reporting requirements

The attached document acts as a reminder that research should be conducted with integrity and gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Notification of serious breaches of theprotocol
- Progressreports
- Notifying the end of thestudy

Feedback

You are invited to give your view of the service that you have received from the Faculty Ethics Committee. If you wish to make your views known please contact the administrator ethics-tech@port.ac.uk

Please quote this number on all correspondence: RJ1

Yours sincerely and wishing you every success in your research

John Williams

J Williams

Chair Technology FEC
Email: ethics-tech@port.ac.uk

(a) **Appendix 1**

(b) **After ethical review – guidance for researchers**

This document sets out important guidance for researchers with a favourable opinion from a University of Portsmouth Ethics Committee. Please read the guidance carefully. A failure to follow the guidance could lead to the committee reviewing and possibly revoking its opinion on the research.

It is assumed that the research will commence within 3 months of the date of the favourable ethical opinion or the start date stated in the application, whichever is the latest.

The research must not commence until the researcher has obtained any necessary management permissions or approvals – this is particularly pertinent in cases of research hosted by external organisations. The appropriate head of department should be aware of a member of staff's research plans.

If it is proposed to extend the duration of the study beyond that stated in the application, the Ethics Committee must be informed.

If the research extends beyond a year then an annual progress report must be submitted to the Ethics Committee.

When the study has been completed the Ethics Committee must be notified.

Any proposed substantial amendments must be submitted to the Ethics Committee for review. A substantial amendment is any amendment to the terms of the application for ethical review, or to the protocol or other supporting documentation approved by the Committee that is likely to affect to a significant degree:

(c) the safety or physical or mental integrity ofparticipants

(d) the scientific value of thestudy

(e) the conduct or management of thestudy.

A substantial amendment should not be implemented until a favourable ethical opinion has been given by the Committee.

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Researchers are reminded of the University's commitments as stated in the Concordat to SupportResearch Integrityviz:

- maintaining the highest standards of rigour and integrity in all aspects ofresearch
- ensuring that research is conducted according to appropriate ethical, legal andprofessional frameworks, obligations andstandards
- supporting a research environment that is underpinned by a culture of integrity and basedon good governance, best practice and support for the development ofresearchers
- using transparent, robust and fair processes to deal with allegations of researchmisconduct should theyarise
- working together to strengthen the integrity of research and to reviewing progressregularly and openly

In ensuring that it meets these commitments the University has adopted the UKRIO Code of Practicefor Research. Any breach of this code may be considered as misconduct and may be investigated following the University Procedure for the Investigation of Allegations of Misconduct in Research.

Researchers are advised to use the UKRIO checklistas a simple guide to integrity.

(f) **Appendix 2**

(g) ANNUAL PROGRESS REPORT

1. Details ofResearcher

Name:	
Address:	
Telephone:	
E-mail:	

2. Details ofstudy

Full title of study:	
Reference number:	
Date of favourable ethical opinion:	

3. Commencement and terminationdates

Has the study started?	*Yes / No*
If yes, what was the actual start date?	

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If no, what are the reasons for the study not commencing? What is the expected start date?	
Has the study finished? *If yes, complete and submit "Declaration of end of study" form*	*Yes / No*
If no, what is the expected completion date? *If you expect the study to overrun the planned completion date this should be notified to the Ethics Committee for information.*	
If you do not expect the study to be completed, give reason(s)	

4. Recruitment of participants

In this section, "participants" includes those who will not be approached but whose samples/data will be studied.

Number of participants recruited:	*Proposed in originalapplication:* *Actual number recruited todate:*
Number of participants completing the study:	*Actual number completed to date:*
Number of withdrawals from study to date due to:	

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Have there been any serious difficulties in recruiting participants?	Yes / No
If Yes, give details:	
Do you plan to increase the planned recruitment of participants into the study? *Any increase in planned recruitment should be notified to the Ethics Committee as a substantial amendment for ethical review.*	Yes / No

5. Amendments

Have any substantial amendments been made to the study during the year?	*Yes / No*
If yes, please give the date and amendment number for each substantial amendment made.	

6. Serious breaches of theprotocol

Have any serious breaches of the protocol occurred during the year? *If Yes, please enclose a report of any serious breaches not already notified to the Ethics Committee*	*Yes /No* *Yes /No*

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7. Otherissues

Are there any other developments in the study that you wish to report to the Committee?	*Yes /No*
Are there any ethical issues on which further advice is required?	*Yes /No*
If yes to either, please attach separate statements with details.	

Signature of Researcher	
Print name:	
Date of submission:	

Appendix 3

DECLARATION OF THE END OF A STUDY

1. DetailsResearcher

Name:	
Address:	
Telephone:	
Email:	

2. Details ofstudy

Full title of study:	
Reference number:	

3. Studyduration

Date study commenced:	
Date study ended:	
Did this study terminate prematurely?	*Yes / No* *If yes, please complete sections 4, 5, 6, & 7.* *If no, please go direct to section 8.*

4. Recruitment

Number of participants recruited	
Proposed number of participants to be recruited at the start of the study	
If different, please state the reason for this	

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5. Circumstances of earlytermination

What is the justification for this early termination?	

6. Temporaryhalt

Is this a temporary halt to the study?		*Yes / No*
If yes, what is the justification for temporarily halting the study? When do you expect the study to re-start?		*e.g. Safety, difficulties recruiting participants, study has not commenced, other reasons.*

7. Potential implications for researchparticipants

Are there any potential implications for research participants as a result of terminating/halting the study prematurely? Please describe the steps taken to address them.	

8. Final report on theresearch

Is a summary of the final report on the research enclosed with this form?	*Yes / No* *If no, please forward within 3 months of the end of the study.*

Signature of Researcher:	
Print name:	
Date of submission:	

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Appendix 4

NOTICE OF SUBSTANTIAL AMENDMENT

Please use this form to notify the Ethics Committee of substantial amendments to all research.

The form should be completed by the Principal Investigator using language comprehensible

Full title of study:
Name of Ethics Committee:
Reference number:
Date study commenced:
Amendment number and date:

Details of Principal Investigator:

Title Forename/Initials Surname
Work Address
PostCode
Email
Telephone
Fax

Type of amendment

(a) Amendment to information previously given in the application form Yes No

If yes, please submit the revised application form with a new version number and date, highlighting changes using MS Word Track Changes.

(b) Amendment to the protocol Yes No

If yes, please submit the revised protocol with a new version number and date, highlighting changes using MS Word Track Changes.

(c) Amendment to the information sheet(s) and consent form(s) for participants, or to any other supporting *documentation for the study.* Yes No

If yes, please submit the revised documentation with a new version number and date, highlighting changes using MS Word Track Changes.

(h) Summary of changes

Briefly summarise the main changes proposed in this amendment. Explain the purpose of the changes and their *significance for the study.* *If the amendment significantly alters the research design or methodology, or could otherwise affect the scientific value of the study, supporting scientific information should be given (or enclosed separately). Indicate whether or not additional scientific critique has been obtained.*

Any other relevant information

Applicants may indicate any specific issues relating to the amendment, on which the opinion of a reviewing body is sought.

List of enclosed documents

Declaration by Chief Investigator

1. *I confirm that the information in this form is accurate to the best of my knowledge and I take full responsibility* *for it.*

2. *I consider that it would be reasonable for the proposed amendment to be implemented.*
Date of submission:......................................
Signature:......................................

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Declaration by supervisor / manager (delete as appropriate)

I support this substantial amendment.
Signature: ....
Print Name:
Post:
Organisation:
Date: *(dd/mm/yyyy)*

Appendix C

Supplements to Findings

C.1 Partial Dataset for Staff ED Knowledgeability Analysis

Table 50

Staff Research Knowledge vs. Employment & Work Hours, Partial Dataset

	Variables			Patients		
Ref	ED Knowledge	Employment	Workload	N = 102	N	%
SQ1.10	Excellent	Part-Time	0 – 19		0	0.00%
			20 – 39		2	1.96%
		Full-Time	20 – 39		1	0.98%
			40 – 59		14	13.73%
			≥ 60		1	0.98%
			Subtotal		18	17.65%
	Great	Part-Time	0 – 19		0	0.00%
			20 – 39		0	0.00%
		Full-Time	20 – 39		3	2.94%
			40 – 59		21	20.59%
			≥ 60		2	1.96%
			Subtotal		26	25.49%
	Good	Part-Time	0 – 19		0	0.00%
			20 – 39		3	2.94%
		Full-Time	20 – 39		4	3.92%
			40 – 59		5	4.90%
			≥ 60		1	0.98%
			Subtotal		13	12.75%
	Fair	Part-Time	0 – 19		1	0.98%
			20 – 39		9	8.82%
		Full-Time	20 – 39		12	11.76%
			40 – 59		3	2.94%
			≥ 60		0	0.00%
			Subtotal		25	24.51%
	Poor	Part-Time	0 – 19		7	6.86%
			20 – 39		6	5.88%
		Full-Time	20 – 39		6	5.88%
			40 – 59		1	0.98%
			≥ 60		0	0.00%
			Subtotal		20	19.61%

Extraction Method: Descriptive Statistics (Performed in MS Excel)

C.2 Factor Components & PCA Analysis Supplements

Code Used to Execute Principal Component Analysis (SPSS 25.0)

```
FACTOR
 /VARIABLES PQ2.01 PQ2.02 PQ2.03 PQ2.04 PQ2.05 PQ2.06 PQ2.07 PQ2.08 PQ2.09 PQ2.10 PQ2.11 PQ2.12
  PQ3.01 PQ3.02 PQ3.03 PQ3.04 PQ3.05 PQ3.06 PQ3.07 PQ3.08 PQ3.09 PQ3.10 PQ3.11 PQ3.12 PQ3.13 PQ3.14
  PQ3.15 PQ4.01 PQ4.02 PQ4.03 PQ4.04 PQ4.05 PQ4.06 PQ4.07 PQ4.08 PQ4.09 PQ4.10 PQ4.11
 /MISSING LISTWISE
 /ANALYSIS PQ2.01 PQ2.02 PQ2.03 PQ2.04 PQ2.05 PQ2.06 PQ2.07 PQ2.08 PQ2.09 PQ2.10 PQ2.11 PQ2.12
  PQ3.01 PQ3.02 PQ3.03 PQ3.04 PQ3.05 PQ3.06 PQ3.07 PQ3.08 PQ3.09 PQ3.10 PQ3.11 PQ3.12 PQ3.13 PQ3.14
  PQ3.15 PQ4.01 PQ4.02 PQ4.03 PQ4.04 PQ4.05 PQ4.06 PQ4.07 PQ4.08 PQ4.09 PQ4.10 PQ4.11
 /PRINT INITIAL CORRELATION KMO AIC EXTRACTION ROTATION
 /FORMAT SORT BLANK(.10)
 /PLOT EIGEN
 /CRITERIA MINEIGEN(1) ITERATE(25)
 /EXTRACTION PC
 /CRITERIA ITERATE(25)
 /ROTATION VARIMAX
 /SAVE REG(ALL)
 /METHOD=CORRELATION.
```

Table 51 **Pearson Correlation Matrix, Patient Questionnaire Items, Colour-Coded by Dimension**

	2.01	2.02	2.03	2.04	2.05	2.06	2.07	2.08	2.09	2.10	2.11	2.12	3.01	3.02	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.10	3.11	3.12	3.13	3.14	3.15	4.01	4.02	4.03	4.04	4.05	4.06	4.07	4.08	4.09	4.10	4.11
2.01	1.0									Spatial																												
2.02	1.0	1.0																																				
2.03	1.0	1.0	1.0																																			
2.04	0.9	0.9	1.0	1.0																																		
2.05	0.8	0.8	0.9	0.9	1.0																																	
2.06	0.5	0.5	0.5	0.6	0.5	1.0																																
2.07	0.4	0.4	0.5	0.5	0.4	0.2	1.0																															
2.08	0.6	0.6	0.6	0.5	0.5	0.3	0.3	1.0																														
2.09	0.6	0.6	0.6	0.5	0.5	0.3	0.3	0.4	1.0																													
2.10	1.0	1.0	1.0	0.9	0.8	0.5	0.5	0.6	0.5	1.0																												
2.11	0.9	0.9	0.9	0.8	0.7	0.5	0.4	0.6	0.5	0.9	1.0																											
2.12	1.0	1.0	0.9	0.9	0.8	0.5	0.5	0.6	0.5	0.9	0.9	1.0																										
3.01	-0.3	-0.3	-0.3	-0.3	-0.3	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	1.0											Ambient														
3.02	0.5	0.5	0.4	0.4	0.4	0.3	0.2	0.3	0.2	0.5	0.4	0.4	0.6	1.0																								
3.03	-0.3	-0.3	-0.3	-0.2	-0.2	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	0.4	0.1	1.0																							
3.04	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.0	0.2	0.1	0.1	0.6	0.7	0.4	1.0																						
3.05	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.7	0.6	0.4	0.7	1.0																					
3.06	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.7	0.6	0.4	0.8	0.7	1.0																				
3.07	-0.3	-0.3	-0.3	-0.3	-0.3	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	1.0	0.6	0.4	0.6	0.7	0.7	1.0																			
3.08	0.5	0.5	0.4	0.4	0.4	0.3	0.2	0.3	0.2	0.5	0.4	0.4	0.6	1.0	0.1	0.7	0.6	0.6	0.6	1.0																		
3.09	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	-0.1	0.0	1.0																	
3.10	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.0	0.2	0.1	0.1	0.6	0.7	0.4	1.0	0.7	0.8	0.6	0.7	-0.1	1.0																
3.11	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.7	0.6	0.4	0.7	1.0	0.7	0.7	0.6	0.0	0.7	1.0															
3.12	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.4	0.5	0.3	0.7	0.5	0.6	0.4	0.5	-0.1	0.7	0.5	1.0														
3.13	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.4	0.4	0.2	0.4	0.5	0.4	0.4	0.4	0.0	0.4	0.5	0.2	1.0													
3.14	-0.1	-0.1	-0.1	-0.1	-0.1	0.1	-0.1	0.0	-0.1	0.0	0.0	-0.1	0.6	0.5	0.4	0.7	0.6	0.9	0.6	0.5	0.0	0.7	0.6	0.6	0.3	1.0												
3.15	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.7	0.6	0.4	0.8	0.7	1.0	0.7	0.6	0.0	0.8	0.7	0.6	0.4	0.9	1.0											
4.01	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.0	0.2	0.2	0.0	0.1	0.1	-0.1	0.2	0.2	0.1	0.2	0.0	0.0	1.0							Functional			
4.02	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.1	0.1	0.3	0.2	0.2	0.1	0.2	-0.1	0.2	0.4	0.1	0.1	0.2	-0.1	0.2	0.4	0.1	0.3	0.1	0.1	0.8	1.0									
4.03	0.3	0.3	0.2	0.2	0.2	0.2	0.0	0.1	0.1	0.3	0.3	0.3	0.0	0.2	-0.1	0.2	0.3	0.1	0.0	0.2	-0.1	0.2	0.3	0.1	0.3	0.1	0.1	0.7	0.9	1.0								
4.04	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.3	0.2	0.2	0.0	0.2	0.0	0.2	0.4	0.1	0.0	0.2	-0.1	0.2	0.4	0.1	0.2	0.1	0.1	0.7	0.9	1.0	1.0							
4.05	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.3	0.3	0.3	-0.1	0.2	-0.1	0.1	0.2	0.0	-0.1	0.2	0.0	0.1	0.2	0.1	0.2	0.0	0.0	0.6	0.9	0.9	0.9	1.0						
4.06	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.3	0.3	0.3	-0.1	0.2	-0.1	0.1	0.2	0.0	-0.1	0.2	0.0	0.1	0.2	0.1	0.2	0.0	0.0	0.6	0.9	0.9	0.9	1.0	1.0					
4.07	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.2	0.2	0.2	-0.1	0.1	-0.1	0.1	0.2	0.0	-0.1	0.1	0.0	0.1	0.2	0.1	0.2	0.0	0.0	0.5	0.7	0.7	0.7	0.7	0.7	1.0				
4.08	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.2	0.1	0.2	0.1	0.2	-0.1	0.1	0.3	0.0	0.1	0.2	-0.1	0.1	0.3	0.1	0.3	0.1	0.0	0.6	0.8	0.8	0.7	0.7	0.7	0.7	1.0			
4.09	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.3	0.2	0.2	0.1	0.3	0.0	0.2	0.3	0.1	0.1	0.3	-0.1	0.2	0.3	0.1	0.2	0.1	0.1	0.6	0.8	0.8	0.8	0.8	0.8	0.6	0.7	1.0		
4.10	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.1	0.1	0.3	0.2	0.2	0.1	0.2	-0.1	0.2	0.4	0.1	0.1	0.2	-0.1	0.2	0.4	0.1	0.3	0.1	0.1	0.8	1.0	0.9	0.9	0.9	0.9	0.7	0.8	0.8	1.0	
4.11	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.2	0.2	0.2	-0.1	0.1	-0.2	0.0	0.2	-0.1	-0.1	0.1	0.0	0.0	0.2	0.0	0.2	0.0	-0.1	0.5	0.7	0.7	0.7	0.6	0.6	0.8	0.7	0.6	0.7	1.0

Extraction Method: Principal Component Analysis (Performed in SPSS)

Appendices

Table 52

Communalities Table, Patient Questionnaire Items, Initial vs. Extracted Values

ID	Questionnaire Items	Initial	Extraction
PQ2.01	Spaciousness, Room Dimensions	1	0.971050907
PQ2.02	Spaciousness, Ceiling Height	1	0.971050907
PQ2.03	Spaciousness, Seating Area	1	0.967291902
PQ2.04	Layout, Tabular Seating Area	1	0.913934423
PQ2.05	Proximity, Bathroom to Bed	1	0.763122561
PQ2.06	Spaciousness, Bed Dimensions	1	0.403745467
PQ2.07	Wayfinding, General Accessibility	1	0.270320727
PQ2.08	Wayfinding, Signage	1	0.453641872
PQ2.09	Layout, Pathway Cluttering	1	0.411749944
PQ2.10	Wayfinding, Stairs/Elevators	1	0.921081547
PQ2.11	Proximity, Nursing Station to Bed	1	0.821285248
PQ2.12	Orientation, Bed towards Door	1	0.914956797
PQ3.01	Aesthetic, Carpeted Flooring, Homelike Feel	1	0.914724719
PQ3.02	Aesthetic, Carpeted Flooring, Non-Slippery	1	0.899035637
PQ3.03	Visual, Daylight, Exposure	1	0.447388802
PQ3.04	Nature, Access to Garden	1	0.858469615
PQ3.05	Nature, View from Windows	1	0.802159218
PQ3.06	Visual, Indoor Lighting, Ambience	1	0.903429614
PQ3.07	Visual, Indoor Lighting, Illuminance	1	0.914724719
PQ3.08	Nature, Appropriate Landscape Artwork	1	0.904035608
PQ3.09	Acoustic, Indoor Noise, Ward	1	0.785261262
PQ3.10	Acoustic, Indoor Noise, Equipment	1	0.858469615
PQ3.11	Acoustic, Outdoor Noise, Premises	1	0.802159218
PQ3.12	Indoor, Room Cleanliness/Hygiene	1	0.585652688
PQ3.13	Aesthetic, Wall Colours	1	0.439054436
PQ3.14	Indoor, Ventilation/Heating	1	0.793585859
PQ3.15	Aesthetic, Fabric Quality	1	0.903429614
PQ4.01	Accessibility, Disability-Accessible Room	1	0.589419202
PQ4.02	Accessibility, Acuity-Adaptable Room	1	0.932523933
PQ4.03	Facilities, Sufficient Storage Space	1	0.954657701
PQ4.04	Control, Open/Closed Door	1	0.917998182
PQ4.05	Control, Window Shades	1	0.893387426
PQ4.06	Control, Lighting Dimmers	1	0.893387426
PQ4.07	Control, Temperature/Thermostat	1	0.685096592
PQ4.08	Control, Entertainment/Television	1	0.732569543
PQ4.09	Facilities, Communication Tools	1	0.709868895
PQ4.10	Facilities, Visible Sink	1	0.932523933
PQ4.11	Facilities, General Ease-of-Use	1	0.622839361

Extraction Method: Principal Component Analysis (Performed in SPSS)

Appendices

Table 53

Component Transformation Matrix

Component	Spatial (1)	Ambient (2)	Functional (3)	(4)	(5)
Spatial (1)	0.618	0.682	0.367	0.133	0.018
Ambient (2)	-0.574	0.055	0.787	0.216	-0.045
Functional (3)	0.535	-0.728	0.414	0.105	0.018
(4)	-0.037	-0.022	-0.219	0.814	0.537
(5)	-0.031	0.018	0.165	-0.512	0.842

C.3 Non-Parametric ANOVA Result Matrices

Table 54

Non-Parametric ANOVA Analysis Results, Significant Findings, Spatial Design

Category	Spaciousness			Orientation		Proximity		Wayfinding			Layout		
#	01	02	03	04	05	06	07	08	09	10	11	12	13
Component/Feature	Larger Room	Larger Bed	Larger Seating Area	Bed to Door	Nursing Station to Bed	Bed to Bathroom	Nursing Station to Bed	Ward Layout	Signage Availability	Stairs/Elevators Location	Room Standardization	Tabular Seating Area	Cluttered Pathway
Sleep Quality/Quantity		.002											
Health Status/Symptoms													
Sense of Privacy/Security				.002	.001	.003							
Wayfinding/Accessibility								.001	.040	.020			.040
Falls/Fall-Related Injury						.005		.003					
Social Communication	.040	.002			.004								
Staff Communication		.002	.002	.001									
Medical Errors													
Stress/Anxiety Levels													
Sense of Choice/Control													
Pain/Physical Discomfort		.040											
Contamination/Infection													

Extraction Method: Kruskal Wallis Test (Performed in SPSS)

Table 55

Kruskal Wallis Data Analysis Results, Significant Findings, Ambient Design

Component/Feature	Carpeted Flooring	Cool/Blue Wall Colour	Fabric Quality/Materials	Daylight Exposure	Indoor Lighting Ambience	Access to Garden	View from Window	Appropriate Artwork	Ventilation/Heating	Cleanliness/Hygiene	Indoor Noise Quality	Outdoor Noise Quality
#	14	15	16	17	18	19	20	21	22	23	24	25
Category	Accessibility			Facilities					Control			
Sleep Quality/Quantity											.002	.005
Health Status/Symptoms				.003	.001	.004			.04			
Sense of Privacy/Security												
Wayfinding/Accessibility												
Falls/Fall-Related Injury	.030											
Social Communication												
Staff Communication												
Medical Errors				.009	.008							
Stress/Anxiety Levels	0.04			.002		.009	.002	.03			.006	
Sense of Choice/Control												
Pain/Physical Discomfort				.003	.004	.004	.001	.060	.004		.001	
Contamination/Infection										.002		

Extraction Method:Kruskal Wallis Test (Performed in SPSS)

Table 56

Kruskal Wallis Data Analysis Results, Significant Findings, Functional Design

Component/Feature	Disability-Accessible Room	Acuity-Adaptable Room	Sufficient Storage Facilities	Communication Tools	Entertainment Tools	Sink Visibility	Facility Ease-of-Use	Door Openness	Window Shades	Light Dimmers	Temperature
#	26	27	28	29	30	31	32	33	34	35	36
Category	Accessibility		Facilities					Control			
Sleep Quality/Quantity											
Health Status/Symptoms											
Sense of Privacy/Security		.001									
Wayfinding/Accessibility	.020	.024									
Falls/Fall-Related Injury											
Social Communication				.003							
Staff Communication				.004							
Medical Errors											
Stress/Anxiety Levels					.006						.002
Sense of Choice/Control								.002	.001	.003	.004
Pain/Physical Discomfort	.001										
Contamination/Infection											

Extraction Method: Kruskal Wallis Test (Performed in SPSS)

Appendix Ds

upplements to NRMP

D.1 Focus Group Session

The topic of human needs has been conceptualized countless times in academic literature over the course of the past century. First gaining influence in the social sciences, the importance of examining needs then saw its applications grow in the fields of psychology, motivation, and more recently, design.

The correlation between design and human needs has been most thoroughly examined in healthcare applications, establishing the requirement to incorporate human needs into the design of healthcare facilities to establish a healing environment.

The ambiguity surrounding needs in the context of healthcare has had many negative implications for practical research applications in healthcare and has made transitioning from service-led healthcare to need-led healthcare a much more difficult task.

This issue is especially relevant in the context of Jordan today (where the study took place), as the Jordanian healthcare delivery system is the primary factor influenced by the massive influx of refugees from neighbouring countries following the Arab Spring. This saw demand for healthcare increase dramatically over the past few years, which has resulted in considerable strain on the healthcare sector as a whole; dramatically reducing the quality of care provided to patients.

Its worthwhile to note facility redesign stands to impact more than just the patients who stand to benefit from such supportive healing environments. Other stakeholders in healthcare, including staff, family members, and healthcare administration/management, took notice of the overwhelming difference in benefit between a traditional healthcare facility, and an optimized one.

As such, the primary aim of this research is to explore the nature and extent to which a healing environment designed in line with a patient's needs stands to benefit patients' outcomes, evaluating the extent to which the built environment could be said to contribute to a patient's healing process.

Briefly outlining the study's objectives, the aim was to:

1. *Examine the conceptualization of patient needs in literature and application*
2. *Investigate how design influences patients' needs from a broad perspective*
3. *Assess the role that healthcare environmental design plays in improving patient healing processes*
4. *To evaluate whether a performance gap exists between theoretical and practical healthcare environmental design applications, and whether we can develop a framework can be designed to close such a performance gap*
5. *And finally,*
6. *Introduce a facility design decision framework, centred around meeting user needs and improving their outcomes*

The study took place over several phases, which are mostly aligned with the standard procedure followed in academic research.

A conceptual and theoretical review was undertaken to identify the extent to which the field has been developed in the past, identifying the most important terms and concepts relevant to this study. In conducting this phase, we identified a standardized set of stakeholders and users in healthcare settings, identified the most commonly cited patient needs and outcomes, and what environmental design components were discussed the most in the literature.

Proceeding forth from here, a systematic approach was used to conduct the second part of the literature review process, which involved identifying studies linking healthcare setting design on patients' needs and outcomes, ensuring the inclusion of only the highest standard of work. As such, the chapter culminated in the development of a conceptual framework upon which the study was conducted, in which a set of 36 design components were identified to have numerous impacts on patients and staff alike.

Upon completing the systematic review, the different approaches undertaken by researchers became evident, and the most suitable approach was then identified on the basis of the restraints governing the study. The study involved the use of mixed methods to obtain empricial evidence linking hospital design to the needs of patients, both directly and indirectly (by influencing the needs of staff), of which the primary data collection mean was a questionnaire (distributed to both patients and staff members).

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In understanding how to improve the built environment, one must first examine the issue from the perspective of the environment's most frequent user groups, obtaining feedback from them on what changes they think matter, and how this environment could be designed in accordance with their needs. Obtaining feedback directly from the primary user groups of a facility is an essential step for quality improvement in the field of healthcare first, as such users are most familiar with the issues they encounter daily while using the environment.

In the context of healthcare environments, the two primary user groups who come into the most direct contact with the facility are hospital in-patients who use those facilities, and the clinical care staff whose job it is to provide care services to those patients (Hopkins et al., 1994).

Two questionnaires were designed. Starting off with the patient questionnaire, many factors had to be considered to account for the nature of the research sample. The questionnaire mainly consisted of questions structured in the form of a 10-point Likert-scale. asking that patients to rank their level of agreement with statement linking different environmental design features to their perceived needs and outcomes.

Other types of questions included in this questionnaire comprise simple and easy-to-understand question types, including: (1) single-response multiple-choice, (2) multi-response Multiple Choice, and (3) Fill-in-the-Blanks.

The staff questionnaire was developed bearing in mind the same considerations as the patient questionnaire, with one minor alteration: the terms used throughout the questionnaire were a little more complex in nature, as to ensure that the participants fully understood what was being asked of them.

The questions included in staff questionnaires were structurally very similar in nature to those in the patient questionnaire.

One issue with the use of questionnaires only is the fact that direct observation is that people tend to change their behaviour when directly observed; either voluntarily or involuntarily. As a result, the observations conducted by the researcher was mostly focused on areas outside patient rooms, carried out using an observation sheet meant to record interactions and events,

Finally, the both questionnaires and any all other measures were run by consultants from academia to review the questions asked and provide feedback on which aspects of the questionnaire were to should be amended. The submitted questionnaire was approved in terms of the concepts and questions asked to the patients and staff members, with adjustments made to the instruments on the basis of the feedback provided by the academic consultants.

The population of 44 accessible private hospitals were visited by the researcher, of which a final sample population of 6 hospitals granted the researcher access to collect data from patients and staff members.

Patient and staff questionnaires were distributed to a final sample population of 216 and 102 participants, respectively. These quantitative data sources, along with direct observations recorded by the researcher in non-standardized forms, were used for data collection. Data extraction and analysis were then performed using Microsoft Excel and IBM SPSS, extracting the data into digital format, which enabled the statistical analysis of the data.

Statistical analysis involved the use of:

Dimensionality reduction & principal component analysis used to validate the categorical constraints within which the needs and design components were categorized.

Non-parametric one way ANOVA (Kruskal-Wallis Tests and Mann-Whitney Tests) were used to analyze the individual interactions between each design component and respective patient need, as reported in the questionnaire. The same was done for the patients' outcomes, but the difference was that the data for this evaluation was drawn from both the patients' and staff's questionnaires (who were asked to report on patient outcome measures for a more objective evaluation of aspects such as functional status).

Using the now validated constructs identified in the conceptual review, the following design elements were identified linking each of the following components to patients' care status, safety, social, and comfort needs: The design components evaluated included:

Aspects relating to spatial design, including:

- Room Spaciousness
- Arrangement of Seating Area
- Impacts of Bed Spaciousness
- Bathroom Proximity to Beds
- Wayfinding & Accessibility
- Cluttering
- Door Orientation & Proximity to Nursing Stations

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Aspects relating to ambient design, including:

- Fabric Quality
- Wall Colour
- Lighting Quality
- Natural Elements (Gardens/View/Artwork)
- Acoustic Quality
- Cleanliness & Hygiene

And aspects relating to functional design, including:

- Control over Design
- Disability-Accessible & Acuity-Adaptable Designs
- Communication Tools
- Recreational Tools
- Sink Visibility
- Facility Ease of Use

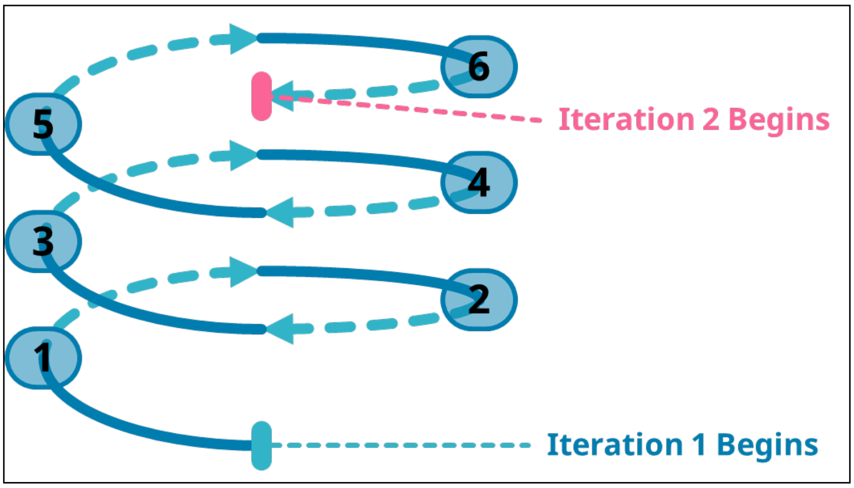
Using the findings for each of these components, which were assorted into a matrix linking each component to each patient need and outcome, a design framework was then developed to facilitate the practical application of design interventions identified in theory in real practical cases.

The model introduced based on the findings, titled ***Needs Realization Management Process*** and can be described as a design decision and management process model centred around the fulfilment and realization of the needs of different environmental users.

The framework's model can be described as a A) cyclical, B) iterative, and C) progressive framework, constituting six primary steps, as is shown in exhibit 1.

[Show exhibit 1, corresponding to Figure 36: Need Realization Management Process, Framework Model]

[Exhibit 1]



Cyclicality describes the fact that the model is repeated in regular patterns that occur at set intervals, enabling the framework's user to begin at whichever point in the process that best suits them. Upon the completion of the final step in the framework, the cycle is repeated, beginning back at the first step in the framework.

Iteration describes the model's cyclicality on an even larger scale, referring to a more expansive cycle of repetition, in which the design interventions/changes are identified, tested, and analysed repeatedly; and are refined in each iteration in the process. Each iteration loop takes place upon the completion of the sixth step of the process, and the loop is not necessarily established back in step 1 of the process, rather, the process can be looped back from steps 3 or 5 if the need is not warranted for previous steps.

Progressiveness describes how the model leads to the advancement and implementation of changes/interventions in environmental design, leading towards better policies, conditions, and methods of reform. Upon the completion of iterative cycle in the process, the framework's users will have progressed towards a healthcare environment that is more suitable to addressing their users' and stakeholders' needs.

Proceeding forth to the steps:

Identified based on the conceptualization of environmental stakeholders and user groups, Step 1 is to determine the different stakeholders and users in an environment. While stakeholders can be anyone who stands to influence/be influenced by the environment, a user is someone who comes into direct and continuous contact with the environment for a set period of time.

Identified based on the differences in needs of stakeholder groups based on the locations and environmental factors they were most exposed to, along with the difference in findings for perceptions of both staff and patient groups, Following the identification of the different stakeholder and user groups of an environment, Step 2 would be to identify the needs and outcomes of each of those groups, such that the commonalities and differences could be assessed between different groups.

Identified based on the conceptualization phase of healthcare settings, which showed that different authors may propose alternate categorizations of components of the environment, Step 3 of the process is to identify the different environmental design components and features within an environment. Prior to examining the specific components and design features specifically, it can be useful to gain some insights as to what design components are commonly referred to in relevant literature

Identified based on the results of the systematic review which showed that different environmental design interventions yielded different outcomes, as well as the difference in findings for perceptions of both staff and patient groups, Step 4 involves linking each of the discussed design components to the different needs and outcomes of each stakeholder group, determining the extent of the impact in terms of individual component, as well as the categorical constructs defined in the previous step.

Identified based on the differences in impact in the perspectives of both staff and patient groups. Step 5 involves evaluating the different perspectives of the various stakeholder groups relevant to the discussion, determining the role that each of those stakeholders has to play in facilitating effective change and decision-making in the process of implementing change, and how each group contributes to this implementation.

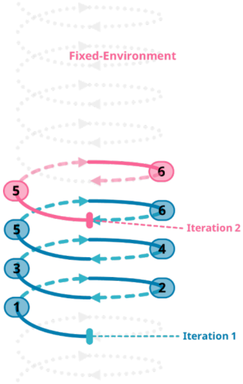
why both of these groups (among others) must be considered in the policy-development process.

Identified in examining the influence of policy-making on the actual implementation of design changes and policy amendments, along with the consideration of how these changes can impact patient well-being and outcomes in general, which warrants their consideration by relevant authorities, Step 6 involves identifying the most pressing environmental design components to change at the current time, the selected decisions are implemented in application, in a manner that allows for the monitoring and evaluation of the actual rate of change caused by the different changes, and incrementally building upon those changes to reflect research and practical findings in the future.

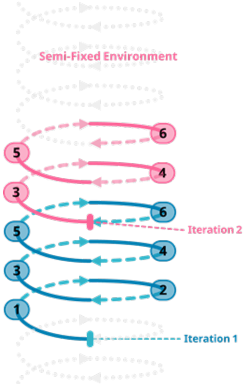
Appendices

In applying the framework, three approaches can be taken, as is outlined in Exhibits 2, 3 and 4, depending on the variability of the environment in question.

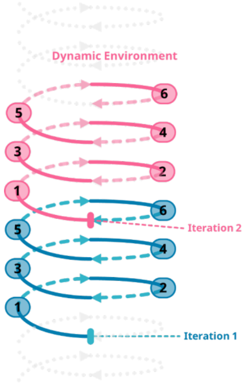
[Exhibit 2]



[Exhibit 3]



[Exhibit 3]



Appendices

R0: Researcher

R1 – R6: Focus Group Respondents (In order of Introduction)

R0 [Now that you have been introduced to the study and framework developed on the basis of the findings, the aim of this discussion is to evaluate the validity of the steps included in the review by assessing your feedback on each of the steps, and whether any improvements could be made to enhance the process; given your expertise on the topic of the study.]

[I will be using an open-ended question guide to proceed with the discussion points of this focus group, and you will all take turns contributing to the discussion and providing feedback on the discussed point].

Starting off, having seen the framework model overall, does anything occur to you at first glance? What are your first thoughts on the framework?

R1 I found it straightforward. That is good; makes it fairly generalizable across different environments.
I presume that the series of steps is based on the process you mentioned earlier conducting the study; am I correct?

R0 Yes, it was.

R2 I agree regarding the steps, but I wouldn't be so sure about the part referenced in the last three exhibits. From what I understand, which duo is reiterated at depends on whether the environment is classified as fixed, semi-fixed or dynamic.
In this case, I suppose you may require an additional framework to classify the environment as one of the above-mentioned classifications. I am unsure about how to proceed as to its development though.

R3 Precisely, which is why I disagree about this point. Proposing that a framework be implemented to classify the environment in terms of its changeability would defeat the purpose and would be very restrictive in nature. Given that the model is intended to be applicable in any scenario, in which any number of users or stakeholders would be involved, it may prove difficult to construct a set of criteria that works for all environments.

R4 While were on that point, I find that the fact that the steps are simple in nature makes for a good way to construct a model that works for different environments. This makes the framework effective in theory, in my opinion; though we would have to apply in it practice to measure just how effective and amend accordingly.

R0 There's a question regarding that point moving forward, so we'll be getting to that eventually.

R5 I like the depiction. I assume its based on the iterative EBD framework; which has been demonstrated an effective process in practice. So it was nice to integrate that feature into the model.

R6 As for me, the groupings I found to be somewhat unnecessary to be frank. I like the model otherwise, but I believe the groupings to be redundant.

R0 Since you went ahead and mentioned that let me move on to the next question and let you elaborate further on why exactly you believe that.

Regarding the groupings of the steps into duos, do you think the groupings are appropriate? Would it possibly help in applications in different environments?

R6 Well, I find them redundant as they add nothing new to the framework in my opinion. May I infer as to why you grouped them?

R0 I grouped the items on the basis of similarity of themes. The first two steps were grouped as they both relate to the evaluation of stakeholders and their needs, the second [duo] were grouped as they both relate to the evaluation of the environment, and the third [duo] relate to the implementation of design changes.

R5 I think what [R6; *name omitted*] is referring to here is why group them in the first place; not the rationale behind the choices picked.

R0 Oh. I grouped them to allow for different approaches to reiterating the process depending on the environment. What I mean by that is that we need a starting point for iteration based on whether the environment is fixed or dynamic… or in-between, of course. As the first items in each set would not be an appropriate starting point for any environment, I found the groupings would clarify where different practitioners could choose as their iteration point.

R2 Could you remind us again of the steps please. Why would the second, fourth and sixth steps be inappropriate as starting points?

R6 I guess I should've done that before I explained, sorry. The first step is to identify the stakeholders and users of an environment, while the second step deals with identifying the needs of each of these stakeholders. Since you would need to identify the stakeholders before assessing the needs of each, I found the appropriate starting point here to be the first step. In case where the stakeholders are fixed, then there would be no need to re-evaluate their needs as that has already been done in the first iteration, and so we proceed to the third step. The same thought process can be applied to the second and third duos.

R2 I see. Well that makes sense. I would disagree with [R6] say they're not redundant in that case.

R0 Alright. Anyone want to add anything else?

Okay. Moving on to the next question.

R0 ***Walking through the first duo (Evaluating Stakeholders/Users; Identifying their needs), do you find this to be an appropriate first step in the process? Are there any remarks you have regarding this duo of steps?***

Please take turns reporting whether you find this duo valid for inclusion, and the reasons why if you have any rationales as to why.

R1 Again, fairly straightforward. I would say yes.

R2 Likewise, I agree with [R1]'s sentiment. I would say yes as well.

R3 Yes. However, I would recommend detailing what sources of knowledge can be or should be used to evaluate the needs of each stakeholder/user.

R4 Agreed. Nothing to add.

R5 Yes, and nothing to add either. The inclusion of the steps is self-explanatory.

R6 You can't identify the impacts of design on needs without identifying the people involved first. Yes from me too.

R0 ***Walking through the second duo (Evaluating Design Components; Linking Design Components to Needs), do you think this is the right course of action to proceed with? Are there any remarks you have regarding this duo of steps?***

R1 In evaluating design components, do you mean theoretically or practically?

R0 Practically.

R1 In this case, I would recommend starting with a theoretical evaluation first. We will proceed with a practical evaluation either way, regardless of whether we find any credible sources.

Just something to note. Otherwise I would say it's appropriate to proceed with this step and the following one.

R2 Yes. Well I am unsure whether we should start with the theory or practice. Starting with either has its benefits. If we start with theory, we can use a confirmatory method to identify the practical similarities. If we start with the practical side, we can focus more on the elements in our environment.

R0 Okay, interesting point.

R3 Referring to [R2]'s remark, would it not be appropriate then to tally up the environmental components in practice, evaluate them in theory, then re-examine them in practice again?

R0 What would be the purpose of the re-examination?

R3 Well, in practice, some elements may not be so apparent at first… I'm failing to come up with an example as to such an element, but it would likely not be a physical object, and would be something more related to senses or spatial orientation.

R0 Makes perfect sense. Thanks for the recommendation.

R4 I agree with [R3]. An example would be any of the indirect effects you observed throughout the study. You know, the ones linking patient needs to staff needs or outcomes; I'm not sure. This would also serve to validate why we evaluate the needs of all stakeholders in the first step of the process.

R5 Excellent point. Upon implementing this minor change, I'd say its acceptable as well.

R6 I completely Agree.

R0 ***Walking through the third duo (Evaluating Stakeholder Perspectives; Implementing Design Changes), do you find this to be the appropriate course of action as to the actual implementation of the framework? Are there any remarks you have regarding this duo of steps?***

R6 I would recommend monitoring the implemented changes to be separated from the other steps as a seventh step to the process model. Monitoring involves fundamentally different practical processes from implementation.

R4 I wanted to say that, but a problem arises then in terms of the reiteration process wouldn't it?

R6 Not necessarily. You would only need to monitor if you have implemented. So perhaps we could bundle up the last three steps [Steps five to seven] into a *trio* rather than a *duo.*

R4 I guess that would work. In that case I'd say separating monitoring in the same way as it is in the EBD framework works best.

R2 Works for me.

R1 Likewise.

R3 I'd like to add something else. Perhaps consider focusing on classifying actors [stakeholders] in this step as indirect or direct in terms of their influence on the design of health facilities. That way, we can isolate who is actually responsible for implementing changes, which may be factored in when evaluating things like costs of implementation.

R0 That is incorporated in the first step of the process. Stakeholders are classified in a number of ways to help in later steps throughout the process.

R3 I suppose it doesn't matter so much when it is done as much as that it is done. It would have been so if step 1 was not the identification phase, but as that takes place before steps 5 and 6, it would be okay as any changes to the stakeholder list would be reflected in the assessment in the latter steps [Steps 5 and 6].

R3 Then I would say it's appropriate as well.

R0 Does anyone disagree regarding the points mentioned here?

R1-R6 [Unanimous agreement responses]

R0 Okay so lets proceed to the next question.

R0 ***What additional changes would you propose to amend the framework in future theoretical development? Please elaborate.***

R3 First thing that comes to mind is developing a proof of concept prototype in future research. The model depicted here works though as a proposition, so perhaps it could be modelled in future work based on confirmation through empirical work.

R2 Agree on the proof of concept point. Perhaps amend in accordance with the findings of the study as well? Basing rationales for the addition or removal of steps in line with the process' feasibility and practicality?

R1 Fairly straightforward proposition. Agreed.

R4 So do I.

R5 And I.

R6 One thing I would like to add regarding the implementation of the framework…
I believe that the application of this model should be dependent on the context of the study in which it is applied. What I mean by that is that the model should be considered more of a dynamic type of framework, where any researcher utilizing the model into their study should consider revising the steps in terms of the fine print, while maintaining the overall structure of the model.

R2 Agreed. One thing to note here is that this is not only applicable to researchers, as the same would be applicable to practitioners developing the model as well.

R0 ***What additional changes would you propose to amend the framework such that it is more applicable in practical cases? Please elaborate.***

R1 IT comes to my mind here. I would say practical application requires; or may be enhanced by applying the model systematically. What better way than IT?

R5 Especially in the proposed seventh step. Integrating the framework into an IT infrastructure paves the way for a more structured approach for the implementation and monitoring of each of the six (now seven) steps of the process.

R6 And try not to be too specific or technical in outlining exactly what IT system is to be used for integration. I say that as different industries may choose IT systems more aligned with their nature of practice and correspondingly, their environment.

R3 One hundred percent with you on that one.

R4 I'm not sure about this, but perhaps a flowchart depiction would be beneficial to the decision-making process? But how would it be applied?

R5 Well, a flowchart would work; its just that it depends on the nature of the IT application in which the model is applied.

R4 I suppose so. Well, nothing else I think. The model is practically applicable I believe. Its all contextual, and the choices of application can get more technical upon analysis, so derivations of the model may be useful in future work.

R0 ***Do you have any additional remarks?***

R5 I think we've covered the most important amendments. So nothing from me here.

R2 Model's appropriate for use in my opinion, provided the considerations and propositions made here should make it even more applicable.

R3 None.

R4 None from me.

R5 Nothing major. I just would like to reiterate the importance of developing a proof of concept to the model. Perhaps add it as a recommendation.

R6 Nothing from me either. I think what's proposed here is sufficient to validate the model

R0 Great. I would like to offer my sincerest appreciation for you taking the time to look over my framework model.]

I'll be sure to take into account everything outlined here.

Thanks again.